DRAFT

NKS(11)3
2011-05-19

nks
Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

Agenda for the board meeting in Copenhagen 31 May 2011

Place: Hotel Hilton, Ellehammersvej 20, DK-2770 Kastrup.
Location: Hermod
Time: 10:00 to 17:00

1 Opening

2 Practical remarks

- Meeting secretary.
- Information from chairman and host.

3 Approval of the agenda

4 Accounts 2010

- See distributed material: Financial Statements 2010, NKS(11)2, Long-Form Audit Report and Letter of Engagement, all dated 2011-03-30.
- Presentation by the auditor and the secretariat, discussion and decision.

5 Financial status for the current year

- See distributed material: Financial status report and financial programme specification, both dated 2011-05-13.
- Presentation, discussion.

6 Minutes of the last board meeting (Stockholm, 2011-01-11)

- See draft minutes NKS(11)1 dated 2011-02-03.
- Review, discussion and decision.

7 News since last board meeting

- Report from the owners group.
- News from the board members organisations.
- Administrative news. – Updates of the Administrative Handbook, NKS(11)4 and the Policy Document, NKS(08)3 Rev 3.

8 R-part: status

- See material from Karoliina Myllymäki: status report May 2011 and documents concerning RASTEP.
- Presentation by the programme manager.
- Discussion and final funding decision on RASTEP.

9 B-part: status

- See material from Justin P Gwynn: status report May 2011 and documents concerning PONPP2.
- Presentation by the programme manager.
- Discussion and final funding decision PONPP2.

10 Information activities

- Renewal of the website.
- Presentation of proposal by the programme managers.
- Discussion, decision.
- New pamphlet, NewsLetters, NewsFlashes etc.

11 Evaluation of NKS research activities 2006-10

- Is there a need for an external evaluation?
- If so, what should be the objective?
- View of programme managers.
- Discussion, decision.

12 Fukushima

- Impact of Fukushima on NKS activities.
- Is there a role for NKS in Fukushima follow up?
- Meeting / seminar on lessons learned in connection with the January Board meeting?
- Discussion, decision.

13 Research activities in 2012

- Call for Proposals
- Preliminary budget 2012
- Evaluation process. Presentation by Justin P Gwynn.
- Discussion, decision.

14 Other issues

- History “From Standardized 4-Year Classics To Customized R&B”, NKS 1994-2008: Organization, Research and Development, draft report #6 of 6, Torkel Bennerstedt, 2011-05-15
- NKS at the NSFS Conference 2011

15 Next meeting

- Next meeting will be in Oslo in January 2012.

16 End of meeting

The Secretariat

2011-03-30
NKS(11)2

nks

Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

Financial statements

for

Det Nordiske Kernesikkerhedsprogram
NKS Secretariat
FRIT

2010

30 March 2011
Finn Physant

Statement by Management on the annual report

Today the NKS Secretariat and Group of owners have discussed and approved the annual report of Det Nordiske Kernesikkerhedsprogram (in the following referred to as 'NKS') for the financial year 1 January 2010 – 31 December 2010.

In our opinion, the financial statements provide a true and accurate picture of the organisation's assets, liabilities and equity, financial position as at 31 December 2010 and the results of the organisation's activities for the financial year 1 January 2010 - 31 December 2010.

In our opinion, the management's review includes a afair review of the matters dealt with in the management review.

We recommend the financial statement for approval by the Group of owners.

Roskilde, 30 March, 2011

NKS Secretariat:

Finn Physant

Copenhagen, 31 May 2011

Group of owners:

Sigurður M. Magnússon Chairman	Steen Cordt Hoe	Jorma Aurela
Ole Harbitz	Leif Moberg	

Independent Auditors' Report

To the Group of Owners of NKS

We have audited the financial statements of NKS for the financial year 1 January 2010 - 31 December 2010, including income statement, balance sheet, notes and economic programme specification for 2010. The financial statements have been submitted in accordance with the agreements and auditing policies.

Managements responsibility for the financial statements

Management is responsible for the presentation and preparation of financial statements that give a fair and true presentation. This responsibility includes designing, implementing and maintaining of internal controls relevant for the presentation and preparation and financial statements that give a true and fair view, free from material misstatement, whether due to fraud or error, selecting and applying appropriate auditing policies and and making accounting estimates that are reasonable in the circumstances. In addition, Management is responsible for the transactions covered by the financial statements are facilities as set out in the agreements and generally accepted practices.

Auditor's responsibility and basis opinion

Our responsibility is to express an opinion on the financial statements based on our audit. We conducted our audit in accordance with the Danish as well as the public accepted auditing standards. These standards requires that we comply to ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatements.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risk of material misstatement in the financial statements, whether due to fraud or error. In making those risk assessment, the auditor considers internal controls relevant to NKS' preparation and presentation of financial statements that give a true and fair view in order to design audit procedures, which are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of NKS' internal control. An audit also includes evaluating the appropriateness of accounting polices used and the reasonableness of accounting estimates made by management, as well as the overall presentation of the financial statements. In addition, the audit includes an assessment of whether the dispositions covered by the financial statements are in accordance with the agreements and public auditing policies.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

The audit did not result in any qualifications.

Conclusion

In our opinion, the financial statements give a true and fair view of NKS' assets, liabilities and financial position as at 31 December 2010 and of the results of NKS' activities for the financial year 1 January 2010 - 31 December 2010 in accordance with the agreements and public auditing policies. In our opinion, the transactions covered by the financial statements are in accordance with the agreements and public auditing policies.

Independent Auditors' Report

Statement on the Public Administration Audit

In connection with our financial audit of NKS' financial statements for 2010, we have conducted an assessment of whether different selected areas contain due financial consideration in the management of NKS and that the objectives and results are correctly documented and adequate in the financial statment for NKS' activities in 2010.

Management's responsibility

The management of NKS' is responsible for establishing guidelines and procedures to ensure that due financial consideration to NKS' Public Administration Audit; and that the information contained in the financial statement objectives and results are documented and adequate for NKS' activities in 2010 .

Auditor's responsibility and the preformed Public Administration Audit

In accordance with accepted Public Administration Audit standards, we have checked, for a number of selected areas, whether NKS has established business procedures to ensure appropriate financial management of allocated funds. We have conducted our audit procedures in the selected areas to obtain limited assurance as to whether the management is conducted in a financially appropriate manner and whether the objective disclosed are documented and adequate in the financial statement for NKS' operations in 2010.

Conclusion

During our Public Administration Audit, we have not been acquainted with any circumstances which give us reason to conclude that the Public Administration Audit in 2010, in the selected areas not handled in a financially appropriate manner, or that the information in the financial statement regarding the objective and results did not document and adequate for NKS' operations in 2010.

Roskilde 30 March, 2011

Dansk Revision Roskilde
Godkendt revisionsaktieselskab

Palle Sundstrøm
Partner, State Authorised Public Accountant

Review of the year

2010 has been characterised by planned work/operation of the R (Reactor) - part and the B (Emergency) - part.

During 2010, the foreign exchange market has evolved in a positive direction especially for the Swedish and Norwegian currencies. The total foreign exchange gain at the end of the year is DKK 372,559 / EUR 49,978

Strålsäkerhetsmyndigheten (the Swedish Radiation Safety Authority) made an extra contribution of SEK 300,000 / EUR 33,282 in 2010.

The financial statements are presented in DKK, but the amounts are also stated in EURO in a separate column.

The financial statements show a profit of DKK 582,425 / EURO 78,132, which is consistent with decisions taken by the Group of Owners.

Subsequently, the equity as at 31 December 2010 constitutes DKK 6,446,196 / EURO 864,750.

In assessing the year's profit and equity as at 31 December 2010, consideration must be made of the contracts for the R and B part of DKK 4,221,792 / EURO 566,349 which was calculated as at 31 December 2010, but where the invoice has not yet been received or where the work is not yet complete.

It may also be indicated that NKS in accordance with programme managers' statements has received external funding of around DKK 4.0 million/ EUR 0.54 million in the form of un-charged contributions. The un-charged funding is the work performed in connection with the implementation of activities for which invoices will not be sent.

Unused coordination and travel funds for programmes for the year 2009 are returned to the reserve as are unused common programme costs for a total of DKK 1,400,296 / EURO 187,848.

Sigurður M. Magnússon
Chairman

Income statement 2010

				Rate
Grants and interest income				**7,4544**
Beredskabsstyrelsen, Denmark	DKK	398,566,74	EURO	53,467.31
Arbets- och näringsministeriet Finland	DKK	2,381,280,00	EURO	319,446.23
Geislavarnir ríkisins, Iceland	DKK	172,456,76	EURO	23,134.89
Statens strålevern, Norway	DKK	1,105,231,20	EURO	148,265.61
Strålsäkerhetsmyndigheten, Sweden	DKK	3,505,580,00	EURO	470,269.91
Additional funding	DKK	754,196,05	EURO	101,174.61
Interest income + other income - exch.adjustments	DKK	403,922.17	EURO	54,185.74
Total grants and interest income	**DKK**	**8,721,232.92**	**EURO**	**1,169,944.32**
Expenses				
R-part	DKK	3,423,038.83	EURO	459,197.10
B-part	DKK	3,380,175.64	EURO	453,447.04
Activity support	DKK	152,582.64	EURO	20,468.80
Fees	DKK	985,000.00	EURO	132,136.72
Common program expenses	DKK	198,011.16	EURO	26,562.99
Total expenses for the NKS programme	**DKK**	**8,138,808.27**	**EURO**	**1,091,812.66**
Income - Expenses	**DKK**	**582,424.65**	**EURO**	**78,131.66**

Balance sheet 2010

Assets:				**Rate**
				7,4544
Giro and bank accounts converted to DKK, Note 1				
FI-giro 800015-70837915	DKK	1,454,602.27	EURO	195,133.38
NO-giro 7874.07.06976	DKK	2,568,136.06	EURO	344,512.78
SE-giro 6 64 63-1	DKK	2,543,334.89	EURO	341,185.73
DK/IS-giro 918-9297	DKK	900,693.34	EURO	120,827.07
Giro account totals	DKK	7,466,766.56	EURO	1,001,658.96
Prepayment, Note 2	DKK	576,250.00	EURO	77,303.34
Total Assets	**DKK**	**8,043,016.56**	**EURO**	**1,078,962.30**
Liabilities:				
Equity:				
Retained from previous years	DKK	5,863,771.19	EURO	786,618.80
Results of this year	DKK	582,424.65	EURO	78,131.66
Total equity	**DKK**	**6,446,195.84**	**EURO**	**864,750.46**
Payables, Note 3	DKK	100,000.00	EURO	13,414.90
Statement for new financial year, Note 4	DKK	1,496,820.72	EURO	200,796.94
Total Liabilities	**DKK**	**8,043,016.56**	**EURO**	**1,078,962.30**

Notes

Note 1: Giro and bank accounts:				7,4544
FI-giro 800015-70837915				
Holding 31.01.2011	EURO	195,133.38		
Exchange equalisation		1,259,468.89		
Holding	DKK	1,454,602.27	EURO	195,133.38
NO-giro 7874.07.06976				
Holding 31.01.2011	NOK	1,475,410.01		
Giro deposits 31.01.2011		1,218,250.64		
Exchange equalisation		-125,524.59		
Holding	DKK	2,568,136.06	EURO	344,512.78
SE-giro 6 64 63-1:				
Holding 31.01.2011	SEK	3,075,374.71		
Exchange equalisation		-532,039.82		
Holding	DKK	2,543,334.89	EURO	341,185.73
DK/IS-giro 918-9297:				
Holding 31.01.2011	DKK	900,693.34		
Holding	DKK	900,693.34	EURO	120,827.07
Total	**DKK**	**7,466,766.56**	**EURO**	**1,001,658.96**

Note 2: **Prepayments**

Remuneration of chief executive for 2011 and the secretariat of 1st quarter 2011.

Note 3: **Payables**

Agreement/ B (09) 2008 NRPA - Part 1 - Paid 01.02.2011

Note 4: **Statement for new financial year**

Statens strålevern, Geislavarnir, KSU and Fennovoima have paid contributions for 2011.

Notes

Financial programme specification - 31 January 2011

	DKK							EURO	Rate 7,4544	
Total	Budget from 09	Returned 09	Budget 10	Total budget 10	Payments	Contracts	Rest	Payments	Contracts	Rest
R-Part	1,958,670	-198,670	3,240,000	5,000,000	3,423,039	1,330,000	246,961	459,431	178,418	33,146
B-Part	3,645,656	-1,014,548	3,742,000	6,373,108	3,380,176	2,801,792	191,140	453,678	375,857	25,654
Activity support	145,129	-145,129	262,583	262,583	152,583	90,000	20,000	20,479	12,073	2,684
Fees	4,650	-4,650	985,000	985,000	985,000	0	0	132,204	0	0
Common program exp.	33,223	-33,223	250,000	250,000	198,011	0	51,989	26,577	0	6,978
Travels	4,076	-4,076	0	0	0	0	0	0	0	0
I alt	5,791,404	-1,400,296	8,479,583	12,870,691	8,138,809	4,221,792	510,090	1,092,370	566,349	68,463
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F_3 = F$

$F - G = H = H_1 + H_2$

Notes

Detailed financial programme specification - 31 January 2011

	DKK							EURO	7,4544	
Specifikation:	Budget from 09	Returned 09	Budget 10	Total budget 10	Payments	Contracts	Rest	Payments	Contracts	Rest
R-Part: Common program.	105,265	-105,265	640,000	640,000	486,858	0	153,142	65,345	0	20,554
MANGAN	100,000	0	0	100,000	0	100,000	0	0	13,415	0
Activity from 2008	1,660,000	0	2,500,000	4,160,000	2,929,900	1,230,000	100	393,243	165,003	13
Travel young scientists	93,405	-93,405	100,000	100,000	6,281	0	93,719	843	0	12,579
B-Part: Common program.	65,570	-65,570	640,000	640,000	512,567	0	127,433	68,795	0	17,104
Preparedness	1,428,715	-86,000	1,310,000	2,652,715	1,216,371	1,436,344	0	163,258	192,684	0
Measurement	964,940	-157,797	1,192,000	1,999,143	1,074,945	924,198	0	144,276	123,980	0
Radioecology	449,375	-148,125	500,000	801,250	360,000	441,250	0	48,318	59,193	0
Waste	180,000	0	0	180,000	180,000	0	0	24,159	0	
CfP May 2009 rest	510,000	-510,000	0	0	0	0	0	0	0	0
Travel young scientists	47,056	-47,056	100,000	100,000	36,293	0	63,707	4,871	0	
Evaluation	45,126	-45,126	0	0	0	0	0	0	0	0
VAT support	100,000	-100,000	20,000	20,000	0	0	20,000	0	0	2,684
NKS history	3	-3	200,000	200,000	110,000	90,000	0	14,764	12,073	0
IRPA 2010	0	0	42,583	42,583	42,583	0	0	5,715	0	
Fee Secretariat	4,650	-4,650	575,000	575,000	575,000	0	0	77,175	0	0
Fee Chairman incl. travels	0	0	410,000	410,000	410,000	0	0	55,029	0	0
Reports etc.	15,006	-15,006	30,000	30,000	9,393	0	20,607	1,261	0	2,766
Postage etc.	3,688	-3,688	10,000	10,000	9,055	0	945	1,215	0	127
Equipment	15,000	-15,000	15,000	15,000	0	0	15,000	0	0	2,013
Internet	0	0	90,000	90,000	81,250	0	8,750	10,905	0	1,174
Auditing	-48,751	48,751	50,000	50,000	56,250	0	-6,250	7,550	0	-839

Notes

	DKK							EURO		
Specifikation:	Budget from 09	Returned 09	Budget 10	Total budget 10	Payments	Contracts	Rest	Payments	Contracts	Rest
Information material	30,000	-30,000	30,000	30,000	26,201	0	3,799	3,517	0	510
Various	18,280	-18,280	25,000	25,000	15,862	0	9,138	2,129	0	1,226
								0		
Travels Chairman	4,076	-4,076	0	0	0	0	0	0	0	0
Travels Secretariat	0	0	0	0	0	0	0	0	0	0
Diff.					-1	0				
Total	5,791,404	-1,400,296	8,479,583	12,870,691	8,138,808	4,221,792	510,090	1,092,369	566,349	68,463
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F3 = F$

$F - G = H = H_1 + H_2$

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Det Nordiske Kernesikkerhedsprogram

Long-form audit report of 30 March 2011 regarding the 2010 financial statements

Long-form audit report

Contents

Long-form audit report

1 Audit of the Financial Statements

1.1 Introduction

As auditors of Det Nordiske Kernesikkerhedsprogram (in the following referred to as 'NKS'), we have audited the financial statements for the financial year 1 January 2010 - 31 December 2010, prepared by the NKS Secretariat (in the following referred to as 'the Secretariat'). Our audit comprised the income statement, balance sheet, notes and financial survey for 2010 .

The financial statements show the following profit, assets and equity:

DKK / EUR	Year under review	Last year
Profit for the year	582,425 / 78,132	-462,479 / -62,149
Equity	6,446,196 / 864,750	5,863,771 / 787,982

1.2 Scope and performance of the audit

The purpose, organisation and performance of the audit, the auditor's responsibilities and reporting, as well as management's responsibilities are unchanged; we refer to our Letter of Engagement of 30 March 2011.

The audit of the financial statements was conducted primarily after the end of the financial year.

The audit comprised such elements as a review and assessment of some of the key business procedures, a sampling review of accounting and voucher material, analysis of the items of the income statement, as well as a review and assessment of the company's balance sheet as at 31 December 2010 cf. item 2.1.

1.3 Auditor's Opinion based on the performed audit

The audit has not given rise to any qualifications of significance to the auditor's opinion.
Special aspects of the presentation of the financial statements are dealt with in the following, cf. below.

Provided that the financial statements are approved in their present wording and presentation and that, as a result of the NKS Board's discussion and approval of the financial statements, no further, significant information arises which would materially affect the financial statements, we will provide the financial statements with an unmodified audit opinion.

2 Comments regarding the audit performed and the 2010 financial statements

2.1 Risk assessment and audit strategy

Our audit was planned and performed in accordance with generally accepted government auditing standards. In addition to our audit of the financial statements, we reviewed and assessed whether due financial care is shown in the management of the funds comprised by the financial statements.

During our audit of the financial statements, we checked whether the financial statements are free of material misstatement and discrepancies We compared the financial statements to the underlying bookkeeping records and checked the compliance of the financial statements with applicable rules and regulations, agreements and common practice.

The performance audit was conducted and integrated in parallel with the financial audit and has included audits of agreements and contracts, reports, analysis of expenditure and revenue items and analysis of budget deviations on a sample basis.

2.2 Discussions with the management about fraud

In the course of the audit, we asked Management about the risk of fraud; management stated that in its assessment, there is no particular risk that the financial statements could contain significant misinformation as a result of fraud.

Furthermore, management stated that it has no knowledge of fraud or ongoing investigations of assumed fraud.

In our audit, we did not come across any elements that would indicate or arouse suspicion of fraud of any significance to the information contained in the Financial Statements.

2.3 Use of IT

In connection with our audit, we reviewed the company’s use of IT, focusing on the following general aspects of IT:

- Systems development and operations,
- acquisition, development, modification and maintenance of system software and user programs
- access security, and
- backup.

The review showed that the company:

- Only makes use of standard software,
- has reasonable access control around programs and data, and
- makes regular backups and test them.

On this basis, we find that the company cannot be deemed to be particularly dependent on IT and that the company’s use of IT contains no risk with regard to future operations.

2.4 Administration

In line with last year, the Secretariat was managed by FRIT ApS.

The management agreement has been extended till 30 June 2012.

In connection with our audit, we found that the Secretariat in March/April 2010 has made individual transfers between bank accounts in the Nordic countries

This is done to minimize the risk of exchange losses in connection with any currency price increases and decreases.

2.5 Approval procedures

We followed up on the Secretariat's business processes and internal controls regarding approval procedures. Our review gave rise to the following comments:

Project expenses

We checked on a sample basis whether the supporting documentation is duly approved by the programme manager or the chairman Sigurður M. Magnússon. Our review did not give rise to any comments.

Further, we established that the Secretariat provides the two programme managers with situation reports on a regular basis. The reports are forwarded approx. every two months, most recently on 25 February 2011. These reports comprise statements of account of project expenses, etc. so as to provide the programme manager with an overview of current payments on the project.

Expenses relating to the Secretariat

We checked fees paid to the secretariat to agreement. We checked on a sample basis whether the invoices have been approved by Sigurður M. Magnússon. Our review did not give rise to any comments.

2.6 Authorisation to sign for the Secretariat

Finn Physant, finance manager and co-owner of FRIT ApS and the chairman Sigurður M. Magnússon, have authority to make withdrawals from NKS' giro and bank accounts, either jointly or individually together with Claus Rubin, who is also a co-owner of FRIT ApS.

Given the limited number of employees, we find the above authority procedures appropriate.

2.7 Sum of corrected and non-corrected misstatements

When the financial statements are presented, uncorrected errors are often ascertained. Typically, such errors are not significant to the presentation of the accounts or for the picture of the company's financial position given in the financial statements.

During our audit, we did not identify any non-corrected errors.

3 Comments on the financial statements

We make the following comments on the individual items in the income statement and the balance sheet for 2010:

3.1 Received contributions/grants

In December 2010, NKS received an additional appropriation from SSM/SE SEK of 300,000 / EUR 33,282.

3.2 Additional financiers

The additional financiers stated in the income statement may be analysed as follows:

	2010	2009	2008
Fortum Power and Heat Oy, Finland	154,783	154,973	149,104
TVO, Finland / Teollisuuden Voima Oyj, TVO	154,783	154,973	149,104
Fennovoima Oy, Finland	44,649	38,763	37,276
Forsmarks Kraftgrupp AB, Sweden	79,996	77,486	74,552
Kärnkraftsäkerhet och utbildning (KSU), Sweden	79,996	77,486	74,552
OKG Aktiebolag, Sweden	79,996	77,486	74,552
Ringhals AB, Sweden	79,996	77,486	74,552
IFE, Norway	44,649	77,486	74,552
Total additional financiers	754,196	736,139	708,244

The additional financiers are in accordance with the supporting documentation.

3.3 Interest income, exchange adjustments and other income

Analysis of the item:

	2010	2009	2008
Interest income	31,363	21,346	157,485
Exchange adjustments	372,559	105,066	-431,295
	403,922	126,412	-273,810

The exchange adjustments are primarily attributable to the fact that amounts in foreign currencies were recorded at the exchange rates at 31 December 2009 throughout 2010, which resulted in differences between applied and actual exchange rates.

However, this practice does not affect the total results of operations, but only the breakdown under individual items in the income statement.

3.4 Budget balances brought forward from one year to the next

The financial survey for 2010 shows budget figures for all expenses. Further, a total of DKK 4,391,108 has been brought forward from 2009, cf. pp. 8 and 9, the first two paragraphs, of the financial statements.

As in prior years, the budget balance relating to shared programme expenses and joint travelling has not been brought forward from 2009 to 2010 but has been transferred to NKS' net assets (the reserve).

It should further be noted that the programme, travelling and activity resources allocated to the programme managers for 2010 but not employed/appropriated during the year will be transferred to net assets in 2010 similar to last year. Only appropriated activity expenses relating to the R and B parts and NKS' history project will thus be brought forward from one year to the next.

4 Public Administration audit

In accordance with generally accepted government auditing standards, we checked, for a number of selected areas, whether NKS has established business processes to ensure appropriate management of allocated funds. We performed our audit procedures to obtain limited assurance as to whether the management is conducted in a financially appropriate manner and whether the performance numbers disclosed are documented and adequate to cover NKS' operations in 2010.

According to our information, the grants (except for the grants contributed by Fortum Power and Heat Oy and TVO) are not earmarked for specific projects but for NKS' programmes as such. Based on this information, our audit was conducted on the basis of NKS' activities as a whole. During our audit, we checked that the grants from Fortum Power and Heat Oy and TVO have been employed as intended.

During our audit, we established that expenses incurred relate to individual projects and that the supporting documentation is duly approved. We noted that the programme and Secretariat budgets are kept. Finally, we checked on a sample basis whether reports have been prepared for completed projects.

We are not in a position to say whether the individual projects could be carried out in a more economical manner. However, no matters have come to our attention that cause us to believe that this is the case.

4.1 Management of funds

We have previously recommended that cash should be invested diffenrently than giro accounts so to obtain higher returns.

Interest income for the year amounted to DKK 31 thousand, which is an increase of DKK 10 thousand over 2009. The low interest income results from excess liquidity from approx. May 2010 has been placed on deposit accounts in different banks. At the balance sheet date, the following interest rates applied:

Danske Bank, DK	0% p.a. on the total balance
DnB NOR, NO	0.10% - 2.00% p.a. depending on the size of the balance
Nordea, SE	0% p.a. on the total balance
SAMPO Bank Abp, FI	0% p.a. on the total balance

4.2 Agreement between bookkeeping records and financial statements

We noted that there is agreement between bookkeeping records and the financial statements for 2010.

As in prior years, all payments received and made in January 2010 are included in the financial statements as if they had been settled before 31 December 2010. This policy does not affect the results of operations. Only the size of cash, receivables and payables is affected.

5 Other aspects

5.1 Economic crime

In accordance with the Danish Act on Approved Auditors and Audit Firms, we are obliged to check whether any management member has committed significant economic crime and under certain circumstances we must report our findings to legislative and enforcing authorities (primarily the Serious Economic Crime Squad).

In the course of our audit, we did not come across any situations or indications that would lead us to believe that any member of management has committed an economic crime.

5.2 Storage of accounting material, etc.

In accordance with the ministerial order on declarations, we are obliged to verify compliance with statutory requirements on accounting and storing of accounting material.

We found that the company is in compliance with statutory requirements concerning accounting and the storing of accounting material.

6 Other assignments

In the year under review, we provided the following other services to the company:

- Assistance in preparing the financial statements

A fee of DKK 42,500 excl. VAT has been agreed for the audit of financial statements, including assistance with preparation of financial statements, attendance at meetings and board meeting as well as translation of the audit report into English. The amount is not appropriated as payables in the presented statements.

7 Statements in connection with the audit

7.1 Management statement

In the course of the audit of the financial statements, we obtained confirmation from management as to the completeness of the financial statements, e.g. with regard to pledges, guarantees, lawsuits, events after the balance sheet date and other areas that are difficult to audit. Management declared that due financial care has been shown in NKS' management of the allocated funds.

We did not note any matters that could indicate or give rise to suspicion of fraud materially affecting the information in the financial statements.

Management has indicated that NKS is not a party to pending cases, which will significantly affect the financial statements.

7.2 Auditor's statements

In accordance with the ministerial order on statements, etc., made by state-authorized public accountants and registered public accountants, we declare that:

- We are in compliance with statutory rules on legal competence, and
- We received all the information we asked for during the audit.

Roskilde 30 March, 2011

Dansk Revision Roskilde
Godkendt revisionsaktieselskab

Palle Sundstrøm
Partner, State Authorised Public Accountant

Presented to the supervisory board, date 31 May 2011

Sigurður M. Magnússon Chairman	Steen Cordt Hoe	Jorma Aurela
Ole Harbitz	Leif Moberg	

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Det Nordiske Kernesikkerhedsprogram

Letter of Engagement of 30 March 2011

Letter of Engagement

Contents

1 Instructions

As the Organisation's auditors, cf. the minutes of the Supervisory Board's meeting dated 2 June 2010, we will initially provide the following general information about the purpose, organisation and performance of the audit, the distinction between the responsibilities of the Management and the auditor, and our reporting to the Organisation's Management.

2 Purpose and formal content of the audit

The main purpose of the audit is for us to make a statement about the Financial Statements in our Auditor's Opinion.

The purpose of the audit is to strengthen the credibility of the Financial Statements. We will verify that the Financial Statements have been prepared in accordance with the accounting provisions laid down in legislation and in the Organisation's Articles of Association, as well as with relevant accounting standards.

Before we, as auditors, can make a statement in the Auditor's Opinion, legislation requires us to verify that the Financial Statements prepared by Management have been drawn up and presented in accordance to the Danish Bookkeeping Act, as well as other legislation.

Furthermore, the purpose of the audit is to ensure that generally recognised accounting policies have been applied and that the Financial Statements give users of the information a fully true and fair picture of the Organisation's assets and liabilities, its financial position and the result of its operations.

In our audit, we must also verify that Management complies with its duties under Organisation legislation to establish and maintain lists and minutes of meetings and to present and sign long-form audit reports.

In accordance with generally accepted government auditing standards, our audit will be planned and performed on the basis of a systematic risk assessment, thereby focusing mainly on the Financial Statements items, those parts of the Organisation's accounting and reporting systems, as well as the Organisation's other procedures that represent the greatest risk of material error. Consequently, the audit does not aim to discover or correct immaterial errors that involve no change in the overall assessment of the Financial Statements.

As a basis for our risk assessment, we will obtain Organisation information about elements such as the following:

- Activities and administration of the funds covered by the financial statements
- Objectives, strategies and associated business risks, and
- Business procedures and the Organisation's internal control system.

In planning our audit, we have to review the Organisation's internal control system and specific controls, including controls in the accounting process and general IT controls, so as to carry out a targeted risk assessment.

The audit does not comprise a review of all vouches and transactions; the audit is carried out in the form of samples taken to obtain documentation or other verification of the correctness of the accounting carried out and the Financial Statements. In this connection we will test the internal controls to the extent we deem necessary for our audit of the Financial Statements.

The audit comprises an assessment and evaluation of the accounting policies used and the accounting estimates made by Management.

Significant errors in the Financial Statements may be caused by unintentional or intentional acts or omissions.

The possibility of preventing significant errors, including fraud and irregularities, depends primarily on ensuring adequate internal controls when organising registration systems and business procedures.

During the audit, we will use requisite professional scepticism to focus on any matters that may be indictors of fraud or other irregularities. When planning the audit, we will consider the following aspects:

- Management's assessment of the risk that the Annual Report may contain significant errors as a result of fraud
- Management's assessment of the accounting and control system it has introduced to counteract such risks, and
- Management's knowledge of ascertained fraud or ongoing investigations regarding fraud.

In addition, we have to ask Management if it has any knowledge of ascertained, assumed or alleged fraud affecting the Organisation.

During the audit, we have to carry out specific audit measures directed at Management's possibility of disregarding established, internal controls.

In addition, we have to verify that the Financial Statements have been reconciled with the underlying accounting, just as we have to review significant account entries and regulations made as part of the preparation of the Financial Statements.

According to legislation, we have to inform Management if, in our audit, we become aware that one or more members of Management is/are carrying out or has/have carried out economic crime in connection with their performance of their tasks for the Organisation. This information must be given to each member of Management if we have a justified assumption that the crime concerns significant amounts or is of a gross nature; furthermore, the information given will be entered in the long-form audit report. If, within 14 days, Management has not documented that the necessary steps have been taken to stop the crime, it is our duty to immediately inform the State Prosecutor for Serious Economic Crime.

If, in our assessment, giving information to members of Management would be unsuitable for the prevention of the crime and for rectifying the damage done, we are obliged to immediately inform the State Prosecutor for Serious Economic Crime, in the event that such a situation arises. This also applies if a majority of the Organisation's Management members are involved in or have knowledge of the economic crimes concerned.

If we ascertain or suspect money laundering, legislation obliges us to probe into the situation. If we suspect crimes for which the punishment could be imprisonment for over one year and we are not able to have this suspicion resolved, we must immediately inform the State Prosecutor for Serious Economic Crime without informing Management. Suspicions of money laundering or ascertained money laundering will not be entered in the long-form audit report.

3 Organisation and performance of the audit

We will carry out an audit of the statutory elements of the Financial Statements. The audit has not been completed until Management has made a final decision on the Financial Statements and we have entered our Auditor's Opinion in the Financial Statements.

The scope of our work is determined on the basis of our overall assessment of the significance and risk of any material misstatements in the Financial Statements.

In our audit of the Financial Statement, we will verify that the assets are present, that they belong to the Organisation and that they have been recognised and assessed responsibly. Furthermore, we will verify that the debt commitments and other commitments, including any contingencies, etc., that rest upon the Organisation has been recognised and assessed responsibly. In addition, we will ensure that accounting items take account of prepayments and accruals and that they are correctly presented in the Financial Statements.

We will consider whether all significant events up to the date of the Auditor's Opinion have been correctly included in the Financial Statements.

Based on the Management's assessment, Financial Statements are normally presented on a going concern basis. The Management's decision requires that Management to form an opinion about all accessible information on the Organisation's development, including in particular the expected cash flow development. As part of the audit, we address Management's assessment.

In connection with the audit of the Financial Statements, we will follow good accounting practice and ask the Organisation's Management to confirm information within a number of areas that are particularly difficult to audit. This could be information about contingencies in the form of pledges, guarantees, lawsuits and fraudulent activity, transactions with affiliated or associated parties, environmental aspects, events after the Balance Sheet date, as well as accounting items associated with particular risk or uncertainty.

Whenever we base aspects of our audit on information prepared by the Organisation, we must carry out auditing activities to verify the accuracy and completeness of the information received.

If, in the course of our audit, we ascertain errors in the Financial Statements, we must notify the Organisation's Management accordingly, and we must ask Management to correct the errors found. The Organisation's day-to-day Management must state whether any uncorrected errors in the Financial Statements ascertained during the audit can be regarded, individually or jointly, as being immaterial to the Financial Statements as a whole.

4 Reporting on the audit performed

4.1 Auditor's Opinion in the Financial Statements

Our opinion based on our audit is stated in the form of an Auditor's Opinion in the Financial Statements. An unqualified Auditor's Opinion or an Auditor's Opinion with supplementary information means that:

- The Financial Statements were audited
- The Financial Statements were presented correctly on the basis of accounting, and
- The Financial Statements give a true and fair picture of the Organisation's assets, liabilities, financial position and the result of the Organisation's activities in accordance with various regulations and requirements in any other provisions regarding the presentation of accounts.

4.2 Reporting to the Organisation's Management

The audit performed and the auditor's opinion will be reported to Management in the long-form audit report. Reporting to day-to-day Management will be in the form of letters and notes.

If significant deficiencies are ascertained in account entries or the accounting system, the long-form audit report will address this issue.

If the audit gives rise to critical comments or if we wish to draw Management's attention to information that is material to the Organisation's financial position, these elements will be entered in the long-form audit report.

For the meeting at which the draft Annual Report is to be discussed, a long-form audit report will be prepared concerning the audit of the Financial Statements. In accordance with good auditing practice, this long-form audit report must contain information to Management about any uncorrected misstatements in the Financial Statements, which the day-to-day Management has regarded both individually and combined as being immaterial for the Financial Statements as a whole.

Our comments in long-form audit reports and any other reports do not imply any restriction of our responsibility for the correctness of the Financial Statements, since any such responsibility can only be restricted by entering qualifications in the Auditor's Opinion in the Financial Statements.

4.3 Qualifications or supplementary information in the Auditor's Opinion

If we become aware of situations that could give rise to qualifications or supplementary information in the Auditor's Opinion in the Financial Statements, we will immediately inform Management accordingly in the long-form audit report and, if relevant, in other ways as well, so as to enable quick reaction and remedial action. This also applies if we become suspicious or aware of significant fraud or other irregularities.

Examples of situations in which qualifications may be entered:

- Significant disagreement with Management, or
- Restrictions in the scope of the audit (inadequate audit proof).

Supplementary information may be entered in the following situations:

- Matters to which we draw attention without entering qualifications about them
- Infringement of legislation on accounting and the storing of accounting material, or
- Matters that may lead to Management liability, including unlawful loans to Management, etc.

5 Delineation between the responsibilities of Management and the auditor

5.1 Division of responsibilities

According to legislation, the audit is based on the following division of responsibility for the Annual Report, including the Financial Statements, between the Organisation’s Management and the auditor:

5.2 Responsibilities of Management

Management is responsible for ensuring that the Organisation’s accounting is in compliance with statutory provisions and that the administration of assets is conducted responsibly, i.a. through the establishment of a reliable internal control system that will form the necessary basis for the audit.

Management is responsible for ensuring that appropriate business procedures as well as recording and control systems are in place to ensure that intentional or unintentional errors can be prevented as far as possible, or be discovered and corrected. According to the Danish Accounting Act, the Organisation shall prepare a description of these business procedures and recording systems commensurate with the Organisation’s size and nature.

Furthermore, Management shall ensure that an Annual Report is prepared each year which complies with the accounting provisions of legislation and the Organisation’s Articles of Association. In addition, Management is responsible for ensuring that the auditor has access to all information deemed necessary by the auditor for performing the audit assignment.

All member of the Group of Owner shall sign the long-form audit reports as proof that they have read the reports and are aware of their contents.

5.3 Responsibilities of the auditor

It is the auditor’s responsibility to verify that the Financial Statements prepared are in compliance with the accounting provisions of legislation and the Organisation’s Articles of Association, which includes an assessment of the Organisation’s accounting policies and the information given and accounting estimates made by Management. It is also our responsibility to verify that the Financial Statements are free of material misstatements.

According to the Danish Act on Approved Auditors and Audit Firms, the auditor is represents the public, so to speak, when giving opinions with the certainty required in legislation or where such statements are not intended only for the client's own use. Consequently, when we give our opinion, we must also take account of users of the accounts other than the Organisation's Management..

It is not our job to produce an audit that is critical of the Organisation's business decisions.

If, following agreement with the Organisation's Management, we perform advisory services and render assistance, we have a separate responsibility as advisors in respect of any such services.

5.4 The auditor's documentation material

Working documents and other documentation, including both electronic and hardcopy working documents, which are provided as part of the audit, belong to the auditor only. Following common procedure, such documentation can be shredded or deleted after five years, unless we consider such documentation to still be of importance to the audit.

If it is deemed appropriate to hand out material or files to the Organisation, this shall be done on condition that the Organisation uses the material for its own purposes only and does not pass it on to any third party.

We assume no responsibility for any use the Organisation may make of any such material given out, unless a separate, written agreement is concluded concerning our assistance with processing the material and our responsibility in this regard.

5.5 Quality assurance of the performed audit.

According to the Danish Act on Approved Auditors and Audit Firms, we are subject to quality control rules enforced by an Auditors Supervisory Authority established by the Danish Commerce and Companies Agency. Auditors carry out this quality control on behalf of the Auditors Supervisory Authority.

Consequently, our work documentation, also including documentation of our audit of the Organisation, may be selected for quality control on a randomised basis.

The members of the Auditors Supervisory Authority and the persons in charge of quality control are bound by secrecy in performing their duties.

5.6 Access to examine the auditor

The Danish Act on Approved Auditors and Audit Firms allows the Danish Commerce and Companies Agency to carry out an examination of and a search of the premises of the auditor without a court order, and to request that working documents, long-form auditor reports, correspondence, etc., be handed over to the Agency if the agency finds that we, as auditors, have infringed the provisions of the Danish Act on Approved Auditors and Audit Firms.

The employees of the Agency are also bound by secrecy.

6 Accounting assistance and advisory services

Basically, the audit does not comprise active participation in the Organisation’s accounting work or the preparation of the Annual Report or other presentations of accounts, just as it does not comprise budgets, assistance with the preparation of the tax return or other tax-related or duty-related elements. Such assistance will be given following agreement and may be stated in the long-form audit report if so requested.

If we agree to assist with budgets or parts of the preparation of the accounts, or if, following agreement, we prepare the entire Annual Report, we assume responsibility for providing this assistance in a professional manner in accordance with the standards applicable to such work carried out by approved auditors. This does not reduce Management’s responsibility for the presentation of accounts.

We should like to point out in particular that it would not be in accordance with requirements concerning our independence as auditors if we were to take part in the responsibility for the Organisation’s decisions.

7 Conclusion

Subsequent long-form audit reports regarding the Financial Statements will refer to this Letter of Engagement.

We have commenced the audit of the Organisation's Financial Statements for the period 1 January 2010 – 31 December 2010 in accordance with the above.

Roskilde, 30 March 2011

Dansk Revision Roskilde
Godkendt revisionsaktieselskab

Palle Sundstrøm
Partner, State Authorised Public Accountant

Presented to the supervisory board, date 31 May 2011

Sigurður M. Magnússon Chairman	Steen Cordt Hoe	Jorma Aurela
Ole Harbitz	Leif Moberg	

Financial status - 13 Maj 2011

Incomes DKK

Expected incomes this year	8.772.931	A = B + C
Received until now	8.447.321	B
Additional payments	325.610	C
Cash balance	11.408.633	D
Available funds	11.734.243	E = C + D

Budget and expenses DKK

Total budget incl. transfer from earlier years	12.823.084	F = G + H
Paid until now	3.496.965	G
Rest budget	9.326.119	H

Available DKK

Rest available for the board	2.408.124	I = E - H

13-05-2011/bly

Financial programme specification - 13. Maj 2011

	DKK							EURO	Rate 7,4544	
Total	Budget from 10	Returned 10	Budget 11	Total budget 11	Payments	Contracts	Rest	Payments	Contracts	Rest
R-Part	1.576.861	-346.861	4.000.000	5.230.000	1.908.999	2.821.001	500.000	256.221	378.434	67.109
B-Part	2.992.832	-609.748	3.850.000	6.233.084	733.335	4.699.749	800.000	98.426	630.466	107.374
Activity support	110.000	-20.000	0	90.000	30.000	60.000	0	4.027	8.049	0
Fees	0	0	1.010.000	1.010.000	713.250	296.750	0	95.731	39.809	0
Common programme exp.	51.989	-51.989	250.000	250.000	109.085	9.375	131.540	14.641	1.258	17.655
Travels	0	0	10.000	10.000	2.296	0	7.704	308	0	1.034
I alt	4.731.682	-1.028.598	9.120.000	12.823.084	3.496.965	7.886.875	1.439.244	469.353	1.058.016	193.172
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F3 = F$

$F - G = H = H_1 + H_2$

13-05-2011/bly

Detailed financial programme specification - 13. Maj 2011

	DKK							EURO	7,4544	
Specifikation:	Budget from 10	Returned 10	Budget 11	Total budget 11	Payments	Contracts	Rest	Payments	Contracts	Rest
R-Part: Common program.	153.142	-153.142	650.000	650.000	225.000	225.000	200.000	30.199	30.184	26.843
MANGAN	100.000	-100.000	0	0	0	0	0	0	0	0
Activity from 2008	1.230.000	0	3.050.000	4.280.000	1.683.999	2.596.001	0	226.022	348.251	0
CfP 2011 rest.	0	0	200.000	200.000	0	0	200.000	0	0	26.843
Travel young scientists	93.719	-93.719	100.000	100.000	0		100.000	0	0	13.422
B-Part: Common program.	127.433	-127.433	650.000	650.000	225.000	225.000	200.000	30.199	30.184	26.843
Preparedness	1.436.244	-290.215	650.000	1.796.029	192.500	1.603.529	0	25.837	215.112	0
Measurement	924.198	-27.143	1.030.000	1.927.055	150.835	1.776.220	0	20.245	238.278	0
Radioecology	441.250	-101.250	500.000	840.000	135.000	705.000	0	18.119	94.575	0
Waste	0	0	420.000	420.000	30.000	390.000	0	4.027	52.318	
CfP 2011 rest.	0	0	500.000	500.000	0	0	500.000	0	0	67.109
Travel young scientists	63.707	-63.707	100.000	100.000	0	0	100.000	0	0	
Evaluation	0	0	0	0	0	0	0	0	0	0
VAT support	20.000	-20.000	0	0	0	0	0	0	0	0
NKS history	90.000	0	0	90.000	30.000	60.000	0	4.027	8.049	0
NSFS 2011	0	0	0	0	0	0	0	0	0	
Fee Secretariat	0	0	590.000	590.000	293.250	296.750	0	39.359	39.809	0
Fee Chairman incl. travels	0	0	420.000	420.000	420.000	0	0	56.371	0	0
Reports etc.	20.607	-20.607	30.000	30.000	18.401	0	11.599	2.470	0	1.557
Postage etc.	945	-945	10.000	10.000	2.039	0	7.961	274	0	1.069
Equipment	15.000	-15.000	15.000	15.000	0	0	15.000	0	0	2.013
Internet	8.750	-8.750	90.000	90.000	25.000	0	65.000	3.355	0	8.724
Auditing	-6.250	6.250	53.125	53.125	43.750	9.375	0	5.872	1.258	0
Information material	3.799	-3.799	30.000	30.000	0	0	30.000	0	0	4.027
Various	9.138	-9.138	21.875	21.875	19.895	0	1.980	2.670	0	266
								0		
Travels Chairman	0	0	0	0	0	0	0	0	0	0
Travels Secretariat	0	0	10.000	10.000	2.296	0	7.704	308	0	1.034
Diff.					0	0				
Total	4.731.682	-1.028.598	9.120.000	12.823.084	3.496.965	7.886.875	1.439.244	469.353	1.058.016	193.172
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F_3 = F$ $\quad$ $F - G = H = H_1 + H_2$

13-05-2011/bly

DRAFT

NKS(11)1
2011-02-03

Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

Minutes from the board meeting in Stockholm 11 January 2011

Present: Sigurður M. Magnússon (chairman), Leif Moberg, Lars Gunsell, Jorma Aurela, Ole Harbitz, Michael Boesgaard Brøndel (part of the meeting), Steen Cordt Hoe, Tarja Ikäheimonen, Finn Ugletveit, Synnöve Sundell-Bergman, Lars Martiny, Antti Daavittila, Nici Bergroth, Atle Valseth, Kaare Ulbak, Justin Gwynn, Karoliina Myllymäki, Patrick Isaksson and Finn Physant (meeting secretary).

1 Opening

The chairman opened the meeting and welcomed all. The chairman expressed his warm thanks to the hosts Leif Moberg and Lars Gunsell. A special welcome was given to the new programme manager Karoliina Myllymäki, and at the same time many thanks were given to her predecessor Patrick Isaksson for the very good co-operation and his excellent contribution to the work of the NKS. Steen Cordt Hoe also received a special welcome – he will be replacing Michael Boesgaard Brøndel, who was thanked for his valuable contribution to NKS. The chairman also congratulated Lars Martiny on being appointed Vice Director of Risø.

2 Practical remarks

Practical remarks about the meeting were given by Lars Gunsell. Finn Physant was appointed meeting secretary.

3 Approval of the agenda

The agenda was approved.

4 Minutes from last board meeting (Copenhagen, 2 June 2010)

The minutes were approved.

Nici Bergroth asked, how the procedure from draft minutes to approved minutes is carried out. A discussion confirmed, that the first draft is distributed to all board members for their comments within 2 weeks after the board meeting. Comments by board members are requested within 2 weeks. Based on the comments, amendments to the draft are prepared by the Secretariat, if needed. A silent procedure of 2 weeks for further comments involving all members is then carried out. Following the silent procedure the draft should be ready for uploading on the open website and open distribution. The NKS board will be informed when the draft has been uploaded to the open website. ”Draft” will be deleted, when the board approves the minutes during the following meeting.

5 News since last board meeting

a) Report from owners group meeting held 10 January, 2011

The owners had met for an informal discussion. No decisions and nothing to report.

b) News from board members organisations

The members informed each other about relevant news.

c) Administrative news

Jorma Aurela presented and introduced to the board - with many recommendations and warm welcome - the new R-part programme manager Karoliina Myllymäki from Fortum. Karoliina has been employed in the Process Analysis group at Fortum since 2008, working on nuclear safety related CFD analysis. Karoliina has a masters degree in mechanical/ energy engineering from Helsinki University of Technology and completed her masters thesis on decommisioning and waste management of French nuclear power plants while working for EDF.

Jorma Aurela also expressed NKS’ sincere thanks to Karoliina Myllymäki’s predecessor Patrick Isaksson for all his work and cooperation as the R programme manager over the last 5 years.

Jorma Aurela also had news about Nici Bergroth, who soon will be starting in a new position at Fennovoima. It is the intention, that Nici Bergroth will continue as board member for the industry.

Steen Cordt Hoe replaces Michael Boesgaard Brøndel as owner and board member from Beredskabsstyrelsen.

Lars Martiny confirmed, that he will continue as board member - also after being appointed Vice Director of Risø.

6 Financial status of 2010

Finn Physant presented the distributed material: Financial status report and financial programme specification, both dated 17 December, 2010. The extraordinary contribution from SSM of SEK 300.000 received in December was included and the reserve just before the start up of the new fiscal year 2011 was estimated to approximately 2.3 MDKK. The board took note of the positive financial status.

7 Agreements

The following agreements were presented to the board:

-R-part programme manager 2011 with Fortum

-B-part programme manager 2011 with NRPA

-secretariat until 30 June 2012 with FRIT and

-auditing for the accounts of 2010 with Dansk Revision.

All the agreements were approved by the board.

8 R-part: status and new activities

Patrick Isaksson presented the status of the ongoing activities. All projects are either running according to plan or have caught up their delays.

Karoliina Myllymäki presented the evaluation results and funding recommendation, prepared by Patrick Isaksson and Karoliina Myllymäki, for CfP 2011. 16 proposals were received altogether for 2011. The board agreed to fund the following activities in 2011 (all amounts in kDKK):

ENPOOL	650
DIGREL	300
SADE	450
POOLFIRE	360
MOREMO	500
NOMAGE4	250
AIAS	540

The total budget for these 7 activities is 3050 kDKK. In addition, a sum of 200 kDKK will be set aside to the next NKS Board meeting in May for final funding decisions on the activity RASTEP. The funding decision on RASTEP was postponed pending the possible involvement of Finnish partners. See budget under agenda item 10.

It was decided that in the evaluation process every proposal should be evaluated. If an evaluator is of the opinion that a project does not fulfil NKS criteria, or that the project should be excluded for some other reason, the evaluator is requested to give the mark 1. PC´s need to convey this clearly to the evaluators to avoid any misunderstandings.

9 B-part: status and new activities

Justin Gwynn first presented a status report for ongoing activities and afterwards presented his recommendations for activities and financing for 2011. 12 proposals were received altogether for 2011.
The NKS board agreed to finance the following activities in 2011 (all amounts in kDKK)

GammaWorkshops	360
NordEx12	300
GammaRate	150
RadWaste	420
PIANOLIB	520
RADPAST	500
ORPEX	350

The total budget for these 7 activities will be 2600 kDKK. In addition, a sum of 500 kDKK will be set aside to the next NKS Board meeting in May for final funding decisions on the activities RASTEP (200 kDKK) and PONPP (300 kDKK). The funding decision on RASTEP was postponed pending the possible involvement of Finnish partners. For PONPP, the NKS Board wishes to see the outcome for the planned workshop in February before deciding on continued support. See budget under agenda item 10.

10 Budget for 2011

Finn Physant presented the distributed budget of 4 January, 2011 from the coordination group. – Ole Harbitz confirmed that the NRPA funding for 2011 will be 1.250.000 NOK.

Atle Valseth asked for the possibility for VTT and Risø to be co-financiers. Jorma Aurela answered that the Ministry covered VTT’s support to the NKS, and the board discussed the Danish situation concluding that financial support from Risø at present time could be difficult.

The NRPA funding together with B activity funding of 3.100.000 DKK and R activity funding of 3.250.000 DKK have been included in the budget approved by the board in appendix A.

11 Information activities

Finn Physant informed the board about the website, NewsLetters etc. – Statistics show for October 2010 a new monthly record of website hits of more than 44.000. – The board decided, that the website in the future shall be only in English. - The new updated DVD (NKS-221 from 2010) containing all earlier NKS reports was distributed to the board.

12 Next meeting

Next meeting will be in Copenhagen 31 May, 2011. – The meeting will include extended presentations of both the B- and R-part by the programme managers.

13 History

The distributed draft 4 of NKS history was highly appreciated by the board. Since the final document will be comprehensive the importance of a user friendly electronic publication as well as a thorough extended summary was raised.

14 Other issues

The chairman informed the board about the receipt of the IRPA-2010 final conference report from Raimo Mustonen. – The board took note of this and the chairman will thank the IRPA-2010 organisers.

The PC´s reported on the experience of having a NKS booth at the IRPA-2010 conference. They had found it to be of value in promoting NKS.

Justin Gwynn proposed a slight change in the guidelines for travel assistance for Young Scientists. The board agreed that Young Scientists may apply for more than one claim for travel assistance per calendar year as long as total claims do not exceed 12 000 DKK, with a maximum award of 10 000 DKK available for any one claim.

15 End of meeting

The chairman thanked the participants for a good meeting and the hosts for a good arrangement.

Sigurður M. Magnússon
Chairman

Finn Physant
Meeting secretary

Appendix A: Budget for 2011 - decision 11 January 2011

Budgets - proposed / actual	**Proposed budget for 2011**	**Proposed budget for 2011**	**Actual budget for 2010**
	EURO	**DKK**	**DKK**
R-part			
Activities	435.984	3.250.000	2.500.000
Fee PC	60.367	450.000	440.000
Travels PC	13.415	100.000	100.000
Coordination	13.415	100.000	100.000
Young scientists' travel	13.415	100.000	100.000
R total	**536.596**	**4.000.000**	**3.240.000**
B-part			
Activities	415.862	3.100.000	2.502.000
Fee PC	60.367	450.000	440.000
Travels PC	13.415	100.000	100.000
Coordination	13.415	100.000	100.000
Young scientists' travel	13.415	100.000	100.000
B total	**516.473**	**3.850.000**	**3.242.000**
VAT			
Reserve	0	0	20.000
VAT reserve total	**0**	**0**	**20.000**
Common			
Common various according to specification	33.537	250.000	250.000
History	0	0	200.000
Common total	**33.537**	**250.000**	**450.000**
Others			
Fee Secretariat	79.148	590.000	575.000
Fee Chairman incl. travels	56.343	420.000	410.000
Travels Secretariat	1.341	10.000	0
Others total	**136.832**	**1.020.000**	**985.000**
TOTAL	**1.223.439**	**9.120.000**	**7.937.000**
Expected incomes according to app. 1	**1.176.879**	**8.772.930**	**8.112.990**
Surplus	**-46.559**	**-347.070**	**175.990**

Any deficits to be covered by the reserve: the rest available for the board according to the financial status report of 17 December 2010: ca. 1.300.000 DKK.
Funding reserved for use in 2010, but not used will amount to ca. 500.000 DKK. Furthermore reserved funding for programme activities more than 3 years old will be returned to the reserve - for activity agreements earlier than 2008 this amounts to ca. 500.000 DKK.

Total reserve January 2011 - ca. 2.300.000 DKK

Specification of ”Common" for 2011

	Proposal for 2011	**Proposal for 2011**	**Actual for 2010**
	EURO	**DKK**	**DKK**
Common			
Reports, materials etc.	4.024	30.000	30.000
Postage, fees	1.341	10.000	10.000
Equipment	2.012	15.000	15.000
Internet	12.073	90.000	90.000
Auditing, consulting	7.127	53.125	50.000
Information material	4.024	30.000	30.000
Various expenses	2.935	21.875	25.000
Common total	**33.537**	**250.000**	**250.000**

Appendix 1 for budget proposal for 2011

Pledge for funding in 2011 - to be confirmed at the board meeting on 11 January, 2011 - Incomes

	Proposal for 2011	Proposal for 2011	Actual for 2010
	EURO	**DKK**	**DKK**
SSM	504.782	3.762.850	3.288.740
TEM	330.000	2.459.952	2.381.280
BRS	53.560	399.258	398.567
GR	23.175	172.756	172.457
NRPA	159.872	1.191.750	1.117.750
Total EURO / DKK	**1.071.389**	**7.986.565**	**7.358.794**

SSM contribution SEK	4.550.000
NRPA contribution NOK	1.250.000

	EURO	**DKK**	**DKK**
Fortum	21.840	162.804	154.783
TVO	21.840	162.804	154.783
Fennovoima	7.000	52.181	44.649
IFE	10.750	80.135	79.996
KSU	10.750	80.135	79.996
Forsmark	11.280	84.086	79.996
Vattenfall	10.750	80.135	79.996
OKG	11.280	84.086	79.996
Total EURO / DKK	**105.490**	**786.365**	**754.196**
Complete EURO / DKK	**1.176.879**	**8.772.930**	**8.112.990**

Valutakurser 2011:

DKK	100,0000
EURO	7,4544
NOK	0,9534
SEK	0,8270
SEK i 2010	0,7228
EUR i 2010	7,4415
NOK i 2010	0,8942

DRAFT
NKS(11)4
2011-04-14

Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

NKS Administrative Handbook

Introduction

This is the NKS Administrative Handbook. The Handbook is aimed at all participants in the programme. The Handbook describes the most important administrative functions and procedures within the programme. The objective is to ensure uniformly efficient routines and thereby a streamlined administration of all parts of the programme. The Handbook is intended as a reference work and as a source of answers to practical questions. The attachments include examples of various documents, etc. The current version of the Handbook will be available on www.nks.org and will be updated by the Secretariat as required. In addition to the Administrative Handbook, the following general document can be referred to: NKS(08)3: NKS Policy, Framework and Procedures which describes areas of responsibilities and organisation.

Content:

1. In general

The procedure involved in the *Call for Proposals* for new activities is described in Section 7.4, in Attachment 1 and in detail on www.nks.org.
The areas of responsibility and work of NKS owners, Board, Chairman, Secretariat and programme managers are shown in Attachment 2.
Participation in activities and seminars outside Scandinavia must be approved in advance by the programme manager concerned.

2. Working language

Call for Proposals and the NKS materials associated with it should be written in English. Applications for NKS funding should also be submitted in English in order to facilitate the assessment of the proposals and to ensure that conditions are as equal as possible for all applicants.

Each working group determines its own language for meetings and reports unless otherwise instructed by the Board. Meetings involving non-Scandinavian participants usually take place in English. We recommend that reports written in English contain a summary in Danish, Norwegian or Swedish and that reports in a Scandinavian language contain a summary in English. The language in which reports are written should be agreed with the programme manager concerned.

3. Reports

Currently, we are running two programmes/major activities: the R Programme and the B Programme. It is important that information about the results of each programme reaches the largest number of stakeholders possible. Reporting on the activities takes the form of technical reports, status reports for the Board and final reports. The programme managers determine the form in which the activities are to be finally reported. All reports must be submitted by the author to the Secretariat in electronic format. Technical reports and final reports must contain an abstract and key words in English. Reports in Danish, Norwegian or Swedish must also be provided with an English title. A data sheet containing this information must form part of technical reports and final reports (see Attachment 3).

All reports being published under the auspices of NKS should contain an acknowledgement by NKS of the financing and participating organisations/persons. In English-language versions the acknowledgement may be worded as follows:

> Acknowledgment
>
> NKS conveys its gratitude to all organisations and persons who by means of financial support or contributions in kind have made the work presented in this report possible.

The name of all organisations must be set out clearly on the title sheet with any abbreviations in brackets, e.g. Strålsäkerhetscentralen (STUK).

The format and distribution of each type of report are explained below.

3.1 Technical reports, etc.

Technical reports should be published under the auspices of NKS, but may in exceptional cases be published as part of the performing organisation’s own series of reports. Documents should contain a reference to the NKS programme and be given an NKS number (see Section 4.1 below). The report should be given an NKS front page (see Attachment 4). The programme manager should approve the report.

All reports must include a bibliographic data sheet (Attachment 3) which is to be completed by the author.

Reports should contain a summary in Danish, Norwegian or Swedish or in English.

Complete collections of the programme’s working documents, scientific publications, lectures, etc. must be kept by the programme manager who determines which documents should also be held by the NKS Secretariat.

These documents are sent to programme participants, the Chairman and other stakeholders as required.

Technical reports should usually – as agreed orally with the Secretariat – be published in a special ‘NKS series’. Usually, they are only published in electronic format. If the programme manager decides that this is appropriate, a technical report may also be published in printed form. If so, the print-ready manuscript must be distributed together with address lists and a covering letter signed by the programme manager. Printing and dispatch costs are to be covered by the programme. Additional copies may be kept by the Secretariat.

The NKS Secretariat provides all technical reports, etc. with an ISBN number.

3.2 Regular reporting

The programme managers present status reports at the board meetings.

Status reports must include:

- a comparison between plans and results with an explanation of any deviations
- financial reporting – budget and results
- list of reports, articles, etc. that have been published
- list of seminars, major meetings, etc.

Contributions must be submitted electronically in accordance with the NKS secretariat directive.

3.3 Final activity reports

- All activities must culminate in a suitable final report.
- For major activities a separate final report should be published in English (but with an additional summary in Danish, Norwegian or Swedish).
- The publication of the final report and a number of the activity’s technical reports in electronic form, e.g. on the NKS website or as DVD or CD-ROM,

must be considered. During the programme, the programme manager should therefore store all contributions electronically to allow such publication.

If required, more detailed instructions will be provided well in advance of final reports being written. A general guide can be found below.

It is practical to prepare a preliminary table of contents for the final report at an early stage in the programme and to use this outline when deciding on programme initiatives.

Content and target group
In the final report, the results of the work should be presented to a professionally qualified circle of stakeholders and an Executive Summary should be included for readers with a general interest in NKS's areas of activity. It must also be possible to utilise the final report in the promotion of the programme's results and NKS's activities. The report must include a complete list of publications published since the start of the activity.

Language and wording
The report must be written in English, but include a summary in Danish, Norwegian or Swedish and in English. The report should be written in clear language. Summary reports for major activities must be proofread. The costs must be covered by the programme and be included in the activity budget already at the planning stage.

Illustrations
Good illustrations increase interest in the report. It must be ensured that illustrations are easily understandable and of high graphic quality. Colour images should be used if this is likely to increase understanding.

Library routines
Reports are provided with an ISBN number by the NKS Secretariat. The activity manager is responsible for ensuring that the author completes a bibliographic data sheet (Attachment 3).

Printing
If a report is to be printed, the Secretariat will assist in this process. A print-ready manuscript must be submitted to the Secretariat.

3.4 Distribution of printed and electronic reports

Distribution
The target group should be as wide as possible – with distribution both in Scandinavia and internationally.

Individual distribution
Special distribution lists must be prepared for each report. The programme manager should prepare distribution lists for stakeholders in Scandinavia and internationally. The lists should include those responsible for activities, activity participants, participating institutions and organisations, end users, sponsors and other involved parties. The library/information department in the author's organisation may also contribute its own distribution list.

General distribution
All reports must be sent to libraries in accordance with the distribution list, the Board and programme managers.

The Secretariat takes care of mandatory submission to The Royal Library in Denmark which handles registration in the national Danish bibliography. An agreement has also been entered into with Risø DTU's library on the submission of NKS publications to appropriate international databases. All reports are uploaded to the NKS website where they are fully searchable and available for download in PDF format.

Electronic newsletters
Information on electronic and other reports is sent out in the form of *NewsLetters* and *NewsFlashes* – see Section 11.

Coverage in magazines
The author should ensure that the programme is covered in relevant trade magazines which should also provide information on where the reports can be found.

3.5 Programme assessment

The owners or Board determine the criteria and dates for assessment of the programme or parts thereof.

4. Numbering and layout of NKS documents, reports and contracts

4.1 The numbering system

All status reports, technical reports, final reports, etc. must be published in a common, numbered series. The number of each report is allocated by the NKS Secretariat. The report number consists of the letters 'NKS' plus a serial number.

Example: NKS-1

A uniform numbering system for joint documents (Board minutes, policy documents, etc.) help to provide an overview and to refer to or find earlier documents and papers. The document number consists of the letters 'NKS' plus year and serial number, e.g. NKS(08)2. Joint agreements and contracts relating to programme managers, Secretariat, accounting, etc. are numbered by the Secretariat, e.g. NKS/AFT(08)3.

R and B Programme contracts with participating organisations are to be numbered by the respective programme manager, e.g. NKS/AFT/R(08)4. Minutes are to be numbered as required by the programme manager, e.g. REF/B(08)5.
Faxes and letters are not covered by the numbering system, but should be written on NKS paper.

4.2 Layout

NKS's graphic profile can be found on the NKS website. It should be used where practically possible. The profile originally used Myriad as its title font. The NKS Board has, however, decided that for practical purposes Arial should be used as the title font. Only the official NKS logo may be used. A green cover may only be used for publications/documents numbered by the Secretariat – please contact the Secretariat.

Documents – NKS paper on which a name has been printed for the programme area should be used for documents.

Reports – a standard report front page should be used (see Attachment 4). This can be placed as an additional front page in reports being published in the institutions’ own series of reports.

5. Meetings and minutes

5.1 Meeting invitations

The owners meet as required. Board meetings are called by the Chairman. The programme managers usually participate in board meetings to report on their activities. Invitations containing agenda proposals are sent out by the Secretariat. Board meetings are usually held twice a year (in January and June).

Programme meetings are prepared by the programme manager or by a person appointed by the programme manager. The programme manager sends out the agenda to participants.

5.2 Minutes

A programme manager is appointed to write the minutes of the board meetings. The minutes are sent to the members of the Board by e-mail no later than four weeks after the meeting, and the members of the Board should then comment on the minutes within another four weeks. The minutes are then uploaded on the website. The Chairman and notetaker sign the original minutes which are archived by the Secretariat.

For coordination meetings a secretary is appointed to take the decision minutes and distribute them to participants for approval.

For programme meetings a secretary can be appointed to take the minutes and distribute them to participants.

6. Seminars, project meetings, etc.

Each programme should organise a suitable number of seminars. NKS seminars should usually be open and not held exclusively for a closed circle of participants. The person responsible for any seminar should ensure that it is advertised on the NKS website under News. Non-Scandinavian participants must be approved by the programme manager in advance.

Purpose

The purpose of the seminars is, for example, to give the programme managers the opportunity to present their results to a circle of specialists: programme participants, Scandinavian safety authorities and other stakeholders who are not themselves involved in the activities/programme.

Practical questions

Plenty of time should be set aside for discussion. This can be achieved by the seminar running for more than one day. It should be agreed with the speakers how detailed their talks should be. A detailed timetable for the seminar should also be in place.

Working language
The seminar organiser decides on the language to be used.

Finance
The NKS programmes may cover the travel costs, transport, hotel expenses, etc. of invited participants/guest speakers. As a rule, other participants cover their own travel expenses. If a participant fee is charged, it should be collected in advance. The fee may include accommodation, food, local transport and contributions to other expenses, e.g. documentation and preparatory work. The option of paying by credit or debit card should be considered. For the programme seminars the programme manager has access to free funds from the coordination account.

The Secretariat is able to assist to some degree in the organisation of seminars (see Attachment 5).

7. Administration and financial functions

7.1 Certification rules and authorisation

Certification rules and authorisations are prepared in partnership with NKS's accountant.

Activities, contracts and regular outgoings for e.g. travel, meetings and seminars:
The programme manager signs off on these. If the activity is carried out by the programme manager's own institution, the chief accountant carries out budget checks and certification.

Programme managers, contracts and regular outgoings for e.g. travel, meetings and seminars:
The Chairman signs off on these. If the programme manager comes from the Chairman's own institution, the chief accountant carries out budget checks and certification.

The Secretariat, contract and daily operations:
The Chairman signs off on these, the chief accountant signs off on invoices related to the daily operations of the Secretariat if the invoice does not exceed DKK 20,000, e.g. postage, printing, telephone, etc.

Chairman:
The chief accountant carries out budget checks and certification.

The Chairman may delegate certification rights to the chief accountant in special circumstances, e.g. the programme managers' travel expenses.

The Secretariat manages the payment of certified invoices.

The Chairman and the Secretariat’s chief accountant have the authority to withdraw funds from the NKS giro and bank accounts together or separately with one additional person appointed by the Board.

7.2 NKS grants

It is the Board that grants NKS funds to activities proposed by the programme managers. Unused funds from current activities are usually carried forward to the next financial year. Unused funds from completed activities are usually transferred to reserves and are allocated by the Board.

7.3 Agreement between NKS and the programme manager organisations

The Chairman or chief accountant enters into agreements on behalf of NKS with the programme managers’ organisations to ensure that the programme managers are available and to determine the scope of and costs involved in their initiatives. A schedule for this is shown in Attachment 6. The cooperation agreement should be described in detail in an attachment to the agreement (Attachment 6.1). NKS’s Chairman must be informed in good time by the programme manager’s organisation if the programme manager due to leave or other planned absence will not be able to carry out his/her NKS work for a limited period. In the event of lengthy absence, the appointment of a new programme manager may be required.

7.4 New activities

Proposals for new activities are presented to the programme managers, usually in conjunction with the *Call for Proposals* (see Attachment 1 and the Policy Document). Proposals are assessed by the programme managers who may recommend them to the Board for a final decision. Approved activities must be commenced as soon as possible within six months and a first status report should be submitted to the Board at the next board meeting.

7.5 The programme managers’ contracts for work funded by NKS

When entering into contracts for work, consultancy services, etc., the programme manager must ensure that NKS funding is used efficiently and services in kind are provided in accordance with Section 7.5. Applicable national/government rules must be followed.

Work is to be agreed when the programme manager enters into the contract with the performing person’s organisation. The contract should include a detailed description of the project, the work, the anticipated results, deadlines, payment and reporting. Contracts may also cover participation in task group meetings, etc. (see Check List, Attachment 7). If NKS is to pay VAT, the amount must be clearly stated in the contract. For further information on VAT please contact the Secretariat.

The contract must state the year(s) it covers. On signing the contract, the programme manager must oblige all programme participants to comply with the guidelines set out in the programme handbook.

The programme manager must submit a hard copy of the signed contract to the Secretariat.

The programme manager may enter into similar agreements on programme initiatives which do not require NKS funding. The scope of these initiatives must form part of the programme manager's summary of all the initiatives contained in the programme.

Payment and transfer of funds
Payment should be made in the currency of the performing country.

The programme manager determines the payment terms. Standard payment terms for amounts exceeding approx. DKK 100,000 may be:

- 50% after acceptance and confirmation of the contract
- 20% on submission of report, etc.
- 30% when work has been finally approved by the programme manager

For amounts below approx. DKK 100,000 it may be practical to have two instalments, e.g. 50% on acceptance and confirmation of the contract and the remaining 50% when the work has been approved by the programme manager.

It is the programme manager who authorises the payment of funds from the programme budget. All invoices must be signed by the programme manager with the completion of a stamped table prior to submission to the Secretariat.

The Secretariat ensures the transfer of funds as directed by the programme manager. For NKS-funded participation in meetings, etc. the programme manager signs the invoice from the organisation concerned and forwards it to the Secretariat for payment.

All invoices must include information on activity/programme number and the applicable contract.

If the programme manager authorises payment to his/her own organisation, the payment must also be authorised by the Chairman or chief accountant.

The Secretariat ensures that funds are transferred to the participating organisation. Funds are mainly withdrawn from the NKS giro account in the participating organisation's country.

Programme managers
The programme managers' administrative initiatives are invoiced in accordance with the instalments set out in the agreement between the programme manager's organisation and NKS. The programme manager's organisation sends the invoice to the Chairman or chief accountant for signature in accordance with the agreement after which the invoice is paid by the Secretariat.

The technical/scientific initiatives which the programme managers carry out themselves with NKS funding are covered by the activity budget, and the amount is entered as an independent item in the budget.

As it is the NKS Secretariat's bookkeeping which is officially applicable, it is in the programme managers' own interest and it is their responsibility at least quarterly to reconcile their own accounts with the Secretariat's, see Section 8.2. The NKS Secretariat provides the relevant documentation to make this reconciliation possible.

7.6 Services in kind and other contributions

Statement

The NKS annual accounts must show the percentage of total funding which is made up of services in kind so that the Board can gain an overview of the total costs of the programme.

The statement includes a total amount for the contributions (consultancy work, working hours, travel expenses, etc.). When calculating the total amount, the following usually apply:

- Consultancy work must be entered with the actual amount in DKK
- Cash contributions must be entered in DKK
- Other costs (e.g. working hours, travel expenses and laboratory resources) must be estimated by the programme manager in DKK

Agreement

If a written contract involving services in kind or other contributions is required, the following must be stated:

- The name of the ordering organisation and the name of the NKS programme
- The title of the activity
- The maximum costs with specification of distribution between ordering organisation and NKS
- Background information
- Task specification with distribution of responsibilities
- Timetables and milestones
- Contacts and any payment terms

7.7 Travel expenses

Travel rules

Travel costs must be kept as low as possible. Travel expenses are usually covered by the participating organisations. Any exceptions to this must be agreed in advance by the programme manager concerned or (in the case of the Secretariat) with the Chairman. Travel expenses are usually calculated in accordance with the participant’s national government rules. The programme manager may, however, determine other payment frameworks, e.g. when meetings include half or full board paid by the programme. NKS does not cover travel expenses for activities and seminar participants outside the Nordic countries unless participants have been specifically invited. Usually, NKS does not support business (activities, meetings, etc.) which take place outside Scandinavia. In exceptional circumstances, the Board or Chairman may approve seminars and meetings in the Baltic states.

As a rule, NKS refunds travel expenses through the participants’ institution. If payment is to be made to a participant’s private account, this must be agreed in advance with the programme manager concerned or the Chairman, and national government rules must be complied with and all receipts attached.

Programme participants

Travel expenses involved in programme work are mainly covered by national funds. Where this is not possible, they may be included in the programme budget. Where programme participants’ travel expenses are covered by NKS funds, the sum must form part of the contract provided by the programme manager.

Travel expenses which have been authorised by the programme manager in advance, but which are not included in an agreement on the work involved, are covered by the participant's organisation. This organisation submits an invoice (documentation/verification is not required) to the programme manager stating date and meeting location for each trip, activity number, purpose and total travel expenses. The programme manager approves the expenses by signing the invoice and forwarding it to the Secretariat for payment.

Programme managers, Secretariat
Travel expenses incurred by the programme manager and the Secretariat which are to be covered by the NKS budget must be contained in the budget for the programme manager and Secretariat in accordance with Board decisions.

Others (owners, Board)
Travel expenses incurred by owners and members of the Board are not usually covered by NKS. This also applies to representatives of other financiers and other commercial organisations on the Board. Travel that has been authorised in advance by the Chairman to be covered by the Secretariat is to be settled by the meeting participant's organisation, unless otherwise agreed, submitting an invoice for the travel expenses stating the date and meeting location for each trip, programme/activity number, purpose and total travel expenses. The invoice is sent to the chief accountant who then authorises the amount for payment.

7.8 Other meeting expenses

For local expenses (meeting rooms, refreshments, etc.) related to meetings paid for by the programme an invoice is sent to the programme manager who signs off on the invoice and then forwards it to the Secretariat for payment. The invoice must include dates, purpose and names of all participants. The same rules apply to seminars, but the names of all participants are not required. The programme manager has a coordination account at his/her disposal to cover these expenses.

7.9 Financial summaries

The programme's bookkeeping is in DKK and the accounts are in DKK and EUR. Conversion is carried out by the Secretariat at the exchange rate applicable at the beginning of each calendar year. The current year's exchange rate can be found on the website at:http://www.nks.org/en/this_is_nks/administration/currency.htm
NKS may, however, decide that conversion should take place every six months.

The programme manager retains an overview into allocated NKS funds and agreed national initiatives – partly through own notes and partly through material provided by the Secretariat.

The Secretariat regularly sends out statements for expenses paid and contracts. The programme manager reconciles the statement with his/her own summary.

7.10 Invoices and VAT

Different invoice and VAT practices apply. Please contact the Secretariat.

8. Central accounts, financial management

The Secretariat manages the funds that are made available to the programme, instructs invoices to be paid directly from the giro accounts set up by the owners and manages the overall accounts.

8.1 Transfer of funds

NKS has accounts in Denmark, Finland, Norway and Sweden. For Iceland, the Danish account is used in accordance with the agreement that is in place. At the request of the NKS Secretariat, the owners and other financiers transfer funds to these accounts.
Funding requests are sent out in January immediately after the Board meeting at which the annual budget is determined and the exchange rate for the year is known.

A programme manager applies for funds by sending a signed invoice which includes programme/activity number to the Secretariat. The Secretariat checks that the budget is able to cover the amount and pays the amount as instructed by the programme manager. In the event that the programme goes over budget, the Chairman is informed by the Secretariat’s chief accountant.

As regards secretariat funds, these are authorised by the Chairman. The Chairman may delegate certification rights to the Secretariat’s chief accountant as required.

As all the funds are deposited in giro accounts, all invoices should be marked with the giro number to which the funds are to be transferred. If the amount is required transferred to a bank account, the bank’s full address and account number must be shown on the invoice.

The Secretariat allocates the funds in such a way as to ensure that expenses for currency exchange are avoided where possible.

The disbursed amount is credited in the applicable currency to the programme account and an exchange rate adjustment is booked on the same account which means that the sum of the two booked amounts corresponds to the sum in DKK.

8.2 Bookkeeping

The Secretariat is responsible for NKS’s bookkeeping. This includes all the income and expenditure for which NKS funds are used. The bookkeeping also includes deposits in each account and financial liabilities that have been entered into, e.g. in the form of contracts. The Secretariat ensures that all documentation is kept for ten years. Copies of the documentation with certification of their authenticity can be made available to the owners.

The Secretariat prepares an account plan and keeps accounts for each programme. The account plan must reflect the Board’s and the programme managers’ requirement for a clear and practically usable submission of accounts.

Bookkeeping for the programme’s running costs is in DKK while the national accounts are in the currency of the country concerned.

The Secretariat provides the owners with statements showing the disbursements made from the national accounts. These statements take the form of audited annual accounts. The audit is carried out by a state-certified accounting firm.

The Secretariat assists programme managers by retaining a financial overview. At the beginning of each year, the Secretariat sets out the exchange rates that are to apply throughout the year. At each Board meeting, the Secretariat prepares an financial overview for use in onward planning in NKS.

8.3 Closing of accounts

Accounts are closed at the end of the year and include only invoices dated and sent during the financial year. All other invoices are included in the new year.

‘Collection accounts’ for all giro accounts are created for disbursements which take place from the new year until the closing of the accounts in January. This is done to comply with Rigsrevisionen’s rules.

Determination of the budget for the following year takes place as decided by the Board in the autumn based on proposals from the Chairman and depends on the previous year’s expenditure. Unused funds from on-going activities in the R and B Programmes will usually be carried forward to the following financial year. Unused funds from completed R and B activities and the Secretariat will usually be transferred to reserves and be allocated by the Board.

8.4 Audits

NKS’s accounts are subject to checks by the Danish Rigsrevisionen. Rigsrevisionen may wish to review the accounts. The NKS accounts are audited annually by a state-certified auditor on the basis of all documentation *(verifications)* and account statements. The auditors are entitled to unannounced inspection of the NKS Secretariat accounts.

At the auditors’ request, the owners provide information about the amounts that have been transferred to the NKS accounts.

In the event that it is desirable to audit the use of national NKS funds in each country, this is done using the certified documentation *(verifications).*

Auditors reports and annual accounts are discussed by the Board and approved by the owners. The original accounts and the auditing standards and guidelines are kept by the NKS Secretariat.

9. List of addresses

The address list is available on an NKS password-protected web page. The NKS Secretariat must obtain the personal consent of each person on the address list.

The Secretariat maintains the address database for owners and Board while the programme managers regularly report changes relating to the programme participants in their own area. The Secretariat then updates the database.

10. NKS websites

NKS hosts a website which is updated and run by the Secretariat. The URL is: www.nks.org. NKS also hosts a closed, password-protected website for internal use by programme participants – further information can be obtained from the Secretariat.

Some activities also have their own programme web pages. Instructions from the NKS Board on policy, content and execution must be complied with.

It is recommended that the websites be updated often and that detailed figures/images as well as other items that make the pages difficult to load are avoided.

11. NewsLetters

NewsLetters in English are sent out twice a year by the Secretariat, usually before the Board's biannual meetings and contain information on new reports, seminars, etc. The main recipients of the newsletters are the Board, financiers, libraries, programme managers, people responsible for activities, activity participants and their institutions and organisations as well as other interested parties who have signed up for the news group on the website. Additional newsletters (*NewsFlashes*) with topical news are sent out as required. Subscription to *NewsLetters* and *NewsFlashes* is free. Please contact the NKS Secretariat.

The programme managers put together the news material about the R and B Programmes and send it to the Secretariat which completes the newsletters and distributes them. The Chairman is the publisher responsible for the newsletters.

ATTACHMENT 1

PRACTICAL INFORMATION ABOUT CALL FOR PROPOSALS

This attachment aims to describe and explain how a Call for Proposals is carried out. The guidelines below reflect a combination of past experience and decisions and relate to an annual CfP held in the autumn. The financial framework is assumed to be determined by the Board.

The CfP year is starts with the coordination meeting which is usually held in May before the Board meeting. The timeframe for the CfP is determined at the May coordination meeting. The usual start date falls in mid-August with the final application deadline at the beginning of October. Past experience shows that the final deadline should be mid-week as a final date on a Friday, for example, attracts enquiries about whether it is possible to submit on the Sunday night. Before the start of the CfP, the website is updated and the documents that were required for the latest CfP were:

- The framework programme for the respective B and R Programmes
- Application form
- Application instructions

Prior to CfP, the website will provide information about the opening date for applications. When CfP starts, links are provided to the documents, and when CfP opens, a NewsFlash is sent out to NKS stakeholders as a reminder of the start of CfP.

The naming and numbering of submitted applications follow a certain structure: NKS_(R or B)_(CfP year)_serial number, e.g. NKS_R_2010_85. The serial number is not managed centrally, but must be entered by the respective programme manager. Applications are only allocated a number once. This means that activities that run for several years retain their original number and that applications which have been rejected and are submitted the following year also retain their original number.

When applications are received, confirmations of receipt are sent out. When the application deadline has passed, applications are assessed. Since CfP 2010, this assessment has been carried out by NKS Board members using resources in their own organisations. The applications are uploaded to a home page where Board members are able to download the applications as well as assessment forms and instructions. The assessment must be ready prior to the autumn coordination meeting which takes place before the autumn Board meeting.

After the assessment and at the Board meeting it is decided which proposals should be allocated funds. After the Board meeting, these decisions are communicated to stakeholders. The activities for which funds are allocated can be presented in a NewsFlash, if appropriate. The activities which are rejected are contacted directly by e-mail or telephone: mass e-mails about these decisions are not appropriate. Any available feedback on the assessment must be provided.

Before the end of the year, contracts are prepared and signed with the parties and coordinators concerned.

Attachment 2

Areas of responsibility and duties

(From the policy document NKS(08)2: NKS policy, Framework and procedures)

Owners

- Regularly enter into written agreements on continued partnerships, their financing and other terms and conditions.
- Elect the Chairman of the Board and appoint other members of the Board, programme managers, assessors, etc.
- Are the top policy body.
- Determine guidelines for structure, work methods and general administrative issues.
- Secure the majority of the financing.
- Approve the accounts.
- Delegate projects and responsibilities at an appropriate level as required.
- Appoint the Chairman.
- Appoint the programme managers for a set period on terms set out in written agreements.

The Board

- Decides issues of prioritisation, programme, budget and activities.
- Puts forward proposals for policy changes to the owners and approves NKS's official policy document.
- Continuously monitors quality and efficiency, assesses the technical/scientific results of the activities and approves activities for which final reports have been submitted.
- Determines the general guidelines for external and internal information, communication and results dissemination and identifies the most important target groups.
- Carries out the tasks as instructed by the owners as well as tasks set out in the Administrative Handbook.
- Delegates projects and responsibilities at an appropriate level as required.
- Appoints the Secretariat for a set period on terms set out in a written agreement

The Chairman

- Appointed by the owners.
- Responsible for the NKS programme being carried out in accordance with set plan and budget.
- Calls meetings with the owners as required and keeps in regular contact with the owners and the Board.
- Part of the Board, chairs its meetings and monitors that its decisions are implemented.

- Acts as NKS's official spokesperson, is responsible for information and is the publisher and editor responsible for the newsletters and represents a shared resource for NKS as a whole.
- Follows the work in the various areas of the NKS programme, including international activities as well as administrative work, including accounts and auditing.
- Monitors the coordination of the programme areas and participates in coordination meetings with the programme managers and Secretariat as required and chairs these meetings.
- Ensures that
    - Board meetings are prepared and the required documentation for the Board is completed (budget proposals, annual accounts, audit protocol, evaluation directive and other bases for decisions)
    - NKS's structure and administrative routines are revised as required
    - the policy document and the Administrative Handbook are reviewed as required
- Enters into agreements as required, signs letters and signs off on certain invoices.
- Carries out other tasks as instructed by the owners and Board and the tasks set out in the Administrative Handbook.

The Secretariat

- Appointed by the Board for a set period on terms set out in a written agreement.

Regular duties

- Represents an administrative support function for NKS as a whole and participates in Board meetings as required.
- Distributes material (reports, invitations to meetings, bases for meetings, etc.) to the Board, programme managers and others as required.
- Is responsible for financial management, handles bookkeeping and disbursements for the whole programme, orders auditing of the accounts, handles agreements, reservations, contracts, etc.
- Compiles financial reports to the owners, Board and programme managers.
- Handles filing of documents and bookkeeping documentation as well as organisation of reference library and library services.
- Requisitions funds from the owners and other financiers according to agreements.
- Processes and edits NKS reports such as technical reports, final reports and evaluation reports.
- Distributes both printed and electronic reports.
- Handles printing contacts, procures printing services, collects report material.
- Maintains and updates the NKS website and sends out the NKS electronic newsletters (Newsletter and NewsFlash).
- Participates in the review of administrative routines, including contract and VAT issues. Further develops the Administrative Handbook in partnership with the Chairman and programme managers. Creates and updates lists of addresses and other administrative documents. Participates in meetings with the Chairman and programme managers a couple of times a year. Participates in telephone conferences with the parties concerned as required.

- Assists in the work on minor seminars which are organised within the R and B Programmes (dispatch of information material, uploading and updating websites, etc.).
- Carries out various tasks which (within the framework of NKS) required by the owners, the Board and the Chairman as well as tasks set out in the Administrative Handbook.

The following tasks are carried out as required and by separate agreement

- Participates in further development of the NKS website.
- Works on the publication of periodical material (DVDs, CD-ROMs, etc.).
- Participates in the work on NKS seminars (preparation, organisation, follow-up).
- Participates in the work on separate R and B seminars (preparation, organisation, follow-up).

The programme managers

- Appointed by the owners for a set period on terms set out in a written agreement.
- Expected to work part-time, the equivalent of approx. 50% of full-time.
- Manage and/or participate in activities and propose new activities to the Board.
- Ensure that the programme is implemented in accordance with the framework programme, other Board decisions and objectives and lead the work on *Call for Proposals* and propose new activities to the Board.
- Maintain active contact with relevant Scandinavian professional environments and end users to anchor NKS's work, bring actors and stakeholders together and identify requirements and trends at an early stage.
- Coordinate activities and maintain regular contact with the Chairman and Secretariat.
- Maintain regular contact with the persons responsible for the activities and ensure that the activities are implemented and reported on in compliance with set plans and lead and monitor information activities in the programme area concerned.
- Report directly to the Board, participate in board meetings and take minutes at these meetings as required.
- Are responsible for dissemination of results to the parties concerned in the form of seminars, scientific articles, reports, documents, work materials, etc. in accordance with the guidelines set out in the administrative handbook.
- Disseminate information from the board meetings to persons and organisations concerned.
- Carry out various tasks (within the framework of NKS) required by the owners and the Board as well as the tasks set out in contract that have been entered into and orders, set programme and activity plans and the Administrative Handbook.

Attachment 3

Bibliographic Data Sheet **NKS-XXX**

Title	xx
Author(s)	xx
Affiliation(s)	xx
ISBN	978-87-7893-xxx-x
Date	xx
Project	NKS-xx
No. of pages	xx
No. of tables	xx
No. of illustrations	xx
No. of references	xx
Abstract max. 2000 characters	xx
Key words	xx

Available on request from the NKS Secretariat, P.O.Box 49, DK-4000 Roskilde, Denmark.
Phone (+45) 4677 4045, fax (+45) 4677 4046, e-mail nks@nks.org, www.nks.org.

Attachment 4

Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

NKS-174
ISBN 978-87-7893-240-2

PardNor - PARameters for ingestion Dose models for NORdic areas

Sven P. Nielsen and Kasper G. Andersson
Risø National Laboratory for Sustainable Energy, DTU, Denmark

July 2008

Attachment 5

Things to consider when

ARRANGING SEMINARS, PROJECT MEETINGS, ETC.

A successful seminar is one of the best ways of disseminating information about the work NKS does and the results it achieves. But seminars require a great deal of planning and preparation. A list of tips can be found below.

- Produce a check list showing distribution of responsibilities and a realistic timetable: who does what when? Appoint someone with overall responsibility (preferably the person responsible for the activities). Update the list regularly.
- Define objective and target group.
- Choose a suitable title (catchy and relevant). Use a more detailed subtitle, if required.
- Determine content in broad terms (sub-areas, important key words). Determine whether the seminar should include
    - invited speakers
    - parallel sessions
    - poster session(s)
    - panel discussion(s)
    - group work
- Take into account experiences from previous seminars in the same or similar areas.
- Decide on dates:
    - Be in good time – major events may require planning up to a year in advance.
    - Coordinate with other, similar events, particularly within NKS.
    - Attempt to avoid clashes with competing events or major events which are already scheduled (e.g. audit periods at nuclear power stations).
- Choose a suitable location:
    - Think about where most of the participants will be coming from.
    - If it is a large conference: Visit a few conference facilities, assess their options, negotiate terms.
    - Is the conference facility able to handle the anticipated number of participants? Are the meeting rooms large enough? Are there enough group meeting rooms? Hotel rooms? Sufficient room for posters? Break rooms? Technical equipment? Support?
    - Choose conference facilities, sign agreement.
- Decide which of the tasks below should be handled by the central NKS Secretariat, by a local coordinator/co-organiser and (for larger events) by a professional conference organiser:
    - receipt and confirmation of registrations
    - creation of participant list
    - finance (participant fees, invoices, bookkeeping, etc.)
    - hotel reservations, room bookings, if applicable
    - maps, signage, decorations, etc.
    - secretariat services in general
    - handling any study visits
    - entertainment programme (e.g. conference dinner, entertainment and excursions)
    - transport
    - registration on the first day of the seminar

  - liaison with the conference facility about rooms, technical equipment, consumables, meals, coffee, etc.
  - copying/printing of materials for the seminar and any subsequent documentation
- Produce a budget outline as early as possible and revise it when costs become clearer. Include a reasonably large item for unforeseen expenses. Agree the budget with the Board as required.
- Try to find sponsors/co-financiers for the conference.
- Decide (as early as possible) how large the participant fee should be and the share of the costs to be covered by NKS funds and any sponsor funds or other contributions. Adjust the participant fee to the participants' circumstances, e.g. media representatives are often not able to pay very much.
- Determine how the participant fee should be paid. This should be done in advance. Cash payment on registration is not advisable. Use e.g. post giros, bank giros, bank account, cheque, payment order or credit cards. If payment is to be made on registration, credit cards are easiest, but the administrative fee charged by the credit card companies is relatively high.
- Produce a detailed seminar programme as soon as possible. Identify your meeting reporter, session facilitators, etc. and confirm in writing. Include a sufficient number of long breaks – they are an important part of the event as they generate contacts and represent an informal discussion forum.
- Send out invitations for the seminar:
  - Produce a detailed analysis of the target group and choose the people and organisations you wish to invite.
  - Attach the information required for participants to decide whether they want to register. Ensure that it is made clear that this is an NKS event.
  - Attach a comprehensible registration form (binding).
  - Upload the invitation, programme, background material and registration form on the NKS website. Update as soon as new material becomes available.
  - Decide on the highest and lowest number of participants. Determine the date you need to decide whether the seminar will go ahead.
- Contact the invited speakers, if appropriate:
  - Choose suitable candidates.
  - Agree well in advance their participation, subject and content of their presentations as well as financial and other terms for their participation. Confirm in writing.
  - Monitor and follow up on all speakers' preparations (e.g. abstracts, reports or lectures/papers).
  - Gather all advance material in one place.
- Does any prior information need to go out to local or other media, e.g. in the form of a press release? Appoint someone with media contacts to handle this.
- Decide whether evaluation and follow-up of the seminar is to be carried out:
  - Should participants leave their view of the seminar by completing a form (*questionnaire*)? If so, prepare a questionnaire.
  - Should an assessment/final report be written? How should it be shaped and who is responsible?
  - Should the seminar be reported to the Board? If so: by whom, when and how?
- On arrival at the conference facility:
  - Registration of the participants. Designate at least one person for this and allow approx. one minute per participant.
  - Distribution of conference material in the form of a map, binder, etc. (including programme and participant list).

    - If name tags are used: ensure that the name is printed clearly in large letters. The person’s name is most important – not the seminar title or organiser’s logo.
- Make sure you are as quick as possible in following up with any promised documentation, e.g. report from the conference or copies of images presented.
- Carry out the agreed follow-up/assessment of the seminar, and amalgamate the responses from the forms (*questionnaire*) for the benefit of the participants. Were the goals achieved? Were the budget and timetable kept to? What was good? What was less good? Lessons for the future? Etc.

Attachment 6

NKS/AFT(XX)X

Agreement

between XX (hereinafter called XX) and Nordisk kärnsäkerhetsforskning (hereinafter called NKS) for the period
1 January – 31 December XX

XX shall hereby undertake management responsibility for the XX programme area as defined by the decision by the NKS Board in the period set out above. XX shall make XX available for this purpose as NKS's programme manager. Should he/she for any reason be unable to fulfil this task, XX shall find a qualified replacement to be made available to NKS at no additional cost to NKS. NKS shall approve the new programme manager. The Chairman of NKS shall be informed well in advance of any prolonged absence of the programme manager so that suitable measures may be taken. The responsibility and authority involved in this appointment shall be set out in the attachments to this agreement. XX shall thus undertake to comply with the rules and timeframes and the budget determined by the Board of NKS for the work as programme manager and the associated activities.

XX certifies that XX has accepted the job as programme manager for the NKS XX Programme and that he/she is able to work on the XX Programme for approx. 50% of a full-time position. The cost to NKS for his/her participation shall be
* DKK XX for the period 1 January – 31 December XX
This amount shall include any VAT and working hours and breaks, office services, expenses, etc. Travel expenses and subsistence shall not be included. A separate budget for work-related travel shall be determined separately by the Board.

The agreed remuneration shall be paid by NKS in the following instalments of the total annual sum on the presentation of an invoice from XX as follows:
* 50% after the signing of this agreement after the new year XX
* 50% after the Board's approval of the status report in November XX.
Invoices shall be submitted to NKS no later than 30 days after the date indicated by the payment plan above.

The present agreement shall apply from 1 January XX to 31 December XX (inclusive) on condition that the owners of NKS make sufficient funds available. The present agreement may be unilaterally terminated by either party with a notice period of six months. In the event of material breach of contract by either party, the agreement may be terminated unilaterally by the other party. NKS shall then pay remuneration for the period in which the programme manager worked up to the date of termination.

The present agreement shall be governed by Danish law.

The present agreement has been created in two original copies. Each party shall retain one original. XX shall undertake to ensure that XX is provided with a copy of the signed agreement and associated attachments.

For XX	For NKS
Date:...	Date:...
.... XX	 XX
Director	Chairman

Attachment 6.1

Attachments to Agreement NKS/AFT(XX)X:

Responsibility and authority for Programme Manager NKS XX in the period 1 January – 31 December XX

The programme manager must in his/her work comply with the terms of this agreement, the decisions made by the owners and Board of NKS and applicable parts of the latest edition of the policy document NKS(08)3 and the Administrative Handbook, NKS(11)4.

The programme manager is responsible for ensuring that:

- the programme and its activities are run in accordance with NKS objectives
- the programme's technical/scientific quality is assured
- information about the programme and its activities is disseminated to the appropriate people in an adequate way
- set timetables and cost levels are met
- current rules for planning, budgeting, status reports and final reports are complied with

Duties and responsibilities can be delegated, but the overall responsibility for the programme rests with the programme manager. The Chairman and person responsible in the home organisation must immediately be notified of any signs of significant deviation from the timetable and/or budget.

The job further involves that the programme manager

- participates in board meetings and reports directly to the NKS Board
- coordinates work with other programme managers and the Chairman
- informs the Chairman and NKS Secretariat well in advance about all major seminars, project meetings, etc. within the programme
- at the request of the Board or Chairman participates in meetings within the NKS programme framework
- keeps a record of the national initiatives (the working hours/breaks, travel expenses, consultancy services, expenses, etc.) in DKK or EUR and reports on the accumulated national financing in all status reports and – for each programme – in all final reports

The programme manager organises his/her own travels within the Nordic countries within a set budget framework. For travels outside the Nordic countries, oral approval is required in advance from the Chairman. All the programme manager's travel expenses must be signed by the programme manager and signed off by the Chairman or chief accountant before they can be reimbursed. It is the programme manager who approves travel within the programme activities and – if applicable – signs off on activity participants' travel expenses.

Current national government rules (or equivalent) for expenses and entertainment must be complied with both by programme managers and other activity participants. Travel accounts must be produced by the traveller’s employer or agreed with the programme manager in advance.

Attachment 7

Checklist for contracts, agreements etc.

All contracts / agreements should be written on the program leader's NKS stationery; see the graphic profile.

- NKS activity number
- Date
- Name of the contracting party
- Activity title
- References (e.g. quotes, meetings, protocols)
- Activity/work description
- Responsible person(s)
- Milestones (e.g., work to be carried out before certain deadlines specified by exact dates) and deliverables
- Estimated total cost (national funding + NKS funding) in DKK or local currency
- Total cost for NKS in DKK or in local currency
- VAT guidelines and how to address and send invoices (contact the NKS Secretariat for details)
- Part payments to be defined
- Cancellation clause to be defined if milestones are not met
- Intellectual property rights

The following should be considered in all contracts/agreements:

The rules and practices stipulated in the current NKS policy document are to be followed by the activity leader and the activity participants.

Intellectual property rights
Copyright to any research results produced shall vest jointly and equally in (organisation) and NKS so that each of the parties may enjoy and exercise their rights independently of the other parties, including the right to modify the material, create derivative works, and publish it in any way, shape or form. Use of the NKS logo requires approval by the NKS program manager or the NKS Secretariat. Similarly, NKS may not publish the material using the other parties' logo(s) without permission. The author(s) shall upon request to NKS have the first right of publishing the result in refereed journals or similar publications, and NKS shall in that event refrain from publishing said material before the author(s) do.

This order is valid when signed in two copies by the NKS program manager and the contracting party.

__________________ __________________

NKS Program Manager The contracting party

NKS(08)3 Rev3
2008-011-19

Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

NKS Policy, Framework and Procedures

Note: The official NKS policy document, NKS(08)2, is in Swedish. See www.nks.org. This is an abridged and adapted translation for those preferring an English overview.

Introduction

Nordic Nuclear Safety Research (NKS) is a platform for Nordic cooperation and competence in nuclear safety and related radiation protection issues including emergency preparedness and protection of the environment. The work is financed and supported by Nordic authorities, companies and other organizations. Information on NKS activities is disseminated through seminars, reports, electronic newsletters and the NKS website, www.nks.org. They are used by financiers and other participating organizations in their decision making processes and information efforts, and are available free of charge to anyone interested in NKS activities.

This is an abridged version of the official policy document NKS(08)2 which is written in Swedish and available on the NKS website. Should the two versions conflict or give rise to interpretations, the Swedish version takes precedence over the English one. The main difference between the two versions is that the Swedish document is more specific as regards practical work, detailed instructions, responsibilities and tasks at the different levels of the organization.

Practical NKS work is governed by an administrative handbook in Danish, also available at www.nks.org. Reviews and updates of the policy document and the handbook will be brought to the Board for approval; smaller changes will be decided by the chairman.

Divided into three main chapters, this document gives background information on NKS and its structure; a presentation of the current scientific framework program; and guidelines for practical work and how to join it. The target group is first and foremost active NKS participants; but it is hoped that any organization or individual wishing to learn what NKS stands for and how work is conducted will find the document useful.

This document sets out to answer questions like:
- What is NKS all about?
- How is NKS and its work organized?
- Who pays?
- What are the main areas of work?
- Do I have to live in one of the Nordic countries to participate?
- How do I join?
- What is a Call for Proposals?
- Can I suggest new activities?
- What criteria must proposals meet?
- How do I get NKS funding?
- How is the quality of the work evaluated?
- How are NKS results communicated?

If, after reading this document, any of your questions remain unanswered, please contact the appropriate Program Manager or the Secretariat at nks@nks.org.

This is NKS

Scope and Objectives

NKS (Nordic Nuclear Safety Research) is a platform for Nordic cooperation and competence in nuclear safety and related radiation protection issues including emergency preparedness and protection of the environment. The work centers around nuclear power related issues and is divided into two main areas:

- Reactor Safety (NKS-R)
- Emergency Preparedness (NKS-B)

In addition, some activities will be identified as being cross-disciplinary, i.e., belonging to both NKS-R and NKS-B.

Normally, the NKS program does not include safeguards; transport of nuclear or radio-active materials; general radiation protection; or external threats.

The hallmark of NKS is a spirit of sharing – all results are available free of charge, not only to NKS participants but worldwide. When quoting NKS material or work supported by NKS, a reference to the source shall be made.

The Nordic Perspective

NKS is an informal forum, serving as an umbrella for Nordic initiatives and interests. Its purpose is to carry out joint activities producing seminars, exercises, scientific articles, technical reports and other types of reference material. Special efforts are made to engage young scientists. The work is financed and supported by Nordic authorities, research institutions, power companies, contractors and other organizations. The results are used by participating organizations in their decision making processes and information efforts. To ensure that the Nordic perspective prevails, all major activities should include representatives from at least three Nordic countries.

The region in question is the five Nordic countries, i.e., Denmark (including the Faroe Islands and Greenland), Finland, Iceland, Norway and Sweden. With a total population of some 25 million people, and a common cultural and historic heritage, the Nordic countries have cooperated in the field of nuclear safety for approximately half a century. Informal networks for exchange of information have developed throughout the years, strengthening the region’s potential for fast, coordinated and adequate response to nuclear threats, incidents and accidents. NKS has served well as a platform for such activities.

Major Nordic Nuclear Installations

The Nordic interest in cooperation and pooling of resources via NKS is due to the large number of nuclear installations and activities in the region. There are four nuclear power reactors in operation in Finland, and one (Olkiluoto 3) is under construction. Sweden has 12 nuclear power reactors. Of these, 10 will continue operation and two have been permanently shut down (Barsebäck 1 and 2). The Barsebäck reactors are being decommissioned. There are research reactors in Denmark, Finland, Norway and Sweden. The three Danish reactors have been closed and decommissioning work has started. The reactors in Finland and Norway are still in operation. The two Swedish research reactors have been shut down and face decommissioning. In Sweden there is also a nuclear fuel production plant in operation. All five Nordic countries have interim storages for radioactive waste. Finland, Norway and Sweden have final repositories in operation for low and medium level waste. In Finland and Sweden work is in progress to allow construction of final repositories for spent fuel. Apart from nuclear installations in the Nordic countries, there are commercial, research and naval nuclear reactors and other nuclear installations in surrounding eastern and western countries.

Financial Support

Only activities of interest to financing organizations and other end users are carried out. The results must be of relevance, e.g., practical and directly applicable. The owners and main financiers are:

- Danish Emergency Management Agency
- Finnish Ministry of Employment and the Economy
- Icelandic Radiation Protection Institute
- Norwegian Radiation Protection Authority
- Swedish Radiation Safety Authority

Additional financial support is obtained from these organizations:

- Fennovoima Oy in Finland
- Fortum Power and Heat Oy in Finland
- TVO in Finland
- IFE in Norway
- Forsmarks Kraftgrupp AB in Sweden
- Nuclear Training and Safety Center AB (KSU) in Sweden
- OKG Aktiebolag in Sweden
- Ringhals AB in Sweden

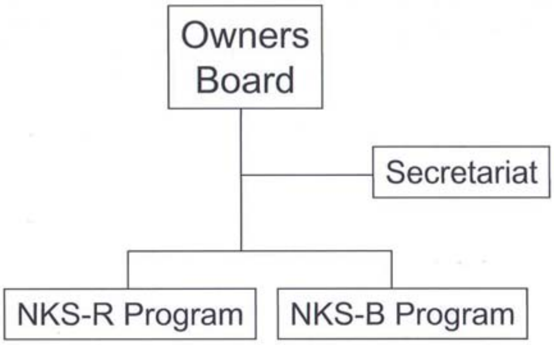
In 2007 the contributions of the owners together with support from the additional financiers above totalled some 7.9 million Danish crowns (1.1 million euros). To this should be added in-kind contributions by participating organizations, e.g., work hours, travel expenses, and laboratory and other resources. These contributions are expected to be worth approximately as much as the actual NKS budget, and the program is highly dependent on them. Hence, all activity proposals are expected to offer at least a 50/50 in-kind contribution by the applicants.

All decisions on budgetary matters are made by the Board, usually for a period of one year at a time. NKS only supports the work of Nordic organizations, although international participation is sometimes accepted granted that external funding is provided by the foreign organizations, fully covering their costs. Non-Nordic participation in the cooperation is welcomed whenever relevant to the overall objectives of NKS and in line with the current program and policy; it will however not be supported financially by NKS. An exception is that travel costs to NKS seminars and workshops can be reimbursed for especially invited participants (e.g., key lecturers).

Organization

The owners and main financiers of NKS are four central authorities and one ministry in the Nordic countries. Together with a number of experts appointed by the owners they constitute the NKS Board. Decisions on financing, program activities, NKS policy etc. are made by the owners and the Board. All major activities are handled by the two program managers, one responsible for reactor safety (NKS-R), one for emergency preparedness (NKS-B). The Board will decide on a case-by-case basis where cross-disciplinary activities belong. A secretariat handles administrative duties such as economy, electronic media, publishing of reports etc.

Organization of NKS:



Presently, the following organizations form the NKS Board:

Denmark	Danish Emergency Management Agency (DEMA)
	Danish Radiation Protection Authority (SIS)
Finland	Ministry of Employment and the Economy (TEM)
	Finnish Radiation and Nuclear Safety Authority (STUK)
	Fortum Nuclear Services Ltd
	Technical Research Center of Finland (VTT)
Iceland	Icelandic Radiation Protection Institute
Norway	Norwegian Radiation Protection Authority (NRPA; two persons)
	Institute for Energy Technology (IFE)
Sweden	Swedish Radiation Safety Authority (two persons)
	Vattenfall AB

Fortum Nuclear Services Ltd and Vattenfall AB represent the nuclear industry in the countries.

Overall Framework Program

Program Areas

Nuclear safety and emergency preparedness have been major Nordic priorities for many years. Two of the greatest challenges are the complexity of the systems and the need integrate knowledge from many different areas (reactor technology, nuclear physics, measurement techniques, environmental sciences, radiobiology, information and communication technology to mention a few). Continuous development and improvement is necessary: new knowledge must be gathered and tools created and kept operational. Optimized use of national resources and the potential need for cooperation and assistance between neighboring countries is of the essence; so is communication with media and individual members of the public. Common Nordic views and approaches are important in order to maintain public confidence in authorities and other actors in the nuclear field.

Therefore, in 2007 the NKS Board adopted a dynamic scientific framework program, divided into two main areas, each led by a program manager:

- NKS-R: Reactor Safety
- NKS-B: Emergency Preparedness

Some activities will be identified as **cross-disciplinary**, i.e., belonging to both NKS-R and NKS-B. The main part of the research program is constituted by NKS-R and NKS-B activities, whereas cross-disciplinary activities are expected to be more sporadic. Financial support is to be given fairly evenly to NKS-R and NKS-B in a long-time perspective.

Activities

The work is divided into activities of varying size and duration and may consist of **studies** (research, investigations, exercises etc.) or **dissemination of information** (conferences, seminars, workshops, courses, websites, scientific papers, technical reports etc.), or (usually) a combination of both. The aim is to maintain and build up **competence** and to develop close informal **networks**. In order to make seminars more valuable, participants should also take part in the preparations and follow-up work, e.g., writing the final report. Care should be taken to use other related Nordic, European and other international seminars for exchange of information and networking, where appropriate.

In many cases the issues at hand generate considerable public interest. Activities on information strategies, management and technologies in relation to NKS-R and NKS-B will therefore be included in the program, when appropriate.

The contents, time frames and budget of the program and its many activities are decided by the Board, in accordance with the NKS-R and NKS-B frameworks outlined below. The criteria summarized in a later section are applied when evaluating the proposals. The program is flexible since the results of ongoing work are evaluated at the biannual Board meetings in May and November. Changes in work plans are made when called for. Activities may be expanded, reduced, or aborted; new activities may be added. The program is constantly renewed through an annual (in exceptional cases, biannual) procedure of **Call for Proposals**, which is open to all relevant Nordic organizations and results in an expansion of the program. When an activity has been finished and the final report accepted by the Board, the results will be disseminated and can be implemented by the end users.

Young Scientists

In order to maintain a high level of competence in the longer perspective, it is important to ensure that enough young people choose to specialize in nuclear safety, radiation protection and related studies. In most Nordic countries, the number of experts is limited. The university sector plays an important role and must be stimulated to offer courses and relevant thesis projects, and to carry out research projects. Competence can be strengthened by NKS through education in different ways, e.g., by organizing and supporting joint Nordic M.Sc. and Ph.D. courses. It is also beneficial if NKS work is relevant for individual students and their NKS participation can aid in their studies. Other forms of educational activities can also be considered, e.g.,

- Workshops of various types, with invited lecturers, preferably producing proceedings in a refereed publication
- Training programs and exchange visits between research organizations

NKS-R Framework: Reactor Safety

R1 Priorities and Challenges

The research activities within the reactor safety part of the NKS program have changed from time to time depending on subjects of interest. This chapter gives a guidance to which areas will be prioritized for financing in years to come. Research activities may be of different kinds, such as developing new knowledge; compilation of knowledge in a systematic manner aiming to support applications; or a pilot project demonstrating the use of new knowledge or techniques. It could also be seminars or courses to spread knowledge.

NKS funding is limited, roughly only one percent of the total Nordic funding in the area of reactor safety, phase-out and waste treatment. The funding can therefore not be expected to be of vital importance for the development in these areas. In addition to the expected result of a research activity in terms of knowledge, it will also be prioritized based on its contribution to the overall NKS criteria, e.g., a Nordic common view on nuclear safety. Priority will also be based on the importance to the safety of existing reactors. Non-safety operational issues as well as economical issues are given low priority. If a proposed activity supports or duplicates other national or international activities, this will also affect the NKS decision on funding.

The nuclear power industry and regulatory bodies have a number of challenges of particular interest where research activities are essential and will be prioritized. The areas are safety upgrade of older reactors comparable to modern standard; harmonization of reactor safety; power upgrade; ageing/life management; phase-out and dismantling of nuclear facilities; waste treatment and final storage.

R2 Main Research Areas and Program Contents

The following main areas are judged to be of current interest and examples are given for each area:

Abbreviations used:

BWR	Boiling Water Reactor
CFD	Computational Fluid Dynamics
HR	Human Reliability
NDT	Non-Destructive Testing
PSA	Probabilistic Safety Analyses
RI-ISI	Risk-Informed In-Service Inspection

Reactor Physics and Thermo-Hydraulics

Examples:

- Core instability/oscillations in BWR high burn-out fuel
- Reactor physics and dynamics
- Thermo hydraulic and CFD calculations
- Integration of different models

Modernization, Introduction of New Techniques and New Demands

Examples:

- Digital control rooms; new demands
- Power up-grades

Ageing of Nuclear Facilities

Examples:

- Thermal and mechanical fatigue
- Radiation induced defects on reactor vessels
- Ageing of concrete containments
- NDT technology and validation of methods
- RI-ISI, strategies and application of methods
- Ageing managing program and ageing mechanisms
- Ageing properties of new materials

Severe Accidents

Examples:

- Chemical behavior of iodine and halogens during severe accidents
- Core – concrete interaction

Probabilistic Methods

Examples:

- Application of PSA in safety assessments
- Clear presentation of PSA results
- Assessment of uncertainties
- Assessment of defense in depth using PSA
- Nordic harmonization of demand on PSA for different applications
- Reference library for rules and guides
- Harmonization of definitions in PSA

Organization, Man and Safety Culture

Examples:

- Models and methods for safety review
- Safety culture significance in occurred events
- Actions taken as a result of event analyses

- Benchmarking between nuclear industry and other industries with high potential risks
- Safety assessment of organizational changes
- Safety culture and assessment of organizations
- Safety aspects on using subcontractors in nuclear power plants
- Introduction of new techniques and new working procedures
- Application of HR methods in nuclear power plants

Phase-Out and Decommissioning of Nuclear Facilities
Examples:
- Phase-out and decommissioning of research reactors
- Stakeholder involvement in the Nordic countries
- Regulatory demands by Nordic authorities on decommissioning projects
- Experience from decommissioning projects

Common Seminars for Reactor Safety and Emergency Preparedness
Examples:
- PSA, severe accidents and emergency preparedness
- Phase-out and demolition of nuclear facilities including release of protection of area
- Environmental Impact Assessments

The list of subjects given above is not complete, and other proposals that can be associated with any of the eight categories above will also be considered in the evaluation process. More specific priorities regarding subjects to be covered can be given in connection with each “Call for Proposals”.

NKS-B Framework: Emergency Preparedness

B1 Aim and Challenges

The aim of the NKS-B program is to strengthen Nordic work concerning
- radiological emergency preparedness
- management of radioactive waste and discharges
- radioecology and environmental assessments

In addition to the threats from potential nuclear accidents, threats related to the possibility of malicious uses of radioactive or nuclear substances is now seen as a major concern. The case of polonium-210 poisoning and contamination in London in November 2006 is an example of an unexpected situation that demonstrates new challenges related to, e.g., special competence regarding measurement/analytical techniques and radiation protection assessments.

During the last 30 years or so, a lot of experience and knowledge regarding consequences of radioactive discharges, fallout and environmental radioactivity have been gained. The research has to a large extent focused on the behavior of a few important radionuclides. This competence and knowledge must be maintained and further developed to include a wider range of relevant radionuclides.

In the past, radiation protection criteria were developed only for humans, and it was assumed that by protecting man, other species would be protected to an acceptable degree. In recent years several problems have been identified with this existing tenet, with the result that systems for protection of flora and fauna, *per se*, are being developed and tested. Several knowledge gaps relating to this have already been identified, especially with regard to radionuclide uptake, transfer and biological response indicators. Furthermore, there is a need to obtain more experience in the practical application of environmental protection frameworks in typical Nordic environments.

Since 2004, uranium prices have increased sharply, leading to a higher interest in uranium prospecting, and also thorium, in several Nordic countries. Mining and milling for uranium and thorium, and also some other metals, give rise to waste rock and tailings with enhanced concentrations of radioactive substances from the natural series. A wide range of monitoring and measurement techniques will be needed for the risk assessments.

The program is structured into three basic fields: Research activities, investigations, exercises etc.; Seminars; and Education. Work performed within the first of these fields should be focused on maintaining and building up competence. Seminars should aim at building and maintaining both competence and networks. Education should help building competence in the individual countries with the aim of reaching the common goals.

When evaluating proposals for activities they will be judged against how well they seem to fulfil the aims of the respective fields, as well as against their scientific and pedagogical merits.

B2 Main Research Areas and Program Contents

E Emergency Preparedness (in general, as well as specific tools)

Examples of activities:

- Recent nuclear and radioecological emergencies and incidents causing public interest: lessons learned and implications for emergency preparedness
- Potential malicious uses of radioactive substances: security and emergency response
- Exercises and harmonization of activities
- Dose assessments and biodosimetry
- Countermeasures: effectiveness and practicability
- Information and communication: further development of systems and methods
- Decision support systems: integration of existing knowledge

W Waste and Discharges

Examples of activities:

- Waste and discharges from decommissioning activities
- Cost assessments of decontamination measures and remediation
- NORM waste from mining and milling (NORM: Naturally Occurring Radioactive Material)
- Interventions and clean-up operations
- Disposal of radioactive sources

R Radioecological Assessments

Examples of activities:

- Transport and ecological transfer of radionuclides in terrestrial environments
- Radioactivity in natural produce and foodstuffs produced in contaminated areas: temporal trends and seasonal effects
- Dose assessments from artificial and natural radionuclides
- Radiation effects in biota: studies of reference ecosystems and reference species for Nordic environments
- Case studies at locations with elevated concentrations of radionuclides
- Marine environments of special importance
- Syntheses of earlier radioecological studies of Nordic interest

M Measurement Strategy, Technology and Quality Assurance

Examples of activities:

- Implementation of international standards and regulations in Nordic countries (e.g., foodstuffs, bulk materials)
- Sampling/measurement strategies for contaminated material, - areas, - foodstuffs
- Systems for mobile measurements
- Validation of methods for sampling and preconcentration of radionuclides
- Radionuclide analytical techniques and intercomparisons

The list of subjects given above is not complete, and other proposals that can be associated with any of the four categories above will also be considered in the evaluation process. More specific priorities regarding subjects to be covered can be given in connection with each “Call for Proposals”.

Cross-Disciplinary Activities

In the near future issues regarding decommissioning of nuclear installations and waste management will demand increased attention. This will include analyses of technical safety aspects, volumes and properties of radioactive waste, radioactive releases and protection of the environment. Hence, activities in a number of fields will not always be strictly R or B related but may be relevant to both programs. The Board decides whether such an activity will be handled under the R or B program, or if it should be treated in some other way.

Some examples of possible areas for cross-disciplinary activities:

- Decommissioning and waste management
- Common seminars covering both R and B activities
- Information and communication activities targeting media and the general public

Guidelines

From Proposal to Final Report

Call for Proposals

During an annual (in exceptional cases, biannual) procedure of Call for Proposals the R and B program managers invite the Nordic nuclear community to submit activity proposals and apply for NKS funding. Usually this takes place in the fall, with a possible extra opportunity in the spring. Relevant information on the procedure (time schedule; deadline for applications; information to be supplied; criteria to be met; evaluation of the proposals; formalities including forms to be used; etc.) is made available well in advance on the NKS website and distributed to the subscribers of the electronic newsletter. The applicants are expected to demonstrate that at least half of the necessary funding of the activity in question will be supplied by the participating organizations, usually in the form of in-kind contributions.

All applications received before the deadline is evaluated by a group of specialists, chaired by the program manager in question. The proposals are evaluated for compliance with the NKS criteria below. The evaluation results are compiled by the program manager together with any recommendations, and a report is sent to the Board members. At its next meeting, the Board decides what activities are accepted, the size of the NKS funding supplied, and any special conditions to be met. The program manager and the various activity leaders then sign individual contracts regarding each activity. This should be done before the subsequent Board meeting, when progress will be scrutinized and continued work approved or aborted. It is the responsibility of the NKS program manager to ensure that the time schedule and budget of the individual activities are kept, together with any conditions specified in the contract, and to report the status of the activity to the Board at its meetings, until the activity is finally finished and the results are accepted by the Board. The results may then be officially published and handed over to the financiers, participating organizations and end users for information and implementation. The Board should initiate an evaluation of activities once they have been concluded and approved.

Proposals turned down by the Board should be listed for future reference and the activity leaders informed on the Board’s decision as soon as possible after the Board meeting. In some cases the Board may indicate that a refused proposal should or could be completed and submitted at a later occasion for renewed assessment.

Silent Procedure

On special occasions the Board may decide to go ahead with an activity even though it has not followed the normal Call for Proposals procedure. The Board will then decide on any special conditions for that particular activity. E.g., in urgent cases the chairman may initiate a Silent Procedure where an activity proposal and pertaining information is distributed electronically to the Board members, together with a suggested decision on the further handling of the proposal. Members who agree with the suggested action need not answer; those opposed must submit their comments before a specified date. If no objections are received, the suggested action is taken.

Criteria for NKS Activities

The entire NKS program as well as the various activities shall fulfil the following criteria:

- Demonstrated compatibility with the current framework program
- A clear Nordic added value, including
    - creating and maintaining Nordic networks
    - dissemination and increase of Nordic competence within the program area in question
- Current interest in and high international standard of the technical/scientific work
- Comprehensive and transparent activities, open to the widest possible range of participants, including young scientists
- Active participation and/or declared interest in the expected results of organizations in at least three Nordic countries in all major activities (occasionally, two countries may be acceptable)
- Distinct and measurable goals
- Relevance to financiers and end users
- The practical results shall be presented
    - at conferences, seminars, workshops etc
    - in technical reports and scientific articles in refereed journals
    - as recommendations, manuals, handbooks, checklists
    - in electronic form such as DVDs, CD-ROMs, websites
    - in the form of educational and information material

NKS work is dependent on in-kind contributions worth on the average at least as much as the NKS funding. These contributions may be work hours, travel expenses, laboratory resources etc. and should be clearly specified in all proposals submitted under the Call for Proposals procedure.

NKS aims at an approximately even overall distribution of funding between the R and B programs as well as between participating Nordic countries and organizations within the various activities. Gender neutrality and participation of young scientists shall be encouraged. When possible and relevant, M.Sc. and Ph.D. support should be included in ongoing or proposed activities and NKS activities coordinated with international projects. Measures should be taken to ensure cost-efficiency, save resources and protect the environment, e.g., by substituting travels and business meetings with electronic contacts and virtual meetings.

Quality Assurance

The quality of the work performed and the activities at large is constantly being surveilled and assured through

- evaluation of applications received during the Call for Proposals
- participation of end users throughout the entire process: planning, execution, deliverables, reporting, implementation, and evaluation
- reporting and discussions at Board meetings
- publication of results in reports and refereed journals
- dissemination and discussions of NKS results in Nordic and international fora (conferences, seminars, topical meetings, workshops etc.)

- regular evaluations of the entire technical/scientific program and the administrative support structure

International Cooperation

There is no formalized NKS cooperation with other international organizations. Participation in international projects is to follow decisions and conditions given by the Board. NKS should strive to create and maintain relevant international contacts and keep the international audience informed on its progress. Whenever feasible and desirable, NKS activities should be coordinated with similar Nordic and international activities in order to increase efficiency and improve exchange of results and experience. When needed, NKS can be used as a platform for international coordination and promotion of Nordic views. Non-Nordic cooperation in NKS activities must be approved by the relevant program manager beforehand and will not be supported financially by NKS.

Communication and Dissemination of Information

NKS communication activities (including information and dissemination of results) shall be planned, systematic and in compliance with directives laid down by the Board. The target groups shall be informed about the possibilities offered by NKS as regards cooperation, funding, and exchange of knowledge. The communication efforts shall help establish a picture of NKS as a competent and active organization – nationally, regionally and internationally. The results of NKS work shall be presented openly and free of charge so as to render them useful and easy to implement. When quoted, due credit should be given to the proper NKS sources and a link to the NKS website www.nks.org given.

The major channels for distributing NKS information are:

- the NKS website
- electronic newsletters and newsflashes
- electronic and (occasionally) printed reports and pamphlets
- conferences, seminars, workshops and international cooperation projects
- scientific articles in refereed journals
- internal NKS correspondence and communication

NKS newsletters are normally published biannually, prior to the regular NKS Board meetings in May and November. The newsletters come without attachments of any kind, and the object is to give links to material on the NKS website for more information on new reports, invitations to seminars and similar events. The material referred to can be downloaded free of charge. In addition to the biannual newsletters, brief newsflashes will be distributed as soon as new reports have appeared or when new information is available on upcoming seminars etc. Anyone wishing a free subscription to the newsletters and newsflashes should contact the Secretariat at nks@nks.org.

Nordisk kernesikkerhedsforskning
Norroenar kjarnöryggis rannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

NKS-R Status Report

Karoliina Myllymäki
NKS-R Programme Manager
May 2011

STATUS SUMMARY

This report gives a short overview and summary of the current status regarding the NKS-R activities.

2011 years activities

For year 2011 seven activities received funding. Six of these activities are new and one is a continuing activity. All activities launched during 2011 are performing according to plan. All contracts are signed (in total 9 contracts). 12 of 18 of the expected first invoices have been received.

2010 years or earlier activities

Four of seven projects from 2010 are completed; Decom-sem, DIGREL, IACIP, MOSACA. Three final reports are being revised; INCOSE, NROI, POOL (VTT). There is one missing final report, POOL (KTH). It is expected to be delivered in May.

Seminars

No seminars have been held since the last board meeting. One upcoming seminar is announced; NOMAGE4 seminar 31.10 - 1.11.2011, Halden, Norway.

Published reports

Since the last board meeting in January 2011, eight new NKS-R reports have been published, see Table 1.

Table 1. Published report since the last board meeting.

NKS code	Date	Author(s) and title	NKS activity
NKS-241	March 2011	Markku Puustinen, Jani Laine, Antti Räsänen: *MULTIPLE BLOWDOWN PIPE EXPERIMENTS WITH THE PPOOLEX FACILITY*	NKS-R / POOL
NKS-240	March 2011	Jani Laine et al: *PPOOLEX EXPERIMENTS ON STRATIFICATION AND MIXING IN THE WET WELL POOL*	NKS-R / POOL
NKS-239	February 2011	Teemu Reiman et al: *Nuclear Safety Culture in Finland and Sweden - Developments and Challenges*	NKS-R / MOSACA
NKS-237	January 2011	Jonas Andersson: *Automation strategies in five domains - A comparison of levels of automation,*	NKS-R / AutoStrat

		function allocation and visualisation of automatic functions	
NKS-236	January 2011	Timo Pättikangas, Jarto Niemi, Antti Timperi: *CFD and FEM modeling of PPOOLEX experiments*	NKS-R / POOL
NKS-235	January 2011	Markku Puustinen, Jani Laine, Antti Räsänen: *PPOOLEX Experiments on Dynamic Loading with Pressure Feedback*	NKS-R / POOL
NKS-234	January 2011	Jani Laine, Markku Puustinen, Antti Räsänen: *PPOOLEX Experiments with Two Parallel Blowdown Pipes*	NKS-R / POOL
NKS-231	January 2011	Makoto Tsuiki and Steven Mullet: *Comparison of VNEM to Measured Data from Ringhals Unit 3 (Phase 3)*	NKS-R / IACIP

ACTIVITIES INITIATED 2010 OR EARLIER

Three of the seven 2010 initiated projects are still uncompleted. The POOL (KTH) report is missing but is promised to be delivered in May. INCOSE, NROI and POOL (VTT) have delivered final reports which are being revised. The following table gives and overview of 2010 projects:

Table 2. Overview of 2010 projects.

Project	Status	Name	Running period	Funding NKS 2010 [kDKK]	Total NKS funding received (incl. 2011) [kDKK]	Project partners
Decom-sem	Completed	Decommissioning seminar	2010	100	100	Studsvik, SKB
DIGREL	Continuing	Guidelines for reliability analysis of digital systems in PSA context	2010 -	200	500	VTT, Risk Pilot
IACIP	Completed	Improving accuracy of the calculation of in-core power distributions for light water reactors	2008 - 2010	300	850	IFE, Vattenfall
INCOSE	Report under revision	In-vessel coolability and steam explosion in Nordic BWRs	2009 - 2010	300	600	KTH
MOSACA	Completed	Development model of safety culture applied in the nuclear industry & Subcontractors' role in the Nordic nuclear safety culture	2008 - 2010	500	1300	VTT, KTH, Risk Pilot
NROI	Report under revision	Nordic research on radiolytic oxidation of iodine	2008 - 2010	550	1450	Chalmers, VTT
POOL	Waiting for one final report	Condensation pool experiments	2007 - 2010	550	2000	VTT, KTH, LUT

ACTIVITIES INITIATED 2011

Status of the projects as reported by the project leaders in April 2011.

1.1 AIAS

Activity name	Adsorption of iodine oxide aerosols on surfaces		
Objectives	Analysis of the behaviour of IOx particles on different surfaces in the reactor containment during severe accident conditions.		
Organisations	Chalmers, VTT		
Initiated	2011	**Year**	1(1)
Funding [kDKK]	540	**NKS-code**	NKS_R_2011_98
Invoices received	1:st		

Status

The work is planned to start in May in Finland. Ph.D student Sabrina Tietze from Chalmers is going to VTT in May to perform experiments.

1.2 DIGREL

Activity name	Guidelines for reliability analysis of digital systems in PSA context		
Objectives	Development of practical guidelines for analysis and modelling of digital systems in PSA for nuclear power plants. Continuing the pre-study made in 2010, now the activity would focus on preparing the guidelines document.		
Organisations	VTT, Risk Pilot AB		
Initiated	2010	**Year**	2(4)
Funding [kDKK]	300	**NKS-code**	NKS_R_2010_86
Invoices received	1:st		

Status

Task	Status
WGRISK activity (task group) focusing on the development of best practice guidelines on failure modes taxonomy for reliability assessment of digital I&C systems for PSA	Several phone meetings One task group meeting in Paris March 28-29 File repository created for the task group Collection of taxonomies Activity plan prepared for 2011 Workshop planned in May 2011 in Washington D.C., USA 25%

Development of the generic digital I&C system example and associated demonstration PSA-model	Draft outline prepared 10%
Nordic end user workshop (Fall 2011)	Not started 0%
Interim report (public NKS report)	Not started 0%

Overall progress 20%

1.3 ENPOOL

Activity name	Experimental and numerical studies on suppression pool issues		
Objectives	Modelling of rapid steam condensation processes in a BWR pressure suppression pool, using computational methods and experiments. CFD methods are further developed. Experiments produce data for validation of the CFD computation and for the 3D computational code GOTHIC .		
Organisations	VTT, LUT, KTH		
Initiated	2011	**Year**	1(5)
Funding [kDKK]	650	**NKS-code**	NKS_R_2011_90
Invoices received	1:st		

Status

Work is progressing well. See Appendix 1 for detailed status report.

1.4 MOREMO

Activity name	Modelling resilience for maintenance and outage		
Objectives	Research in resilience engineering for mainteanance and outage of nuclear power plants, using Ringhals and Loviisa as case studies.		
Organisations	IFE, VTT, RAB		
Initiated	2011	**Year**	1(2)
Funding [kDKK]	500	**NKS-code**	NKS_R_2011_95
Invoices received	1:st		

Status

The MOREMO project started with a kick-off workshop in March where the data collection plan was finalized and the methodology was refined. During an initial data collection in Ringhals on March 14, information about the organization of outage activities was collected (planning process, scheduling, coordination of activities during the outage). An extended data collection will take place in Ringhals in week 15 and 16, when observations of maintenance activities will be conducted by researchers from VTT and IFE. Over the summer, the data will be analysed using the Functional Resonance model (FRAM) and the Organizational Core Task model (OCT). Another data collection is planned for October.

The project is progressing according to plan. My estimate is that around 12 person-days have been used so far.

1.5 NOMAGE4

Activity name	Nordic Nuclear Materials Forum for Generation IV Reactors network activities		
Objectives	Support of the "Nordic Nuclear Materials Forum for Generation IV Reactors" network by seminars, webpage, mobility support for students and by giving presentations.		
Organisations	Studsvik, VTT, IFE, Risø		
Initiated	2011	**Year**	1(2)
Funding [kDKK]	250	**NKS-code**	NKS_R_2008_63
Invoices received	1:st		

Status

A kick-off meeting was held in March. The NOMAGE4 seminar has been planned and announced. The seminar will be held in Halden, 31st October - 1st November 2011. Invitations have been sent to all NOMAGE4 members. The seminar is advertized on the NKS webpage: http://www.nks.org/en/seminars/future_seminars/

1.6 POOLFIRE

Activity name	Predictive analysis of pool fires in enclosures by means of CFD models for risk assessment of nuclear power plants		
Objectives	Development and validation of prediction models for pool fires in enclosures using pyrolysis models in a CFD model, which can be used in risk assessments of nuclear power plants.		
Organisations	Lund, VTT, Haugesund, RAB		
Initiated	2011	**Year**	1(3)
Funding [kDKK]	360	**NKS-code**	NKS_R_2011_96
Invoices received	1:st		

Status

VTT is running and investigating the actual models available in FDS for fire development of pool fires.

LTH is conducting the first literature review. Haugesund will only come into the project later this year. The project is running as scheduled.

1.7 SADE

Activity name	Safety culture in design and implementation of technological and organisational solutions		
Objectives	Research of safety culture in design and implementation activities in the nuclear industry. Preparation of guidelines to support the design process and giving development ideas for the management of design and implementation activities.		
Organisations	VTT, KTH, Risk Pilot AB		
Initiated	2011	**Year**	1(3)
Funding [kDKK]	450	**NKS-code**	NKS_R_2011_97
Invoices received	1:st		

Status

Project kick-off meeting has been arranged with VTT, KTH and RiskPilot. At the meeting the concrete project plans for 2011 were specified. A meeting has been held at STUK concerning their role in the project. A further meeting has been scheduled with Fennovoima for week 15.
Also, the next SADE project meeting has been scheduled to take place at Stockholm 14.4.

APPENDIX 1

STATUS REPORT OF ENPOOL-NKS and NORTHNET RM3 April 4th, 2011

Work at Lappeenranta University of Technology (LUT)

Markku Puustinen, Lappeenranta University of Technology

ENPOOL-NKS (Funding from NKS and VYR/SAFIR2014/EXCOP)

Deliverable 1: Improvement of PPOOLEX instrumentation at the vicinity of the blowdown pipe outlet with an addition of a PIV and/or other sophisticated measurement system.

The behaviour at the blowdown pipe outlet during air/steam discharge needs to be investigated experimentally in more detail in order to improve simulation models. To achieve this goal sophisticated measuring solutions are sought and installed to the PPOOLEX test facility. For example, with Particle Image Velocimetry (PIV) or Electrical Impedance Tomography systems the flow fields and the level of turbulence at the vicinity of the blowdown pipe outlet could be found out.

The basic operation principle of a PIV measurement system has been studied and different possibilities for installing the system to PPOOLEX have been reviewed. A trip to Paul Scherrer Institute (PSI) in Switzerland to learn how PIV is utilized in the PANDA facility has been made. Possible suppliers of PIV systems have been preliminary contacted.

Task completion: 20 %

Deliverable 2: Execution of the experiment series on DCC.

Direct contact condensation (DCC) at the blowdown pipe outlet with improved instrumentation for tracking the flow fields and the level of turbulence will be studied experimentally in the PPOOLEX facility. The overall goal of the experiments is to produce CFD grade measurement data of rapid steam condensation processes to be used in the development and validation of simulation tools by VTT and KTH. So far, the calculation exercises of the previous PPOOLEX experiments have indicated incomplete condensation in cases with air/steam mixtures. In addition, information on thermal stratification in the gas space of the wetwell will be gathered for the verification of improved turbulence modelling.

The experiments on DCC will start after the PIV measurement system has been purchased and installed.

Task completion: 0 %

Deliverable 3: Reporting of the DCC experiments.

The experiments on DCC will be analysed and reported after the experiment series has been carried out.

Task completion: 0 %

Deliverable 4: Delivery of relevant experiment data to the simulation partners.

Measurement data of several previous PPOOLEX experiment series have been added to the STRESA database of the research group at LUT. Data from thermal stratification and from some chugging experiments have been delivered to KTH and VTT (by granting access to the STRESA database).

Task completion: 40 %

NORTHNET RM3 (Funding from NORTHNET and VYR/SAFIR2014/EXCOP)

Deliverable: Execution and reporting of the experiments with a blowdown pipe sparger.

The effect of a sparger at the outlet of a blowdown pipe on condensation related loads will be tested. The shape and geometry of the blowdown/vent pipe outlet designs are known to have a significant effect on structural loads experienced by submerged condensation pool structures. In a previous experiment series with the PPOOLEX facility, a collar design at the pipe outlet was tested but somewhat contradictory results compared to expectations were achieved. With improved instrumentation the phenomena and physics behind the effect of the collar (and other pipe outlet designs) could be explained.

A scaled sparger model will be manufactured and installed to the blowdown pipe outlet of the PPOOLEX facility. Additional pressure sensors will be installed to the pool volume in order to gain high resolution data of the movements of pressure waves during steam discharge through the sparger. The speed of the sound measurement system will be optimally positioned for the determination of the effect of the steam bubble distribution.

Funding decisions from VYR have been achieved but from NORTHNET they are still pending. Only some preliminary work has been done.

Task completion: 5 %

Work at VTT

POOL-NKS and SAFIR2010/NUMPOOL

Timo Pättikangas, Jarto Niemi and Antti Timperi VTT

Deliverable 1. CFD simulation of direct-contact condensation of pure vapour in a PPOOLEX experiment.

Direct-contact condensation (DCC) model for a large vapour bubble in a water pool is being developed. The model is tested against PPOOLEX experiments, where condensation of bubbles with pure vapour occurs. Different alternatives for modelling the interfacial area of gas and liquid water are studied. Currently, the interfacial area density is estimated from the gradient of the void fraction at the bubble surface. This method has been found out to lead to underestimation of vapour condensation in the water pool. In addition, the effect of turbulence on condensation is studied. The turbulence level in liquid water near the bubble surface is known to strongly affect condensation.

Comparison of simulations performed so far suggest that turbulent mixing near the outlet of the vent pipe is underestimated. Alternative methods for modelling the turbulent heat transfer in this area are studied. CFD simulation of one PPOOLEX experiment with almost pure vapour will be done.

Task completion: 20 %

Deliverable 2. FSI calculation of a PPOOLEX experiment with a large condensing steam bubble.

The work on modeling large, rapidly condensing steam bubbles with the Volume Of Fluid (VOF) model is continued. The work aims at finding approximations for water-hammer loads on the pool walls by using numerical simulations as well as available experimental and literature data. As the Star-CD code showed anomalous results on the gas-phase temperature in the earlier calculations, Star-CCM+ and/or Fluent will be tested for this purpose. Also, new versions of Star-CD could be tested. An FSI calculation is performed by two-way coupling of the CFD and structural codes with MpCCI. The calculations are compared with the PPOOLEX experiments, where high-speed camera recordings of bubble collapse as well as measured pressures and displacements are available.

Task completion: 0 %

Deliverable 3. FSI calculation of blowdown with a sector model of a BWR.

The model for the BWR sector is further developed, so that interaction of multiple blowdown pipes can be studied. The early phase of the discharge is calculated, when the discharge consists of non-condensable gas. The VOF model is used for modelling the large gas bubbles. Both gas and water are modelled as compressible, so that the interaction of sound waves especially in the pipes and in the drywell can be studied.

Task completion: 0 %

Deliverable 4. Report on the CFD and FEM calculations.

Subtask has not yet been started. Task completion: 0 %

Work at Royal Institute of Technology (KTH), Division of Nuclear Power Safety

POOL-NKS and NORTHNET-RM3

Deliverable 1. Development of new effective models for prediction of stratification and mixing in a pressure suppression pool.

Review of existing experimental data, models and approaches to prediction of effective momentum and mixing induced by steam injection into a pool has been performed. No model which takes into account flow regime (quasi-steady or chugging) of steam injection into a subcooled has been found. Models for the Effective Momentum Source (EMS) and Effective Heat Source (EHS) are under development. Available experimental data and previously developed models for steam condensation oscillations in different regimes are used to develop EMS.

Task completion: 50 %

Deliverable 2. Validation of new models against available experimental data including tests in the POOLEX and PPOOLEX facilities.

Data from the previous POOLEX and PPOOLEX tests about dynamics of the free surface motion in the blowdown pipe is used for assessment of the EMS in chugging regime.

Task completion: 20 %

Deliverable 3. Simulations of plant scale phenomena.

Preliminary results for 3D simulation of plant scale phenomena with direct steam injection modelling are obtained. Effect of different boundary conditions was investigated and results were compared to available measured data. Reasonably good agreement achieved between predicted and experimental. An input for more complicated transients with switch on and switch off of the different cooling and mixing systems is under development.

Task completion: 35 %

Deliverable 4. Simulations of direct contact condensation phenomena with GOTHIC and comparison with CFD approach (VTT).

Wall condensation tests in PPOOLEX facility have been simulated with lumped parameter GOTHIC models. The GOTHIC models for the PPOOLEX facility have been developed. The LP and 2D simulations against STR-01 and STR-04 have been performed. The energy balance can be predicted well with LP modelling by GOTHIC. For test STR-04 where the thermal stratification is observed, mixing is obtained with 2D modelling by GOTHIC. The implementation of EHS/EMS model is under development for 2D simulation.

Task completion: 40 %

Deliverable 5. Report on model development and validation.

Draft report on basic EMS model development is under preparation.

Task completion: 10 %

NKS-R Status Report

Karoliina Myllymäki

NKS-R Programme Manager

Summary status of the activities initiated 2011

- 6 new and 1 continued activity
- All contracts are issued and signed (total 9)
- 12 first invoices received, 6 missing

Additional financers 2011

Additional financers:

- Fortum contract ok, p.o. ok, invoice sent to Fortum
- TVO contract ok, waiting for purchase order

Summary status of the activities initiated 2010

- Only minor delays

- 4 of 7 projects are completed

- 3 final reports are being revised

- 1 final reports still missing; expected to be delivered in May

Completed projects

Project	Running period	Partners	Total NKS funding [kDKK]
Decom-sem	2010	Studsvik, SKB	100
IACIP	2008 - 2010	IFE, Vattenfall	850
INCOSE	2009 - 2010	KTH	600
MOSACA	2008 - 2010	VTT, KTH, Risk Pilot	1300
NROI	2008 - 2010	Chalmers, VTT	1450
POOL *	2007 - 2010	VTT, KTH, LUT	2000

* 1 final report missing

Decom-sem

Decom-sem	**2010**	**Studsvik, SKB**	**100**

- Seminar on decommissioning of nuclear facilities

- Studsvik 14.9 – 16.9.2010

- About 130 participants from several countries including Sweden, Germany, Denmark, Finland, Norway

- Power companies / NPP:s, consultants, suppliers, authorities and research centres were represented

- Presentations, papers, posters available on NKS webpage

- The seminar was very much appreciated -> plans for a new seminar in 2012

Decom-sem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Samples from the inner steeltank of DR 3


DL 6395

IACIP

IACIP	**2008 - 2010**	**IFE, Vattenfall**	**850**

- Verification of nodal transport code VNEM (Variational Nodal Expansion Method) by comparing it to plant data from Ringhals-3 PWR

- 2008, comparison with hot stand-by condition, without feedback effects

- 2009, VNEM neutronics module was implemented in a light water reactor core simulator CYGNUS (PWR version), including feedback effects, comparisons with hot-operating cases

- 2010, core follow calculation of whole cycle 1A of Ringhals-3, studying the intra-nodal burnup tilt effect

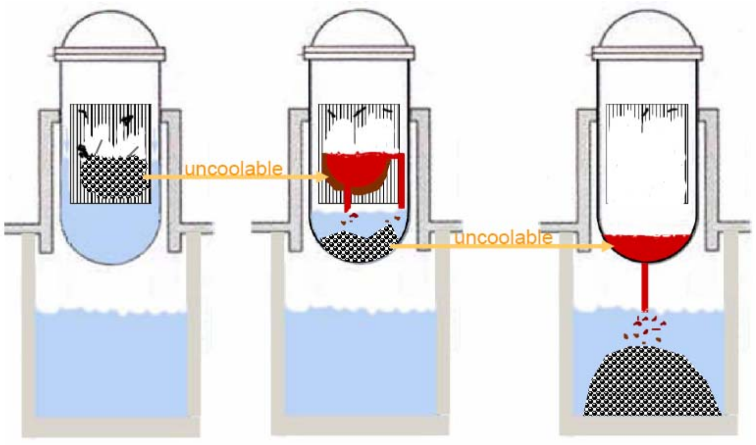
- Comparison with neutron detector readings are excellent

- A preliminary 2D numerical benchmarking was performed for BWR cores, to investigate the applicability of VNEM to a BWR core

INCOSE

INCOSE	**2009 - 2010**	**KTH**	**600**

- In-vessel coolability and steam explosion risk in Nordic BWRs (which uses cavity flooding as SAM) during severe accident



- Next four slides by courtesy of Weimin Ma at KTH

(a) in the core ***(b)*** in the lower plenum ***(c)*** in the reactor cavity
Fig.: Debris bed formation during different stages of a severe accident scenario.

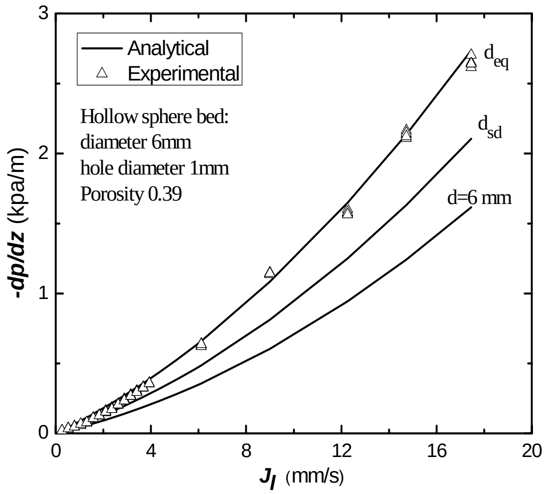
In-vessel Coolability and Steam Explosion in Nordic BWRs

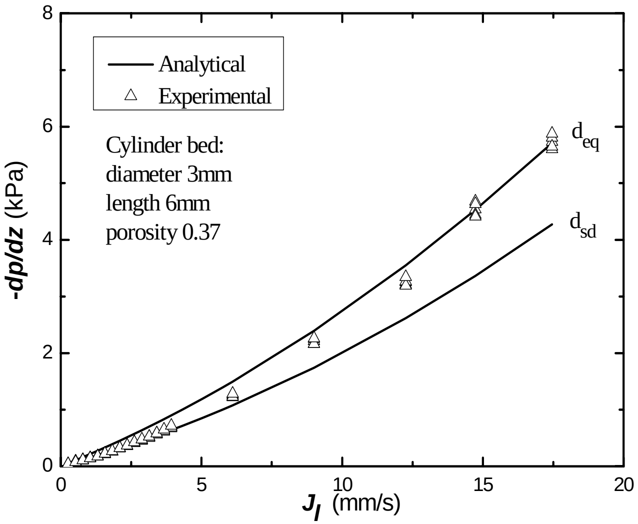
Weimin Ma

Division of Nuclear Power Safety - NPS
Royal Institute of Technology - KTH

Highlights of INCOSE research

- **Topic 1**: Friction laws of particulate beds packed with irregular particles, which are of important to coolability analysis of debris beds.

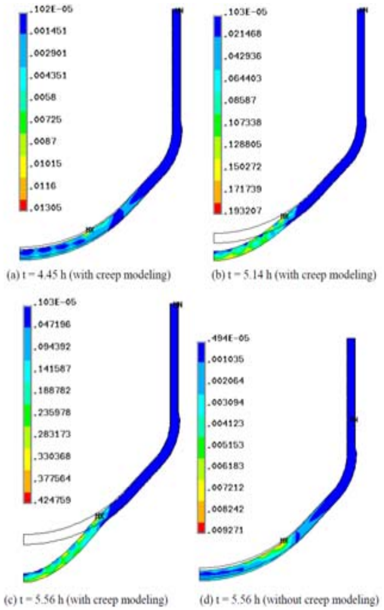




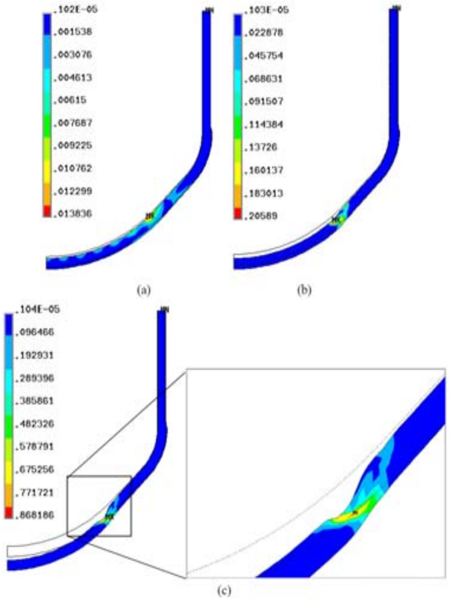
- The POMECO-FL experimental data suggest that the Ergun equation is applicable if the effective particle diameter of the particles is represented by the equivalent diameter of the particles, which is the product of Sauter mean diameter and shape factor of the particles

Highlights of INCOSE research

- **Topic 2**: Creep of the lower head of a BWR under thermo-mechanical loads.



ballooning

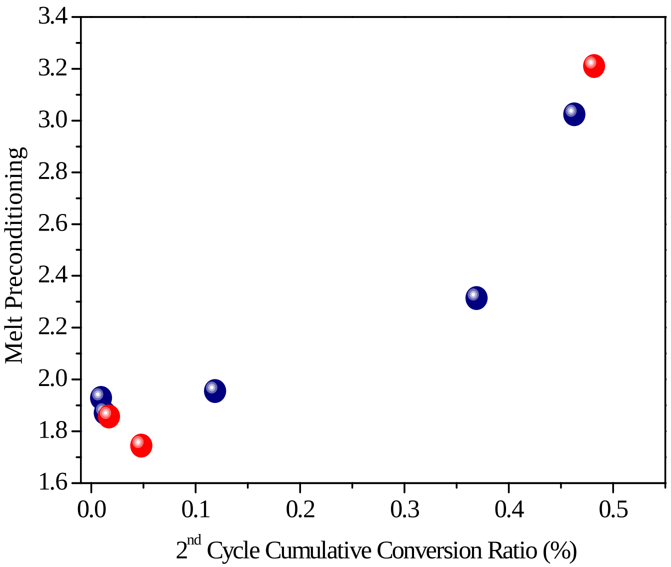


Localized creep

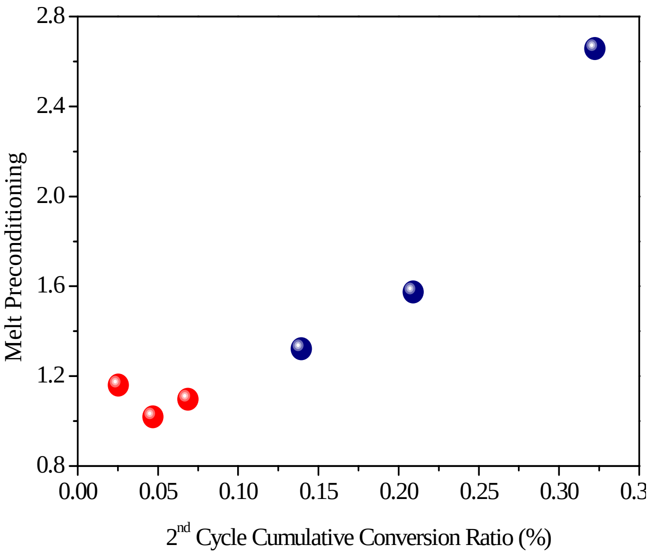
- One-way coupling between PECM model for melt pool heat transfer and ANSYS thermo-structural mechanics was developed to analyze the vessel creep, and the results revealed two different modes of vessel failure: a ‘ballooning’ of the vessel bottom and a ‘localized creep’ concentrated within the vicinity of the top surface of the melt pool.

Highlights of INCOSE research

- **Topic 3**: Effect of binary oxides mixture's properties on steam explosion.



high melt superheat: ~200 °C



low melt superheat: ~100 °C

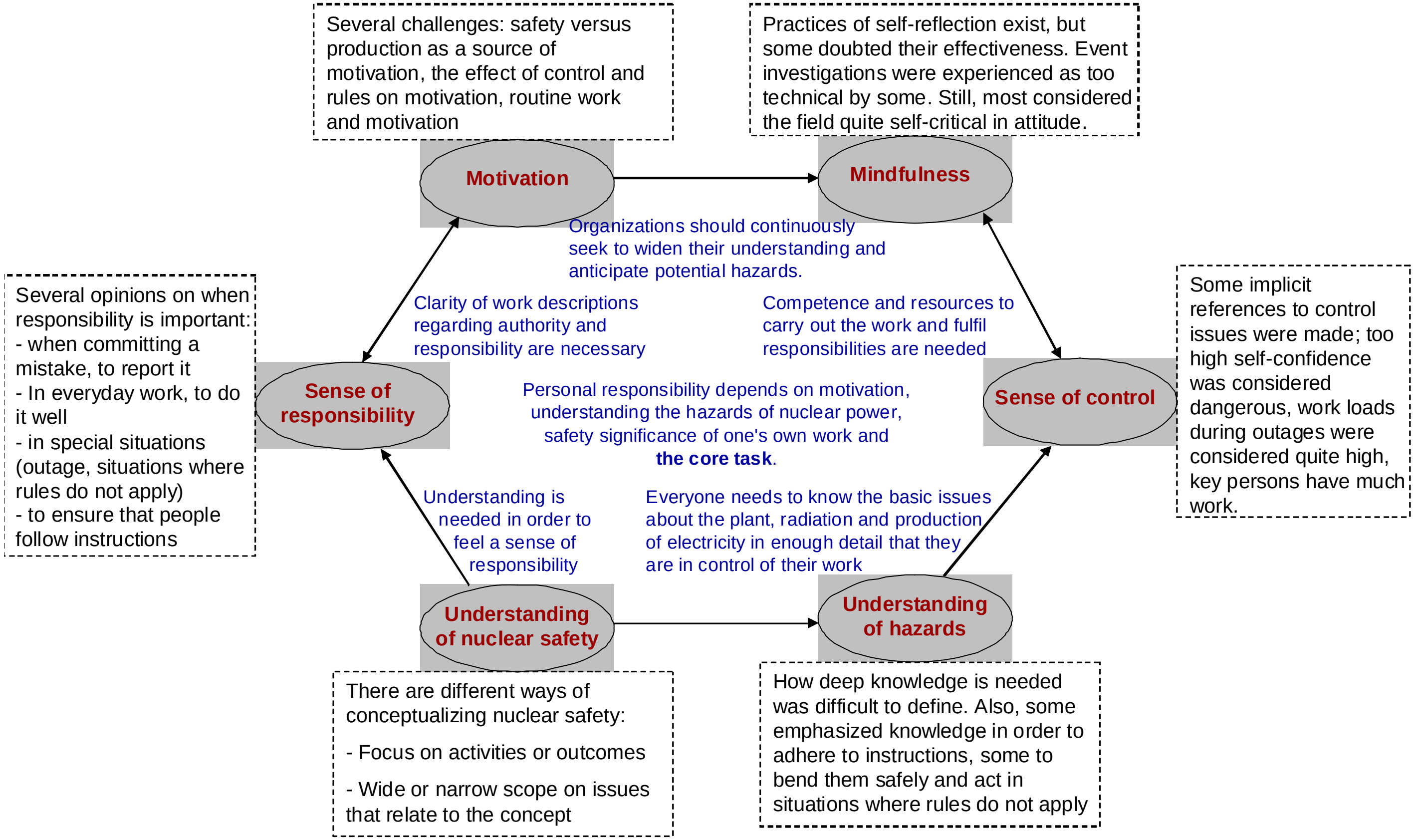
- The results of steam explosion experiments performed at low melt superheat (100 °C) using oxidic mixture of WO_3-CaO detect an apparent difference in steam explosion energetics between the eutectic and non-eutectic materials.

MOSACA

MOSACA	**2008 - 2010**	**VTT, KTH, Risk Pilot**	**1300**

- Nuclear safety culture in Finland and Sweden
  - History and present; Nordic developments, incidents,
  - Developments and challenges, including contractors' role in the Nordic nuclear industry
- Data was collected by interviews (Sweden: OKG, RAB, FKG, RiskPilot, Vattenfall, SSM, KSU, SKB / Finland: LO, STUK, Posiva, OL, Fortum)
- Definition of safety culture, how to evaluate nuclear safety, the model of key psychological safety culture dimensions

MOSACA



Several challenges: safety versus production as a source of motivation, the effect of control and rules on motivation, routine work and motivation

Practices of self-reflection exist, but some doubted their effectiveness. Event investigations were experienced as too technical by some. Still, most considered the field quite self-critical in attitude.

Motivation

Mindfulness

Organizations should continuously seek to widen their understanding and anticipate potential hazards.

Several opinions on when responsibility is important:
- when committing a mistake, to report it
- In everyday work, to do it well
- in special situations (outage, situations where rules do not apply)
- to ensure that people follow instructions

Clarity of work descriptions regarding authority and responsibility are necessary

Competence and resources to carry out the work and fulfil responsibilities are needed

Sense of responsibility

Personal responsibility depends on motivation, understanding the hazards of nuclear power, safety significance of one's own work and **the core task**.

Sense of control

Some implicit references to control issues were made; too high self-confidence was considered dangerous, work loads during outages were considered quite high, key persons have much work.

Understanding is needed in order to feel a sense of responsibility

Everyone needs to know the basic issues about the plant, radiation and production of electricity in enough detail that they are in control of their work

Understanding of nuclear safety

Understanding of hazards

There are different ways of conceptualizing nuclear safety:

- Focus on activities or outcomes
- Wide or narrow scope on issues that relate to the concept

How deep knowledge is needed was difficult to define. Also, some emphasized knowledge in order to adhere to instructions, some to bend them safely and act in situations where rules do not apply

MOSACA

Conclusions and recommendations:

- Knowledge and understanding: the safety significance of one’s work

- Learning from past incidents (root causes and common contributing factors), also from human factors and safety culture point of view

- The concept of nuclear safety is all but clear -> needs to be discussed openly

- Contractors role: work as information carriers but also a challenge to manage

- Mindfulness and constant development, remain humble; safety is a dynamic non-event (absence of accidents), require constant work to achieve

- History shows: Important to maintain long-term focus in the nuclear field

NROI

NROI	**2008 - 2010**	**Chalmers, VTT**	**1450**

- Experimental study on iodine chemistry

- Behaviour of iodine in the containment during a (hyp.) severe accident

- Data can be used in severe accident propagation simulation codes (ASTEC, COCOSYS) and plant analysis -> work ongoing in SARNET

-> contribute to a better determination of the source term of iodine during a (hyp.) severe accident

NROI

- 2008, radiolytic oxidation of elemental iodine

- 2009, radiolytic oxidation of organic iodine

- 2010, methyl iodine (organic iodine) experiments,

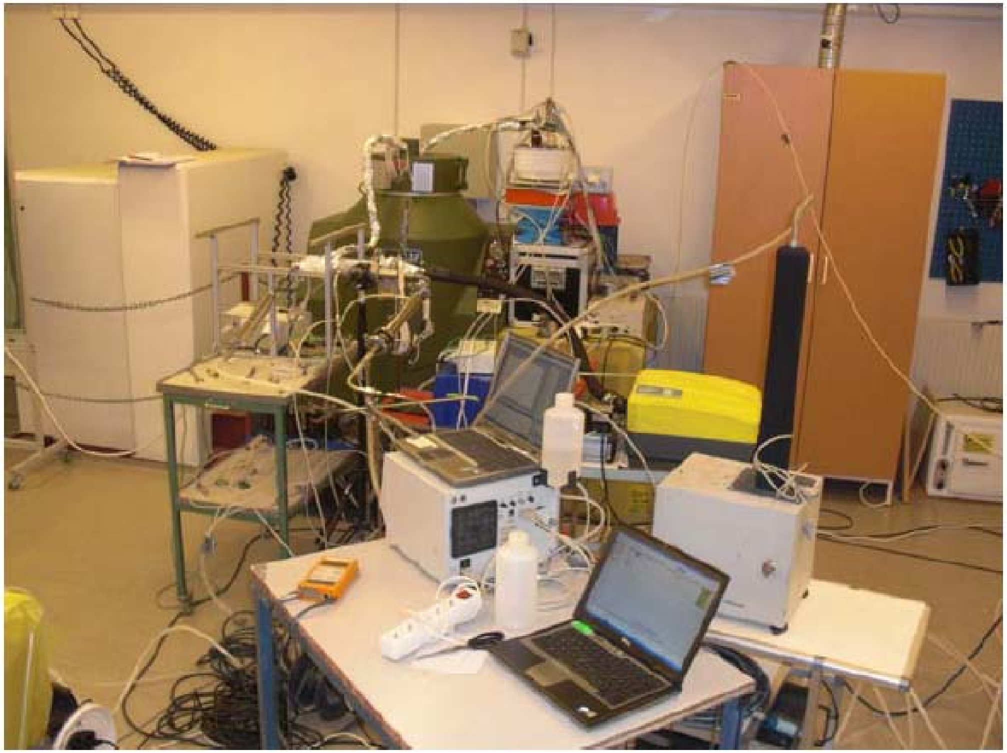
    - VTT, EXSI facility: effect of ozone, UV-radiation

    - Chalmers: effect of gamma radiation

- Example of findings: When gaseous iodine (organic and inorganic) is exposed to radiation and ozone, iodine particles are formed, iodine oxides (I2 especially converts easily to particles)

- Chalmers & VTT co-operation in iodine oxide in containment research continues in NKS-R activity AIAS 2011

NROI



EXSI facility.

POOL

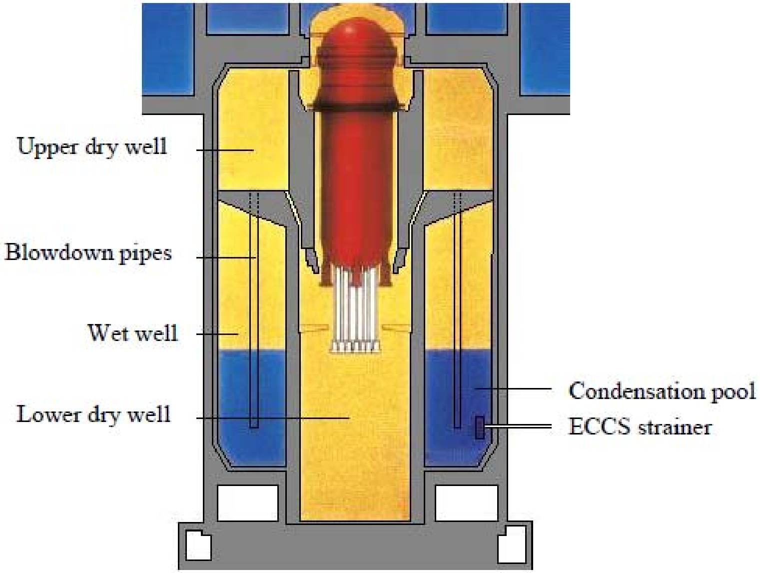
POOL	**2007 - 2010**	**VTT, KTH, LUT**	**2000**

- Condensation pool experiments and development of simulation codes

- LUT: experiments, VTT: Fluent analysis, KTH: Gothic analysis

- PPOOLEX facility: BWR pressure suppression containment with drywell and wetwell. Steam condensates in the pressure suppression pool during a (hyp.) main steam line break.

POOL



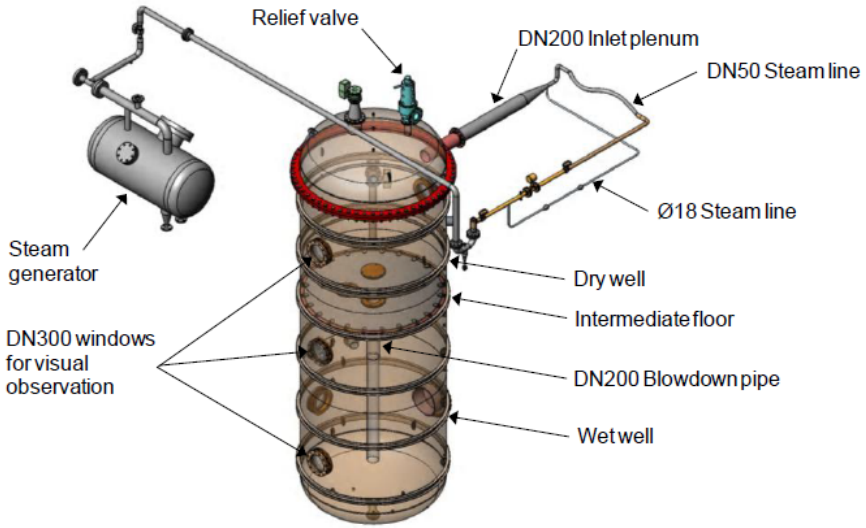
Olkiluoto type BWR containment.

- Improve understanding of the thermal hydraulic phenomena occurring in the pressure suppression containment

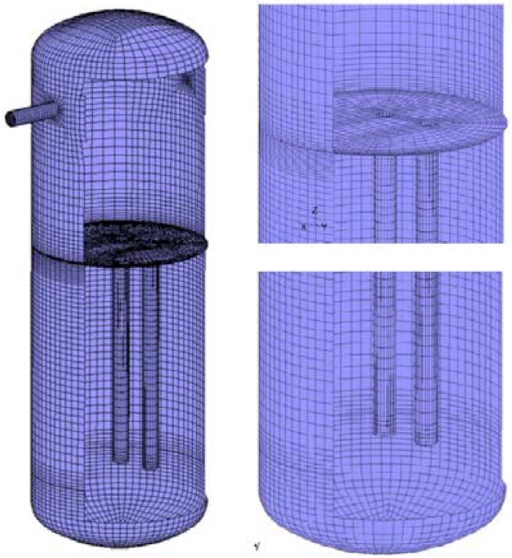
- Define mechanical loads on the pool structures during blowdown of air and steam in the condensation pool

- Experiments give validation data for numerical methods

POOL



PPOOLEX test vessel.



Surface mesh of the CFD model for experiments with two vent pipes.

POOL

- The CFD simulations predict well the main features of the experiments

  - Development still needed in simulating the direct contact condensation and interfacial area of the bubble

- GOTHIC is a useful tool in reactor applications for complex fluid-physics scenarios

  - Was further developed to be better suitable for simulating the steam injection -> implementation of “effective heat source” and “effective momentum” approaches

- Same project team continues in NKS ENPOOL 2011

Thank you

Nordisk kernesikkerhedsforskning
Norroenar kjarnöryggis rannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

RASTEP evaluation results

CfP 2011

Karoliina Myllymäki
NKS-R Programme Manager

May 2011

EVALUATION RESULTS FOR RASTEP IN CFP 2011

The funding decision for project RASTEP was postponed from the January 2011 board meeting to the May meeting 2011. This document is intended to give background information of the evaluation results for a final funding decision on RASTEP.

Table 1. Ranking among proposed activities 2011 (NKS-R). Projects are sorted from 1 - 16 according to the average ranking given by the evaluators (in the ranking form).

Project Acronym	Ranking	Average ranking	Overall mark average	Total mark average
ENPOOL	1	4	6.40	6.23
DIGREL	2	4	6.40	6.03
SADE	3	4.2	6.20	6.03
POOLFIRE	4	5.4	6.00	6.06
MoReMO	5	6.4	6.00	5.77
NOMAGE4	6	7	5.50	5.39
RASTEP	**7**	**7.5**	**5.33**	**5.24**
AIAS	8	8.8	5.40	5.63
DPSA	9	8.8	5.00	5.20
NAFTI	10	9.4	5.20	5.23
GRID	11	9.6	5.20	4.91
NAFCS2	12	9.8	5.00	4.96
VNEMVALID	13	11	4.75	4.64
EXAM-HRA	14	11.6	4.40	4.63
FMNPP	15	14.8	3.75	3.89
PANDAROSA	16	14.8	3.25	3.89

Table 2. Evaluation marks (NKS-R).

Criteria	Fortum	VTT	STUK	IFE	SSM
Nordic value	4	4	-	-	7
Technical and/or Scientific standard	6	3	-	-	6
Distinct and measurable goals	6	3	-	-	7
Relevancy to NKS end-users	6	2	-	-	7
Participation of young scientists	6	4	-	-	6
Links to other programmes	6	4	-	-	7
Overall evaluation	6	3	-	-	7

Table 3. Evaluation marks (NKS-R).

	Fortum	VTT	STUK	IFE	SSM
Recommended					X
If possible	X				
Not recommended		X	X		

Table 4. Evaluation marks (NKS-B).

Evaluator	Nordic value	Tech/Sci standard	Distinct goals	Relevancy to end users	Young scientists	Links to other programmes	Overall mark
DEMA	6	6	7	7	5	6	7
SIS	6	6	3	6	4	5	6
STUK	1	2	3	2	3	2	1
IRPI	3	5	4	3	5	4	4
NRPA	4	5	4	5	4	3	3
IFE	6	6	5	6	7	6	7
SSM	3	6	5	5	3	5	4
Vattenfall	6	6	6	6	3	5	5
Mean	**4.4**	**5.3**	**4.6**	**5.0**	**4.3**	**4.5**	**4.6**

Table 5. Evaluation marks (NKS-B).

Recommended	4
If possible	2
Not recommended	2

EVALUATORS' COMMENTS (NKS-R)

- Does this proposal belong to NKS-R. No Finnish experts involved.

- Interesting and very ambitious project, with clear potential results to end users. Why is not Finnish utilities and the Finnish nuclear safety authority (STUK) amongst the participating organisations?

- During the year 2009 evaluation it was instructed the project group to ask Finnish participants to the project. However the proposal is the same as last year. The widening of the project is recommended also now.

- Recent contacts with STUK indicated that there is interest in the project with possible in-kind contribution or participation in the reference group.

EVALUATORS' COMMENTS (NKS-B)

- Interesting topic. Should be financed under the R-programme? Only Sweden and Norway participate. Quite expensive project.

- Only reservation is the quite high financing of one single company!

- Should be financed only if financially supported by NKS-R, no own contribution from IFE Halden, few countries involved.

- The strong financial support from the Swedish authorities and NPP's makes it likely that the result of the project will indeed be used.

- It is positive that the proposal assumes participations of young scientists in the field. Activities have involved the input and processing of data, and possibly proceedures that could be developed into algorithms, but funding has generally not been given in the past to the development of computer source code.

- Doubtful if this projects falls under the NKS-B criteria.

nks
Nordisk kernesikkerhedsforskning
Norrœnar kjarnöryggis rannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

Proposal must be sent by e-mail
to justin.gwynn@nrpa.no
no later than
Friday, 15th of October 2010

1. Summary information about the proposed activity

Name of the activity	Proposed acronym[1]
Using Bayesian Belief Network Modelling for Rapid Source Term Prediction after a Severe Accident	RASTEP

Start date	End date	New / continued activity
2011-01-01	2012-12-31	New activity

Proposed classification (E, W, M, R)	Is the proposed activity aimed as a cross-over activity between the NKS-R and NKS-B programmes?
E: Emergency preparedness	Yes

Short summary of the activity (max. 1800 characters)

The proposed activity aims at providing a basis for improving off-site emergency management by developing a computerized source term prediction tool. The name of the tool will be RASTEP (Rapid Source Term Prediction). RASTEP will use Bayesian belief networks (BBN) to model severe accident progression in a nuclear power plant. The output will be a set of possible source terms with associated probabilities. RASTEP consists of two fundamentally different parts, i.e., a BBN model used to model accident progression, predict plant states, and release paths, and a source term definition part used to characterise the source term (height, composition, amount, timing).
The BBN model is based on prior information from the plant PSA level 1 and model which is iteratively updated based on plant observables. Source term definition and severe accident progression uses information from deterministic severe accident analysis tools, e.g., MAAP. The tool shall interface with commonly used off-site dose calculation tools, e.g., LENA and/or ARGOS. The approach chosen aims at facilitating decision making in a situation with incomplete or partly contradictive information.
As input of plant information via automatic signal transfer is one option, the NKS project will include the issue of signal validation. Also, as the source term prediction part of the tool is crucial and separate from the BBN part, the possibility to integrate a deterministic source term prediction code will be explored.

List of participating organisations (including the co-ordinating one)

SSM (Swedish Radiation Safety Authority), Scandpower, OKG, FKA (Forsmarks Kraftgrupp), Ringhals AB, IFE Halden

Requested funding from the NKS in 2010. If continuation of activity is assumed beyond 2010, please estimate requested funding in later years.

In 2011: 400 (in 1000 DKK)   Expected requested funding in later years (if applicable): 400

[1]: If this activity is a continuation of a previously funded NKS-B activity, please use the same acronym as before (a list of acronyms of ongoing activities can be found on the NKS-B web site)

Please note that the above information may be made public on the NKS web site **if** the proposal is accepted by the NKS Board

2. Relevance of proposed activity to NKS criteria

Summarise how the proposed activity will maintain and build up competence and informal Nordic networks

This is a cross-over activity between NKS-B and NKS-R, connecting some crucial aspects related to the use of probabilistic information for risk-based applications with the needs and challenges of emergency preparedness and prediction of off-site consequences from severe accidents. It will adddress a number of issues receiving considerable attention both nationally and internationally. Build-up of competence will be assured by forming a project group representing a number of different competences, by wide participation of end users in the project, by holding project seminars, and by writing papers for international conferences and journals. The project includes participants from Sweden and Norway (SSM, Relcon Scandpower, Ringhals, Forsmark, OKG, and IFE Halden), and is performed with the active participation of all these organisations. In connection with the project seminars, wider participation will be encouraged, including relevant Finnish utilities and authorities. Specifically, RASTEP will be subject for a coming meeting between SSM and STUK.

Summarise the proposed activity’s technical and scientific merits

The proposed activity aims at providing a basis for improving off-site emergency management by developing a computerized source term prediction tool using bayesian belief networks for modelling the plant during severe accident progression. In doing so, the activity addresses a number of issues that are currently under discussion, e.g., ways of making efficient use of the information from probabilistic safety assessments, ways of supporting decision making under uncertainty, and ways of providing timely and easily interpreted source term information to the emergency preparedness organisation.

Summarise what the proposed activity will deliver in the form of distinct and measureable goals

1. The activity will develop a documented analysis methodology, including the necessary QA procedures and procedures for validation and verification of developed BBN models.
2. In connection with this, it will result in the development of the RASTEP computer based tool and interface with required functionality, including required user and program interfaces.
3. As part of the activity work, basic RASTEP models will be developed for Swedish BWR:s and PWR:s.
4. Interfaces with some other tools will be developed, e.g. LENA or Argos.
5. Signal validation issues will be explored in connection with transfer of plant information.

Summarize who are the potential end users and how it has been ensured that the proposed activity is relevant for them

End users are in the areas of reactor safety and emergency preparedness. Involvement of potentila users will be assured through direct projct participation and participation in the project reference group, consisting of:

- Forsmarks Kraftgrupp AB / Staffan Hennigor
- OKG AB / Marcus Johansson
- Ringhals AB / Anders Henoch
- SSM (Swedish Radiation Safety Authority) / Wiktor Frid (and other)

In addition, project seminars will be held at the end of every project year.

Summarise the participation of ‘young scientists’ in the proposed work (Degree, masters, PhD, post doctoral level)

Two to three young experts on masters or PhD level will be involved for parts of the work.

Interfaces to other relevant projects (past or present NKS activities, national research programs, EU programs, etc.)

The work will be partly based on a pilot project performed in 2001-2005 within the EU project STERPS (part of the EU FP 5 and 6). The activity will include experience exchange with some other European organisations exploring the possibility of using BBN based source term prediction, e.g., GRS in Germany and NRG-Arnhem in the Netherlands. The signal validation part of the project has connections with the CAMS project (OECD Halden Reactor Project), which was initiated in NKS-SIK-2.7, and continued in NKS-RAK-2. As the IAEA has expressed interest in the project, discussions on arranging a seminar hosed by the IAEA have been initiated.

3. Co-ordination of activity

Institution or company

Scandpower AB

Activity co-ordinator

Michael Knochenhauer

Postal address

Box 1288, SE-17225 Sundbyberg

E-mail

mkn@scandpower.com

Telephone (international format)	Fax (international format)
+4684452141	+4684452101

4. Other organisations involved

Institution or company	Contact person	E-mail

SSM (Swedish Radiation Safety Authority)	Wiktor Frid	Wiktor.Frid@ssm.se
Institution or company	Contact person	E-mail
OKG	Marcus Johansson	Marcus.Johansson@okg.eon.se
Institution or company	Contact person	E-mail
Ringhals AB	Anders Henoch	Anders.Henoch@vattenfall.com
Institution or company	Contact person	E-mail
FKA (Forsmarks Kraftgrupp)	Staffan Hennigor	sig@forsmark.vattenfall.se
Institution or company	Contact person	E-mail
IFE Halden	Davide Roverso	Davide.Roverso@hrp.no
Institution or company	Contact person	E-mail

5. Assumed distribution of NKS funding amongst participants (in 1000 DKK)[1]

	2011	2012 - 2012
Scandpower	240	240
IFE Halden	160	160
Total	400 k DKK	400 k DKK

6. Assumed distribution of own contributions amongst participants (in 1000 DKK)[1]

	2011	2012 - 2012
SSM	500	500
OKG	80	80
FKA	80	80
Ringhals AB	80	80
Scandpower	80	80
Total	820 k DKK	820 k DKK

7. Milestones, deliverables

	Date

---

[1] Use decimal point (.) as a separator for decimals in all tables

Detailed project plan	2011-01-31
Reference group meeting	2011-04-30
Project seminar	2011-10-30
Final report	2012-12-31

8. Submission of proposal

This form must be sent by e-mail no later than the 15th of October 2010 from the official e-mail address of the activity co-ordinator (as given on this form) to justin.gwynn@nrpa.no .

Please use the *acronym* as a file name and add the number "1"

Is supplementary description (maximum 4 pages) included?
Yes (please click on drop-down form field at left to select "Yes" if needed)
Name of file: RASTEP2 (please use the acronym and add the number "2")

The date of sending will be regarded as the date of submission.

Please note that a confirmation of the reception of the proposal will be sent by the Programme Manager

P M

Till: NKS Patrick Isaksson, Justin Gwynn	
Från: Michael Knochenhauer	**Kopia:** SSM Wiktor Frid
Projekt nr.: 210137	**Datum:** 15 oktober 2010
Ämne: **Activity Plan "RASTEP – Using Bayesian Belief Network (BBN) Modelling for Rapid Source Term Prediction"**	

1. BACKGROUND AND SCOPE

Development of tools for use in the fast, online event or accident diagnosis and subsequent radiological source term forecasting at nuclear power plants is increasingly desired by off-site emergency planning and response personnel. Availability of such analytical tools would enhance the efficiency in preparing accident response options, and online implementations would be invaluable in quickly predicting likely offsite consequences and result in a more appropriate off-site response.

Large uncertainties are inherent in severe accident situations at nuclear power plants. In trying to model severe accident sequences a mixture of probabilistic and deterministic approaches are typically used. Thus probabilistic safety assessment (PSA) models are used for creating an over-all logical model representing the reaction of the plant to various challenges, and identifying critical event sequences leading to unacceptable radioactive releases. Deterministic analyses are used to determine critical aspects related to physical phenomena during progression of a severe accident, to the time and composition of releases, etc.

The proposed activity aims at providing a basis for improving off-site emergency management by developing a computerized source term prediction tool. The suggested name of the tool is RASTEP (Rapid Source Term Prediction). RASTEP will use Bayesian belief networks (BBN) to model severe accident progression in a nuclear power plant. The output will be a set of possible source terms with associated probabilities. RASTEP will consist of two fundamentally different parts, i.e., a BBN model used to predict plant states and release paths, and a source term definition part used to characterise the source term (height, composition, amount, timing).

The BBN model is based on prior information from the plant PSA model which is iteratively updated based on plant observables. Source term definition and severe accident progression uses information from deterministic severe accident analysis tools, e.g., MAAP. The tool shall interface with commonly used off-site dose calculation tools, e.g., LENA and/or ARGOS. The approach chosen aims at facilitating decision making in a situation with incomplete or partly contradictive information.

The work will be partly based on a pilot project performed in 2001-2005 within the EU project STERPS, which was part of the EU framework programmes 5 and 6[1, 2]. Nordic participation in the EU project was through the Royal Institute of Technology in Stockholm (KTH), with Wiktor Frid (professor at KTH at the time; now at SSM) as project manager, with the participation of Scandpower (Michael Knochenhauer), and extensive in-kind participation from OKG. Information exchange with some of the partners in the EU project is planned to be included in the NKS activity.

As input of plant information via automatic signal transfer is one option, the NKS project will include the issue of signal validation. Also, as the source term prediction part of the tool is crucial and separate from the BBN part, the possibility to integrate a deterministic source term prediction code will be explored.

During 2008 and early 2009, SSM has sponsored a pro-project with the aim to make a feasibility study for the RASTEP project based on experiences from the EU project. The pre-project included information exchange with a reference group with utility representatives as well as with further developments made by the German Gesellschaft für Reaktorsicherheit (GRS), also a former participant from the EU STERPS project.

2. DESCRIPTION OF ACTIVITY SUB-STEPS

A number of sub-steps have been defined and will be performed over the two project years. This will be further detailed in the initial detailed project planning.

2.1 Definition of User Interface

In a computer based decision support tool intended for use during severe accident conditions, relevant and easily used user interfaces will be important. This includes both input interfaces (creation of model, running of model) and output interfaces, including interface with LENA/ARGOS, ADAM, etc.

2.2 Definition of BBN Functionality

The pre-project has already resulted in a proposal for a radical re-composition of the BBN structure suggested in the EU STERPS project, see Figure 2-1, which also gives a good view of the general lay-out of a BBN. Other aspects of BBN modeling are the identification of relevant PSA information (prior information) and of relevant observables. Finally, the definition of a relevant and defendable set of conditional probabilities related to BBN nodes has proved to be a major challenge, and will need to be further explored.

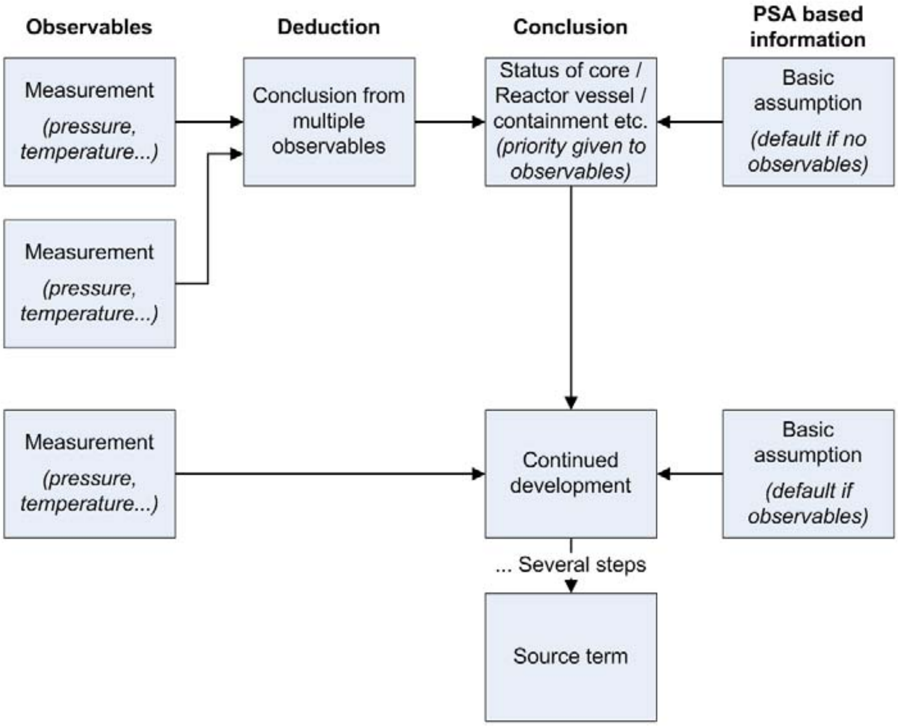


Figure 2-1 RASTEP – Suggested basic structure of BBN model

2.3 Source Term Definitions

The STERPS pilot project based source term definition on a complex excel spread-sheet model including a set of pre-calculated source terms, which were associated with various end states of the BBN. This proved to work well in some cases, but was often perceived to be too inflexible.

This sub-step includes the exploration of various approaches, including the improvement of the functionality of the STERPS simplified spreadsheet approach, but also looking at more sophisticated approaches, such as interfacing RASTEP with a deterministic source term prediction code, e.g., MELCOR, MAAP or ADAM. Such codes would use as input the characteristics of the accident initiator and the availability of various systems, and calculate the various phenomenological outcomes and their resulting radiological source terms for the alternative scenarios (with different probabilities).

2.4 Signal Validation

A critical aspect affecting the uncertainty in the estimates of a rapid source term prediction tool is the availability of correct measurement information from the monitored plant. This involves the validation of plant measurements (pressures, temperatures, ...) at the starting point and during accident progression to update the predictions of the BBN models. Research on signal validation techniques for on-line instrument channel monitoring has been a central activity at IFE and at the Halden Reactor Project for the past fifteen years, where techniques and tools have been developed and tested in numerous applications, e.g., [3].

The typical application of these techniques has been during normal operation for the on-line monitoring of the calibration status of instrumentation. A research challenge in the proposed project would be to investigate the applicability of these techniques to severe accident situation.

2.5 Application to Plants

The basic part of the application of RASTEP involves development of generic BBN models for Swedish BWR:s and PWR:s, followed by specific plant applications:

- Generic BWR model followed by specific plant application
- Generic PWR model followed by specific plant application
- Performance of demonstration exercise

2.6 Dissemination of Results

The following dissemination of results is anticipated during 2010:

- Conference paper and presentation at PSAM 10 *Probabilistic Safety Assessment and Management*; Seattle, USA; May 2010 (paper accepted)
- A project seminar will be held in late 2010.
- NKS report.
- Presentation at NKS-R/B mini seminar (if held during the year)

3. PROJECT ORGANISATION

The SSM project manager is Wiktor Frid. NKS activity leader and Relcon Scandpower project manager will be Michael Knochenhauer. Expertise on signal validation will be provided by IFE Halden. In addition, the activity will include expertise related to PSA, severe accident analysis and programming (BBN, Netica, source term characterisation, input and output interface, LENA/ARGOS interfaces).

End users will be represented through a reference group, including experts in severe accident analysis and emergency preparedness from SSM and the Swedish utilities (Forsmark, Ringhals and Oskarshamn). Information exchange will be organised with some of the previous STERPS partners, e.g., GRS in Germany and NRG-Arnhem in the Netherlands.

4. REFERENCES

1. E. Grindon, M. L. Ang, M. Kulig, M. Slootman, H. Löffler, G. Horvath, A. Bujan, W. Frid, W. Cholewa and M. Khatib-Rahbar, “A rapid response source term indicator based on plant status for use in emergency response (STERPS)” Proceedings of FISA 2003, November 2003, Luxemburg.
2. W Frid, M. Knochenhauer, M Bednarski, “Development of a Bayesian belief network for a boiling water reactor during fault conditions”; CAMES Computer Assisted Mechanics and Engineering Sciences, Vol. 12, No.1 2005
3. P.F. Fantoni, M. Hoffmann, R. Shankar, E.L. Davis, ” On-line monitoring of instrument channel performance in nuclear power plant using PEANO”, Progress in Nuclear Energy, Volume 43, Issues 1-4, 2003, Pages 83-89.

Nordisk kernesikkerhedsforskning
Norrœnar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

NKS-B Status Report

Justin Gwynn
NKS-B Programme Manager
May 2011
Norwegian Radiation Protection Authority

Status summary

Overall the work in NKS-B is progressing well, although the Fukushima accident has created some delays. Since the last NKS-B status report was made to the NKS-Board in January 2011, 3 new final reports from completed NKS-B activities have been published on the NKS website. Of the delayed NKS-B activities that commenced prior to 2010, all should have been completed (i.e. final reports submitted) by the time of the NKS Board meeting. Of the activities that started in January 2010 all but one are expected to be completed by the time of the NKS Board meeting. Of the NKS-B activities that started in 2011, contracts have been agreed and signed with all but one activity. Of those activities that started in 2011 where contracts have been agreed, all are currently on schedule.

NKS-B reports

The following NKS-B reports have been published on the NKS website since the last NKS-Board meeting.

NKS-B NordRisk II
Bent Lauritzen
NKS-B NordRisk II: Nuclear risk from atmospheric dispersion in Northern Europe - Summary Report

NKS-B Method MS
Lindis Skipperud et al.
Method-MS Final report

NKS-B NordRisk II
Ulrik Smith Korsholm et al:
NKS NordRisk II: Atlas of long-range atmospheric dispersion and deposition of radionuclides from selected risk sites in the Northern Hemisphere

NKS-B PIANOLIB
Lilián del Risco Norrlid et al.
In-vivo whole body measurement of internal radioactivity in the Nordic countries

NKS-B activities

Delayed NKS-B activities prior to 2008

NordRisk II

Nuclear risk from atmospheric dispersion in Northern Europe
Activity Leader: Bent Lauritzen, Risø DTU

The NKS funding for the work is **DKK 230 k**

Work in 2007 was delayed and the work plan for 2007 was instead extended into 2008 with a revised work plan in a contract with the following milestones:

1. Kick-off meeting 2007
2. Atmospheric dispersion model calculations for the Nordic Hemisphere using DERMA (DMI). Draft version of extended atlas December 2008.
3. Short progress report April 2008
4. Assessment of key dispersion parameters for software model, obtained from statistical analysis of calculated dispersion and deposition fields (Risø, DMI). Data collected for subsequent publication.
5. Preparation of NordRisk atlas data in a format suitable for presentation in the ARGOS

decision support system (DMI, DEMA)
6. Progress report December 2008 (Risø)
7. The work is planned to be completed by December 31, 2008.

Status

New Atlas produced and distributed. Activity completed.

NKS-B activities from 2008 (June)

DepEstimates:

Estimation of fallout deposition background for various radionuclides
Activity Leader: Sigurður Emil Pálsson, Geislavarnir ríkisins

NKS-B funding: **250 kDKK**

Milestones defined in contract:
1. Planning meeting, Bergen (June 2008)
2. Short status report (November 2008)
3. Progress report, including description of concentration function (December 2008)
4. Seminar (January – February 2009)
5. Draft paper for submission to a scientific journal (15 March 2009)
6. Final report (1 April 2009)

Status

The DepEstimates activity is being concluded with a final report to be concluded before the NKS Board meeting in June. The conclusions of the work have been accepted for an oral presentation at the ECORAD 2011 conference in Canada in June and will also appear in a paper to be submitted to a scientific journal.

NKS-B activities from 2009 (June)

FOOD

Countermeasures in food production in the Nordic countries
Activity Leader: Inger Margrethe Eikelmann, NRPA

NKS-B funding: **200 kDKK**

Milestones defined in contract:
1. Develop agenda for the seminar and finalise invitations
2. Conduct the seminar
3. Final report

Status

Activity expected to be completed via submission of final report before the NKS Board meeting. Delayed to Fukushima.

NKS-B activities from 2010 (January)

MareNuc

Operationalisation of risk assessments for marine reactors
Activity Leader: Ole Reistad, NRPA

NKS-B funding: **340 kDKK**

Milestones defined in contract:

1. Joint op-ed on the marine nuclear activities in the Nordic waters and the relevance for a Nordic network addressing the risks associated with these activities (Ultimo March 2010)
2. Workshop 1: Agreed methodology for scaling of source terms in relation to certain type of vessels, and prioritization of the most important nuclides for further consideration in impact assessments, on the basis of relevant literature on marine reactors and source term derivation from small reactor (April 22-23, 2010);
3. Workshop report 1 (Medio June, 2010);
4. Workshop 2: Assessment of the possible changes of risk associated with the operation of nuclear reactors in Northern European areas in relation to expected changes in vessel construction plans, new applications and introduction of new technologies (Ultimo August, 2010);
5. Workshop report 2 (Medio November, 2010):

Status

First workshop was postponed due to the volcanic ash travel restrictions and subsequently held in Reykjavik in October 2010. Co-ordinator has left his position with NRPA. NRPA will continue to administrate activity. Second seminar has been suggested to take place immediately after the NSFS conference in Reykjavik in August. It will be a two day seminar and the programme has been agreed. Delayed due to Fukushima.

PONPP

Preparedness organization at nuclear power plants in the Nordic countries
Activity Leader: Jan Porsmyr, IFE-Halden

NKS-B funding: **300 kDKK**

Milestones defined in contract:

1. Interviews/Data collection/Analysis (15.01.10 - 15.08.10)
2. Status report after completion of interviews and analysis (15.09.10)
3. Workshop (October 2010)
4. Distribution of "Workshop" material and results (15.11.10)
5. Final Report (31.12.10)

Status

Activity completed.

PIANOLIB

Phantom-based intercomparison Among Nordic whole body counting facilities and the development of a Nordic phantom library website
Activity Leader: Lilián del Risco Norrlid, SSM

NKS-B funding: **320 kDKK**

Milestones defined in contract:

1. Report on inventory of available phantoms and sources for calibration of whole body counters among the participants
2. Phantom library website
3. Progress report after completion of the library website
4. Intercomparison exercise
5. Final report

Status

Activity completed.

Methode-MS

Application of mass spectrometry for the measurement of low level, long-lived radionuclides
Activity Leader: Lindis Skipperud, UMB

NKS-B funding: **470 kDKK**

Milestones defined in contract:

1. Tracers and Standard reference material purchase (spring 2010)
2. Inter laboratory exercise (spring 2010)
3. Further ICP-MS measurements and Quality Control of selected radionuclides (table 1)
4. New method developments and improvements (2010)
5. Short progress report and new application for third year by 15th October 2010
6. Applications/measurments of different matrices (Autumn 2010)
7. Progress meeting (September 2010)
8. Final Report on results of the first 2 years (December 2010)

Status

Activity completed.

RADPAST

Natural Radionuclides in Meadow and Pasture land in the Nordic countries
Activity Leader: Klas Rosén, SLU

NKS-B funding: **500 kDKK**

Milestones defined in contract:

1. Meeting in February 17-18, 2010
2. Interim report on field studies by the end of September 2010
3. Workshop in the mid of November 2010
4. Final report by the end of December 2010

Status

Final report for work in 2010 to be finalised shortly (delayed due to Fukushima).

NKS-B activities from 2011 (January)

GammaRate

Safe use of portable gamma radiation ratemeters for environmental monitoring
Activity Leader: Hans Bjerke, NRPA

NKS-B funding: **150 kDKK**

Milestones defined in contract:

1. Workshop May 2011, contribution to the final report including guidelines for calibration and use of some portable dosemeters
2. Publication of results from the comparison
3. Final report of GammaRate

Status

Contract signed. On schedule.

GammaWorkshops

Workshops for gamma spectroscopy
Activity Leader: Henrik Ramebäck (FOI)

NKS-B funding: **360 kDKK**

Milestones defined in contract:
1. Planning meeting in Reykjavik
2. Workshops
3. Final Report

Status

Contract signed. On schedule. The workshop will be held at Risø on 27-29 September.
The main topics will be:

- Monday, afternoon: Natural radionuclides, ½ day workshop
- Tuesday, morning: Matrix and absorption corrections, ½ day workshop, software specific, could mean parallel sessions
- Tuesday, afternoon: Uncertainties and detection limits, ½ day workshop
- Wednesday: True Coincidence Summing corrections – 1 day workshop, to a large degree software specific, parallel session

NordEx12

Nordic Exercises 2012
Activity Leader: Sigurður Emil Pálsson (Geislavarnir ríkisins)

NKS-B funding: **300 kDKK**

Milestones defined in contract:
?

Status

Contract not yet signed be should be agreed prior to NKS Board meeting.

Update from activity leader as follows:
Originally the framework for NordEx12 was to be presented and decided at a meeting of the Nordic Emergency Preparedness group. The meeting was postponed to autumn due to Fukushima. The Fukushima case has also meant that all the participating organisations have had to revise their plans on exercises and related issues. A revised framework has been defined and approved by all the participating organisations (IRSA (IS), STUK (FI), NRPA (NO), SSM (SE), SIS (DK) and DEMA (DK)). The key elements of the work are:

1. Sharing of national exercises. Each organisation will as appropriate invite the others to take part in planning of its exercises, take part in them and share the lessons learned
2. Joint table top exercise – problems in sea transport of radioactive materials. This is a topical issue for many of the participating authorities. This exercise will be conducted in autumn / early winter.
3. Exercise: Assessment of an accident in a nuclear powered vessel. This exercise will use the output of the NKS-B MareNuc seminar scheduled in autumn and the plan is to conduct it as a table-top exercise. The exercise will be planned and prepared in late 2011 and conducted at the beginning of 2012.

4. Initial planning and preparation for a joint Nordic participation in a large Swedish exercise to be held in 2012. The exercise itself is planned, organised and conducted by Sweden (SSM). The NordEx part is to co-ordinate the participation of authorities outside Sweden, definitions of common objectives and prepare a joint follow-up / identification of potential lessons learned.
5. Extra item: Nordic co-operation in the aftermath of the Fukushima case – lessons learned. The identification of lessons learned from the Fukushima case is in many ways a similar process as identification of lessons learned from an exercise, apart from that this was a real event. Dealing with the situation in Japan has and will be the focus of the work of most of the participating organisations this year and the Nordic co-operation has been one of the key elements in this.

Items 1-4 are consistent with the original proposal, item 5 is an addition.

ORPEX

Orphan Sources and Fresh Fallout: Virtual Exercise in Mobile Measurement
Activity Leader: Mark Dowdall (NRPA)

NKS-B funding: **350 kDKK**

Milestones defined in contract:
1. Derivation of data sets and materials – April 2011
2. Exercise – May 2011
3. Final report to NKS, materials posted on NKS website – September 2011

Status

Contract signed. Practice materials distributed. On schedule.

PIANOLIB

Phantom-based intercomparison among Nordic whole body counting facilities and the development of a Nordic phantom library website
Activity Leader: Lilián del Risco Norrlid (SSM)

NKS-B funding: **520 kDKK**

Milestones defined in contract:
1. Report on the intercomparison results
2. Regional Workshop
3. New set of radioactive rods for phantom IRINA
4. Scientific paper
5. Final report

Status

Contract signed. PIANOLIB workshop planned for Gothenburg 15–16 September 2011. On schedule.

RADPAST

Natural radionuclides from 238U and 232Th decay series in rural areas of the Nordic countries and dose assessments.
Activity Leader: Klas Rosén (SLU)

NKS-B funding: **500 kDKK**

Milestones defined in contract:

1. Workshop in March 3, 2011
2. Interim report on field studies by the beginning of September 2011
3. Workshop in the mid of October 2011
4. Final report by the end of December 2011

Status
Contract signed. On schedule.

RadWaste

Radiochemical analysis of radionuclides difficult to measure for waste management in decommissioning and depository
Activity Leader: Xiaolin Hou (Risø-DTU)

NKS-B funding: **420 kDKK**

Milestones defined in contract:
1. Initial project meeting in week 7 (14-16 Feb, 2011).
2. Establish an internet based Nordic network for radioanalysis, Jan. - Oct. 2011.
3. Optimize and develop radioanalytical methods, Feb. – Nov. 2011
4. Intercomparison exercise on radioanalysis of some radioactive waste samples
5. Project meeting, Nov. – Dec. 2011
6. Final report, 31st Dec. 2011

Status
Contract signed. On schedule.

Nordisk kernesikkerhedsforskning
Norrœnar kjarnöryggis rannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

Proposal must be sent by e-mail
to justin.gwynn@nrpa.no
no later than
Friday, 15th of October 2010

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1. Summary information about the proposed activity

Name of the activity Preparedness Organization at Nuclear Power Plants in the Nordic countries		Proposed acronym[1] PONPP-2
Start date 01.06.11	End date 01.06.12	New / continued activity Continued activity
Proposed classification (E, W, M, R) E: Emergency preparedness		Is the proposed activity aimed as a cross-over activity between the NKS-R and NKS-B programmes? No

Short summary of the activity (max. 1800 characters)

The activity is proposed as a continuation of the project "Preparedness Organization at Nuclear Power Plants in the Nordic countries" which was carried out in 2010 and accomplished and reported to NKS April/May 2011 (Ref. report "IFE/HR/F-2011/1497: Preparedness Organization at Nuclear Power Plants in the Nordic countries")

The main purpose of the project carried out in 2010 and spring 2011 was to compare how emergency preparedness is organized at the Nordic nuclear power plants. Vattenfall, Fortum and IFE participated in the project.

The project focused on evaluation of the work processes and the decision-making processes in the existing emergency management's preparedness room (KC). The aim was to evaluate if there was a common Nordic understanding of these issues among the emergency management teams and to identify possible improvements in the processes. The collaboration and communication to external organisations (County Council ("Länsstyrelsen"), police, resque service, authorities etc..) in the emergency management process was partly taken into account during the survey.

The survey of the of the situation in the emergency preparedness room (KC) was carried out by means of interviews and analysis carried out in cooperation with relevant persons in the emergency management teams at Vattenfall, Fortum and IFE using a method developed by IFE. This method is used today for evaluating work processes and decision-making processes in control- and collaboration rooms with several references within the oil- and gas industries. The methodology and analysis experieces was utilized and adapted for use in the nuclear emergency preparedness domain. When carrying out the interviews and analysis one also focused on identifying improvement potentials based on access to new technology and/or organizational changes.

The interview material from the various emergency management teams was collected and analyzed with regard to a common Nordic understanding of these issues among the Nuclear power plants. The material also revealed possible improvements. The result was presented and discussed with the emergency management teams and representatives from the Nordic authorities in a workshop at IFE, Halden in February 2011. One session of this workshop especially addressed ideas and issues for continuation of the activity. Especially one issue was consideres of high importance; collaboration and communication with the authorities during the emergency management process.

The participating organizations have shown great interest in continuing the PONPP project also in 2011/2012 focusing on interviews and analysis of the authorities for evaluation of their work processes and the decision-making processes both in the emergency management's preparedness room (KC) and at the authorites headquarter during an emergency situation.

It was also of interest to continue with new activities within the emergency management teams at the utilities based on suggestions for improvements and to evaluate possible measures, including HES (Health, Environmental, Safety). These activities will not be similar for the different utilities and will therefore be started and financed by the utilities itself.

On behalf of the participating organizations and results from the Workshop, we would like to ask the NKS board to support the continuation of the PONPP project in 2011/2012 in the area of interviews and analysis of the authorities for evaluation of their work processes and decision-making processes both in the emergency management preparedness room (KC) and at the authotities headquarter during an emergency situation.

List of participating organisations (including the co-ordinating one)

Institutt for energiteknikk (IFE) and NRPA (Norge); STUK (Finland), SSM (Sverige)

Requested funding from the NKS in 2010. If continuation of activity is assumed beyond 2010, please estimate requested funding in later years.

In 2011/12: 300 (in 1000 DKK) Expected requested funding in later years (if applicable):

1: If this activity is a continuation of a previously funded NKS-B activity, please use the same acronym as before (a list of acronyms of ongoing activities can be found on the NKS-B web site)

Please note that the above information may be made public on the NKS web site **if** the proposal is accepted by the NKS Board

2. Relevance of proposed activity to NKS criteria

Summarise how the proposed activity will maintain and build up competence and informal Nordic networks

Emergency preparedness shall ensure that the consequences of a nuclear accident/incident are kept as low as possible by means of initiating purpose-built measures at the right time. To ensure this, the responsibilities, plans and emergency organization must be unambiguously defined both internally in the departments involved in the incident as well as among the departments. It is vital that the same message is communicated to all parties involved in the accident/incident management.

The efficiency and effectiveness of an emergency preparedness regime is dependant on the information flow between -, decision making at - and transparency of interaction between all actors in an emergency preparedness organization, i.e. authorities and operating organizations of Nuclear power plants. It is challenging and may compromise effective contingency measure if the whole emergency chain is not functioning well.

The operating organizations of a Nuclear power plant is the closest to the nuclear accident area and has the highest potential to reduce the direct consequences of the accident. The work and decision-making processes with respect to interaction with authority representatives locally (emergency preparedness room (KC)) and externally(headquarter) is of great importance and will often have direct influence on the development of an accident. It is of vital importance that the emergency management team function optimally so that the right decisions are taken at the right time based on correct information and that measures are carried out as agreed. It is also important that the actions and mitigation measures taken in course of the accident are followed closely to ensure that the desired effects are reached.

The cooperating partners in the proposed project is interesting to compare how preparedness is organized at Nordic authorities, exchange information, share competence and identify possibilities for improvements. The already existing information exchange and competence sharing between the cooperating partners will be utilized and enhanced. Focus will be on enhancing work practices and decision-making processes with respect to collaboration and communication with the authority representative locally(in KC) and externally(headquarter) during the emergency management process.

Summarise the proposed activity's technical and scientific merits

The project is developed by applying a methodology developed by IFE. This method is used today for evaluating and analyzing work and decision-making processes in control- and collaboration rooms and has several references within the oil- and gas industries. Results from use of this methodology are now forming the basis for changing to a new operation standard on large parts of the Norwegian section of the Continental Shelf. This methology and analysis experieces was utilized and adapted for use in the nuclear emergency preparedness domain during the PONPP project in 2010/2011.

Summarise what the proposed activity will deliver in the form of distinct and measureable goals
Expected result of the project is a final report focusing on common understanding of the work among the authorities during emergency situations at nuclear power plants and identification of areas for possible improvement. Focus will be on enhancing work practices and decision-making processes with respect to collaboration and communication with the authority representative locally(in KC) and externally(headquarter) during the emergency management process. For the authorities the results will focus on possibilities for optimal use of their core competence and role of their work tasks which have a positive impact on their work situation. The HSE(Health Environment Safety) is an important aspect in each step within the metodology which should result in an enhanced HSE for the working situation at the authorities during an emergency preparedness situation. The analysis will also indicate if some work/actions should be supported by means of enhanced technical solutions, e.g. decision support systems, collaboration rooms etc.
Summarize who are the potential end users and how it has been ensured that the proposed activity is relevant for them
The authorities in the Nordic countries have shown interest in evaluating the work processes and the decision-making processes during emergency management situations at the nuclear power plants. The aim is to obtain what can be defined as a common Nordic understanding among the authorities and also to look for possible improvements.
Summarise the participation of 'young scientists' in the proposed work (Degree, masters, PhD, post doctoral level)
The HSE(Health Environment Safety) part of the methodology will be further developed during the analysis. A master thesis will be carried out as part of the project focused on the HSE aspects for the work and decision-making processes and further role of their work tasks in the organization.
Interfaces to other relevant projects (past or present NKS activities, national research programs, EU programs, etc.)
OECD Halden Reactor Project, by organizing the work in groups in critical situations in an optimal way. Norwegian Assistance Programme (financed by Ministry of Foreign Affairs in Norway) focused on emergency preparedness at the Kola NPP. This project is of relevance to both NKS-R and -B, and may also be of interest to other countries, especially within Human Factors in NKS-R.

3. Co-ordination of activity

Institution or company	
Institutt for energiteknikk (IFE)	
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Institution or company	Contact person	E-mail
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Institution or company	Contact person	E-mail
SSM (Sverige)		
Institution or company	Contact person	E-mail
NRPA (Norge)		
Institution or company	Contact person	E-mail

Institution or company	Contact person	E-mail
Institution or company	Contact person	E-mail

5. Assumed distribution of NKS funding amongst participants (in 1000 DKK)[1]

Activity will run from June 2011 – June 2012	2011/2012	
IFE	210	
STUK (Finland)	30	
SSM (Sverige)	30	
NRPA (Norge)	30	
Total	300 k DKK	0 k DKK

6. Assumed distribution of own contributions amongst participants (in 1000 DKK)[1]

Activity will run from June 2011 – June 2012	2011/2012	
IFE	210	
STUK (Finland)	30	
SSM (Sverige)	30	
NRPA (Norge)	30	
Total	300 k DKK	0 k DKK

7. Milestones, deliverables

	Date
Interviews/Data collection/Analysis	01.08.11 - 01.12.11
Status report after completion of interviews and analysis	31.12.11
Workshop	February 2012
Distribution of "Workshop" material and results	15.04.12
Final report	01.06.12

8. Submission of proposal

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[1] Use decimal point (.) as a separator for decimals in all tables

This form must be sent by e-mail no later than the 15th of October 2010 from the official e-mail address of the activity co-ordinator (as given on this form) to justin.gwynn@nrpa.no .

Please use the *acronym* as a file name and add the number "1"

Is supplementary description (maximum 4 pages) included?

No (please click on drop-down form field at left to select "Yes" if needed)
Name of file: (please use the acronym and add the number "2")

The date of sending will be regarded as the date of submission.

Please note that a confirmation of the reception of the proposal will be sent by the Programme Manager

IFE/HR/F – 2011/1497

Preparedness Organisations at Nordic nuclear Power Plants

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Summary

This report presents an overview of Emergency Preparedness Organisations (EPO) in Sweden, Finland and Norway and presentations of insights from a study of the staff positions' work instructions in the command centre in an emergency situation.

The results indicate potential for improvement in several areas. A number of the improvements are related to introduction of new technology and they should be seen in connection with ensuring safe and reliable communication lines and power supply.

Analysis of the data identified four main categories where further studies could contribute to improvement.

- Communication and exchange of information
- Tools and technology
- Staffing and organisation
- Procedures

The usefulness of the Man Technology and Organisation method in analysing the emergency management decision-making process within the authorities has been considered as an interesting issue for continuation of the project. The interface between utility and authorities has been pointed out as an important area for continuation.

	Name	Date	Signature
Prepared by	Asgeir Drøivoldsmo, Espen Nystad, Jan Porsmyr	2011-05-10	Espen Nystad Asgeir Drøivoldsmo Jan Porsmyr
Reviewed by	Øivind Berg	2011-05-11	Øivind Berg
Approved by	Davide Roverso	2011-05-12	

Contents

1 Introduction

The main purpose of this project has been to compare how emergency preparedness is organized at the Nordic nuclear power plants. Vattenfall, Fortum and IFE have participated in the project. The project has focused on evaluating the work processes and the decision-making process in the existing emergency management's preparedness room (Command Central) at the sites. The aim has been to evaluate if there is a common Nordic understanding of these issues among the emergency management teams and to identify possible improvements in the processes. The collaboration and communication with the authorities in the emergency management process has also been partly addressed during this survey.

The project has been carried out in cooperation with relevant staff in the emergency management teams at Vattenfall, Fortum and IFE using a method developed by IFE. This method is used today for evaluating work processes and decision-making processes in control- and collaboration rooms with several references within the oil- and gas industries. The methodology and analysis experiences have been utilized and adapted for use in the nuclear emergency preparedness domain.

The project team would like to thank the staff at Loviisa, Ringhals and Forsmark emergency preparedness organisations. Special thanks to Klaus Sjøblom, Jan-Olof Bengtsson and Staffan Henningor for their invaluable contribution of knowledge and experience and their brilliant organisation of the data collection.

1.1 Integrated operations (IO) as input to nuclear emergency organisations development

In autumn 2004, the Norwegian Oil Industry Association (OLF) decided to implement an industry-wide IO program, being a new self-service concept for remote, real-time management of oil & gas fields on the Norwegian Continental Shelf (NCS) [9, 10].

IO is a new approach to solving the challenges of having personnel, suppliers and systems located offshore, onshore and in different countries. IO is about removing the physical boundaries between people, making cooperation across different locations in real time possible. IO involves using real time data and new technology to remove the division between disciplines, professional groups and companies. It's about how information technology that makes remote operation possible forms the basis for new and more effective ways of working [8].

In the autumn 2005, a work group established by OLF and representatives from the major oil companies, licensing authorities and the Norwegian energy research institutes, delivered a report that has become the guidance for implementation of new work practices [11].

In its simplest form, insights to a decision making structure and consequently a potential organisational structure outline may be revealed by the following questions [11]:

- What Decisions are to be made?

- What Information is needed to be able to make those decisions?

- Which People are best qualified to make that decision?

- Where should those people be located?

- What Work Processes and Technology are needed to present the decision makers with the right information at the right time irrespective of location and organisational belonging?

In its operationalised form, IO is about utilisation of the new technology for working more efficiently and making better decisions. During the last years the focus areas have changed from technology to more emphasis on the human and the organisation. Work processes based on existing and new models for integrated work and cooperation is believed to be the main vehicle for changing the way of working according to the new IO philosophy.

The nuclear industry has traditionally been more conservative than the petroleum in implementation of new technology and organisational models. In some areas like instrumentation and safety systems, the nuclear standards and requirements will make it difficult to utilize IO technology in the near future. However, the good results achieved from implementation of IO concepts in the organisation of petroleum activities should be investigated and adapted for potential use in the nuclear domain.

One area where cooperation and decision-making processes are of high importance is in the emergency preparedness organisations.

The Swedish national audit office “Riksrevisionens” has written a report focusing the consequences of accidents and the nuclear industry ability to handle the situation [4].

“The government's objectives and requirements, including those for participation of the authorities in the emergency efforts and exercises, is unclear and not followed up. The emergency preparedness exercises that responsible authorities should implement have deficiencies in efficiency and synergy. The majority of the exercises have focused on the acute phase during a nuclear accident, while the long-term phase has been exercised very rarely. The authorities' transfer of information between each other and to the public is not working well enough. The audit also shows that the rescue services agency's supervision of the county board's relief work is weak and that the agency's evaluation of preparedness exercises need to be improved. The three affected county boards have no or only draft reorganization plans, despite the fact that plans are required by rule.”

The IO approach could be a strong and relevant input for identification of improvements in the areas of information exchange, reliable communications, information to the public and work processes, addressed in the conclusions of the Swedish national audit office.

2 Method

A two- to three-days survey of the situation in the preparedness room has be carried out at each site (Forsmark NPP, Ringhals NPP and Loviisa NPP) by means of interviews and analysis with personnel representing each category of the personnel in the emergency command central. For each category of personnel a total of up to 14 persons pr. site, a two hours interview and analysis has been carried out with focus on their work instructions (initial and recurring activities). All their activities within the work instructions have been reviewed and mapped with focus on understanding of instruction clarity, what they do, where they do it, how they do it, who do they communicate with during work process and what type of media they use for communication.

The interview material from the various emergency management teams which has been collected and analysed by the IFE team with the aim to obtain a common Nordic understanding of these issues among the nuclear power plants. What is common? What is different? This material also reveals possible improvements both in work processes, organization and enhanced technical solutions. The results have been presented and discussed with the emergency management teams from Forsmark NPP, Ringhals NPP, Oskarshamn NPP and Loviisa NPP in a workshop where also the authorities in the Nordic countries and members of the NKS board were represented.

The analysis of the interviews has focused on improvements of the command centre work situation, including way of working, staffing, understanding/competence, and new technology.

The interviews with the emergency management's command centre personnel at the sites were successfully carried out according to the following schedule:

a) Interviews at the Forsmark NPP carried out in the period 31st May - 3rd June, 2010

b) Interviews at the Ringhals NPP carried out in the period 24th August - 27th August, 2010

c) Interviews at the Loviisa NPP carried out in the period 18th October - 21st October, 2010

A comparison of the personnel categories is shown in Table 1.

All data mapped and analysed in the interviews are provided in the data appendix to this report. These matrixes were used as a basis for further analysis in the "Data Analysis" phase. A total of about 900 tasks were mapped during the interviews and the interview subjects provided a total of 270 proposals for improvements.

3 Nuclear preparedness organisations

This chapter gives an overview of the connections between the 2nd line utility internal organisation and the external cooperation partners. A comprehensive description of the national nuclear preparedness organisations in Sweden, Finland and Norway is presented in the NKS report "Nuclear Emergency Preparedness in the Nordic and Baltic Sea Countries" [1].

3.1 Swedish Nuclear Emergency Preparedness Organisation

As shown in figure Figure 1 the EPO work is a comprehensive collaboration between the utilities and the local and central authorities.

In a crisis situation the division between utility and the supporting organisations will typically be along the fence surrounding the nuclear site. Outside the utility area the County administrative board (Länsstyrelsen) is responsible for both emergency preparedness and radiation protection measures. Within the utility area the licenced operator is responsible for maintaining necessary measures for safety and emergency preparedness.

Cooperating institutions is shown in Figure 1.

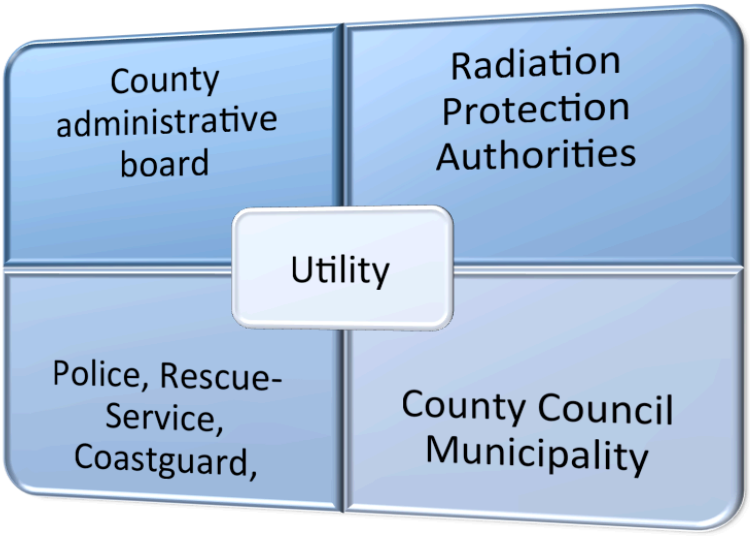


Figure 1. Utility cooperation partners

The internal utility organisations can be compared with the 1st, 2nd and 3rd line EPO we know from the international industry. First line consists of the personnel located at the reactor unit that has the problem, the second line is a dedicated command central at the utility, and the third line at company headquarters.

3.1.1 Emergency alarm levels

Should an event occur in a Swedish nuclear power plant, two different alert levels are used. If there is no immediate threat of radioactive releases, the plant issues are raised to a preparedness alert. If a radioactive release has already occured or a release cannot be ruled out within twelve hours, an accident alarm is issued. Responsible authorities are alerted both in case of a raised preparedness alert and in case of an accident alarm [4].

Both Ringhals and Forsmark have introduced a third emergency alarming level for utility preparedness. At Forsmark this level is new from 2009. Emergency alarming is divided into three levels:

1. ***Utility preparedness*** (anläggningberedskap – FAB and RIHAB) where an event has led to or can lead to a demand for personnel to handle a internal situation at the plant.
2. ***Raised preparedness (Alert)*** (høyd beredskap) where an incident or disturbance has led to a situation threatening the surrounding environment.
3. ***Accident alarm (General Emergency)***, where an incident or disturbance has led to disposal of radioactivity, or where disposal of radioactivity can take place, and where protective measures have to be taken outside the utility area. The nuclear power station alerts regional and central authorities through regional and national alarm centres. The preparedness organizations of the authorities come into action.

In their report "Strålsäkerhetsläget vid de svenska kärnkraftverken 2009", SSM states that the emergency preparedness at the Swedish NPPs is developing, and that there are improvements. However, the complexity and scope of scenarios used in radiation source calculations (källtermsbedømning) and the competence for work with difficult breakdowns should be looked into.

3.1.2 First and second line emergency preparedness

In an emergency situation, the Central Control Room (CCR) unit staff and a technical support group constitute the 1st line staff. The technical support group consists of competence within the process, radiation protection, chemistry, reactor core analysis and emergency situations. This is the contact point for the second line organisation.

Second line is located in the command central of each utility. The command central organisation can be seen in Figure 3.

3.2 Nuclear Emergency Preparedness Organisation in Finland

The Finnish way of division between utility and the supporting organisations in a crisis situation is similar to the Swedish organisation presented in Figure 3. Outside the utility area the County administrative board is the responsible body for both emergency preparedness and radiation protection measures. Within the utility area the licenced operator is responsible for maintaining necessary measures for safety and emergency preparedness.

3.2.1 Emergency alarm levels

Emergency is divided into three levels:

- ***Emergency stand-by*** **-** NPP emergency organisation is alerted to ensure the plant safety
- ***Site emergency*** - NPP safety deteriorates or is in danger of deteriorating significantly
- ***General emergency*** **-** there is a hazard of a radioactive release that may require protective measures in the vicinity of the NPP.

The Finnish and the Swedish levels of emergency alarming correspond.

3.2.2 First and second line emergency preparedness

Similar to Swedish utilities, in an emergency, the unit CCR staff and a technical support group constitute the 1st line staff in Finnish plants. The technical support group consists of competence within the process, radiation protection, chemistry, core analysis and emergency situations. The technical group is the contact point for the second line organisation.

Second line is located in the command central of each utility. The command central organisation can be seen in Figure 3 above. The Loviisa 2nd line has also a connection to the technical support organisation in Espoo.

3.3 Nuclear Emergency Preparedness Organisation in Norway

Similar to Sweden and Finland, the division between utility and supporting organisations in Norway follow the principle of responsibility inside and outside the utility area.

3.3.1 Emergency alarm levels

The nuclear emergency response organisation possesses two levels of preparedness - *"information preparedness"* and *"heightened nuclear emergency preparedness"*.

3.3.2 The organization at IFE

Norway has no nuclear power plants. The research reactor in Halden and the isotope-producing reactor in Kjeller represent the most important domestic nuclear threat. Radiation emergency can also be connected to the wide use of radiation sources in industrial, especially petroleum and medical applications, and potential terror actions.

The structure of the 1st, 2nd and 3rd level is inversed compared with the normal labelling, but the responsibilities within each level can be compared with the other Nordic organisations.

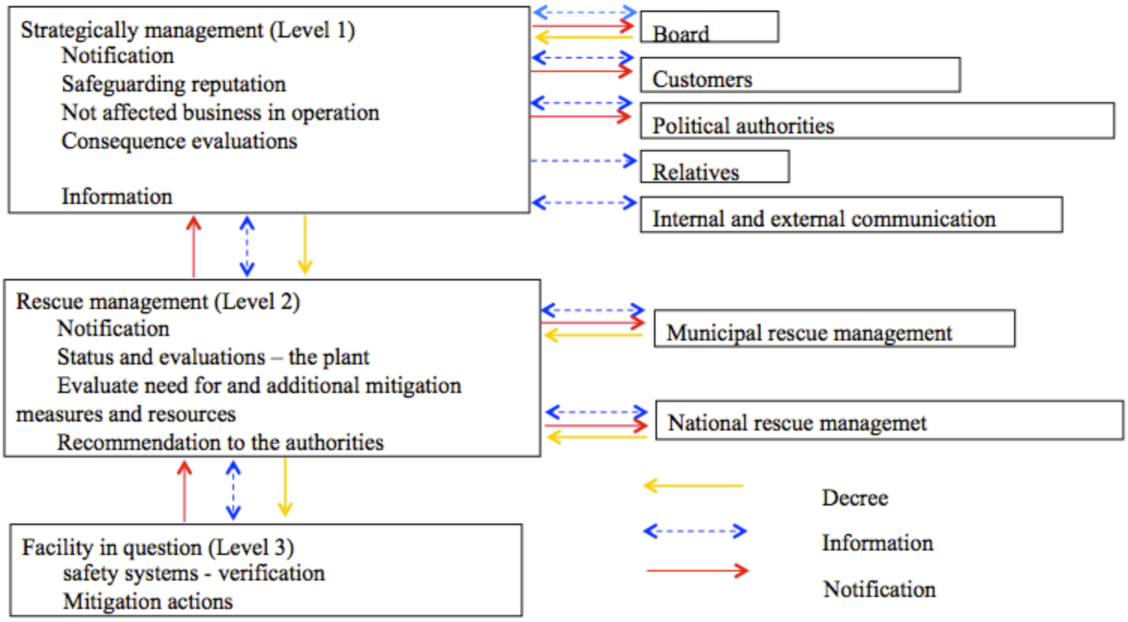


Figure 2. Emergency preparedness organisation and information flow at IFE

3.3.3 Statens strålevern

The Norwegian Radiation Protection Authority is the Secretariat for the Crisis Committee. In the daily preparedness work, the Secretariat shall carry out courses, exercises and build up good lines of communication in the preparedness organisation. In case of a nuclear incident, the NRPA shall obtain and work with information and measurement data, prepare prognoses and maintain the overview of the situation, together with placing a motion for action [6].

4 2nd line nuclear emergency preparedness organisations

The purpose of this chapter is to provide an overview of the function and describe features of the 2nd line of the nuclear EPOs (Emergency Preparedness Organisations). The description will start with the Swedish organisation and this will be compared with the Finnish organisation. It is also provided relevant links to the Norwegian organisations.

The organisations in Sweden, Finland and Norway can be compared with nuclear EPO organisations worldwide as well as EPO organisations in other industries.

A common structure is the division between 1st, 2nd and 3rd line in EPOs worldwide. As shown in Figure 3, when an incident is detected according to procedures, a technical team supports the control room staff and field operators. In addition, the 2nd and 3rd line emergency organisations are established.

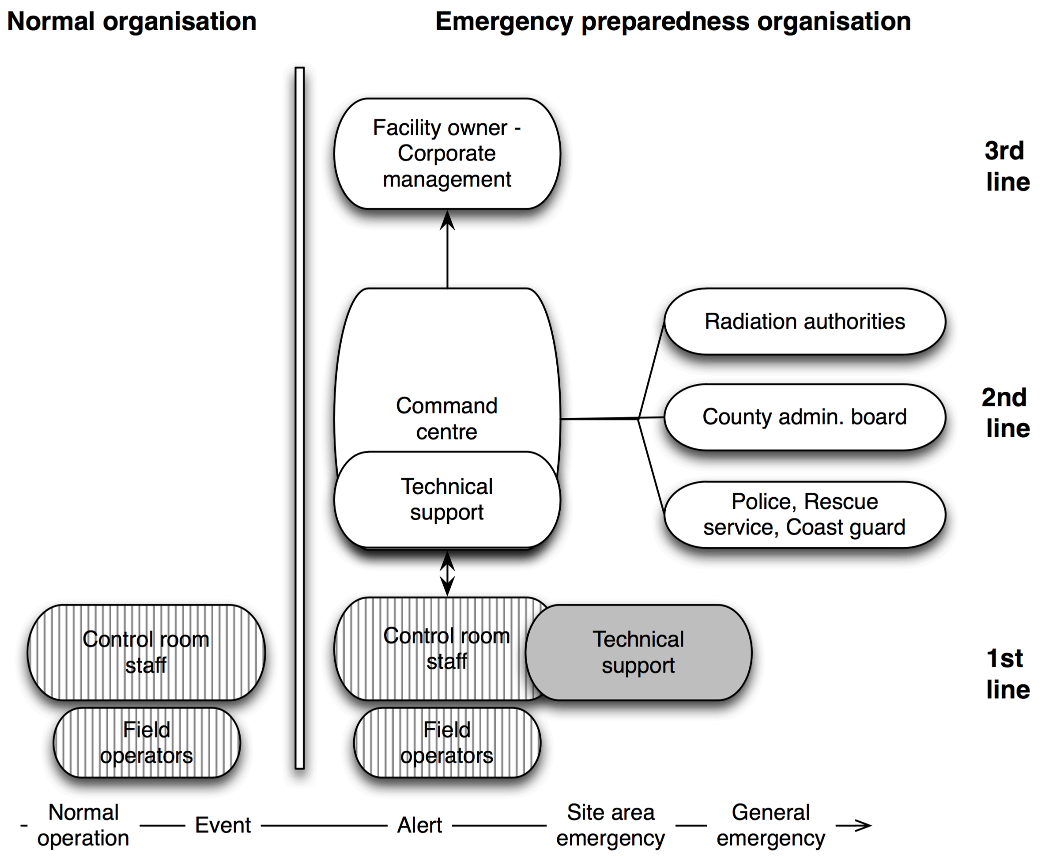


Figure 3. Establishing the emergency preparedness organisation.

4.1 Command centre organisations

The staffing of the command centre EPO is made to cover the 3 most important areas in a crisis handling.

- Reactor safety
- Radiation safety
- Information

By comparing the 2nd line organisations of Ringhals, Forsmark and Loviisa one can see that the similar positions appears in all three organisations. One significant difference may be that the Loviisa repair manager, which has direct control of a number of repair, teams. In the Swedish utilities these teams are primarily managed from the affected units control room managements and the CC operation manager ("Anläggningsledare") has the task of supporting the affected unit's management with personnel for the repair teams.

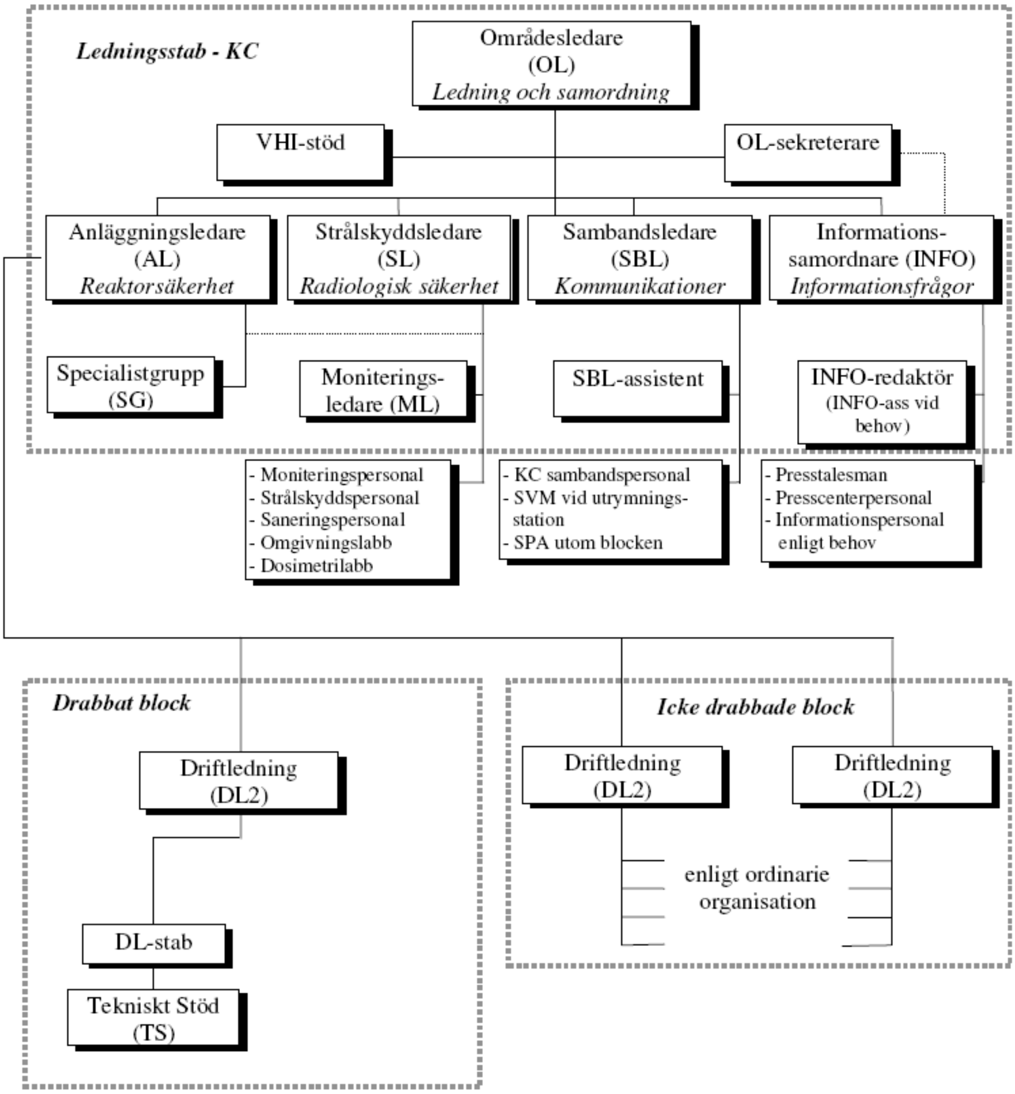


Figure 4. EPO organisation at Forsmark NPP

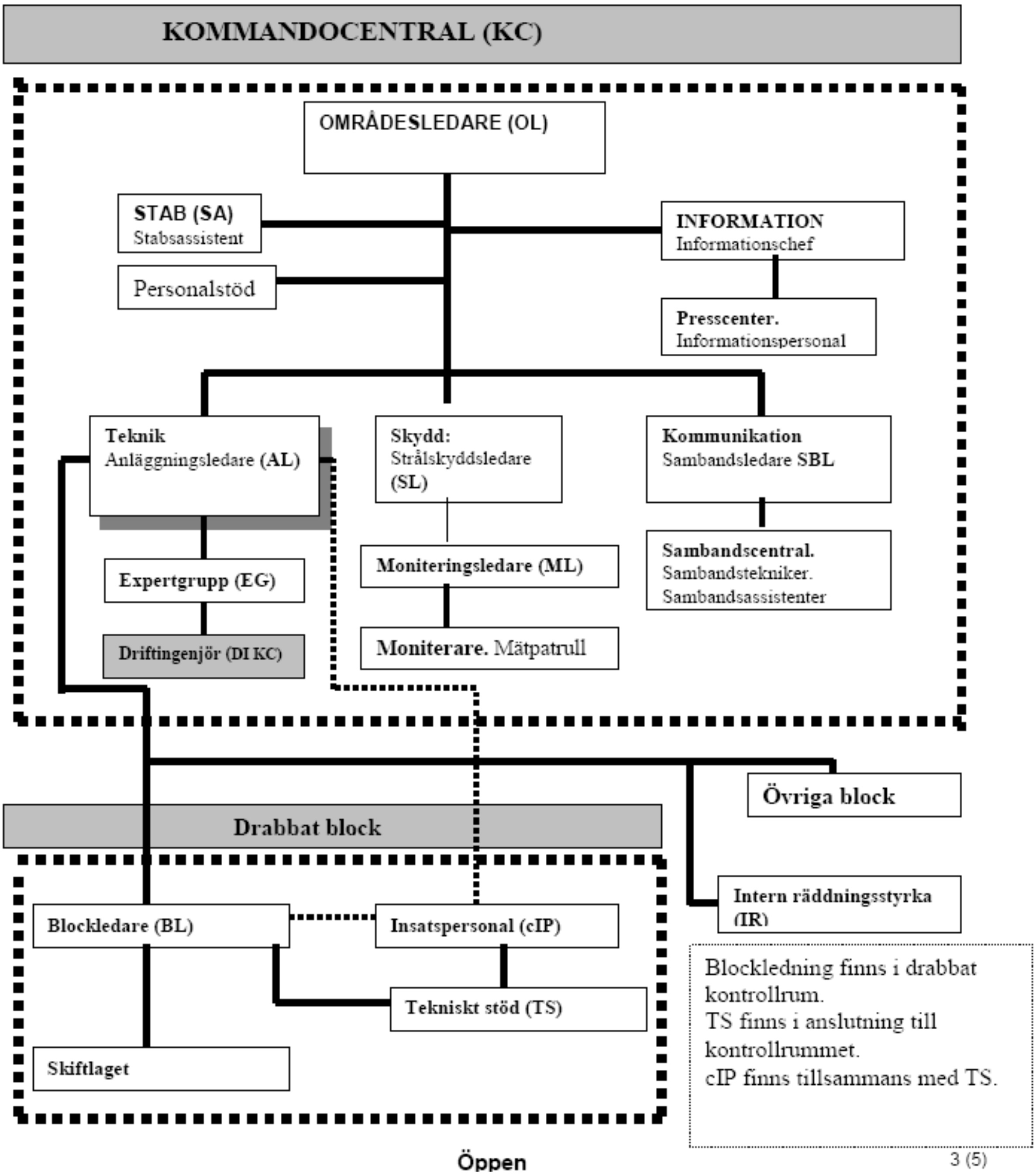


Figure 5. EPO organisation at Ringhals NPP

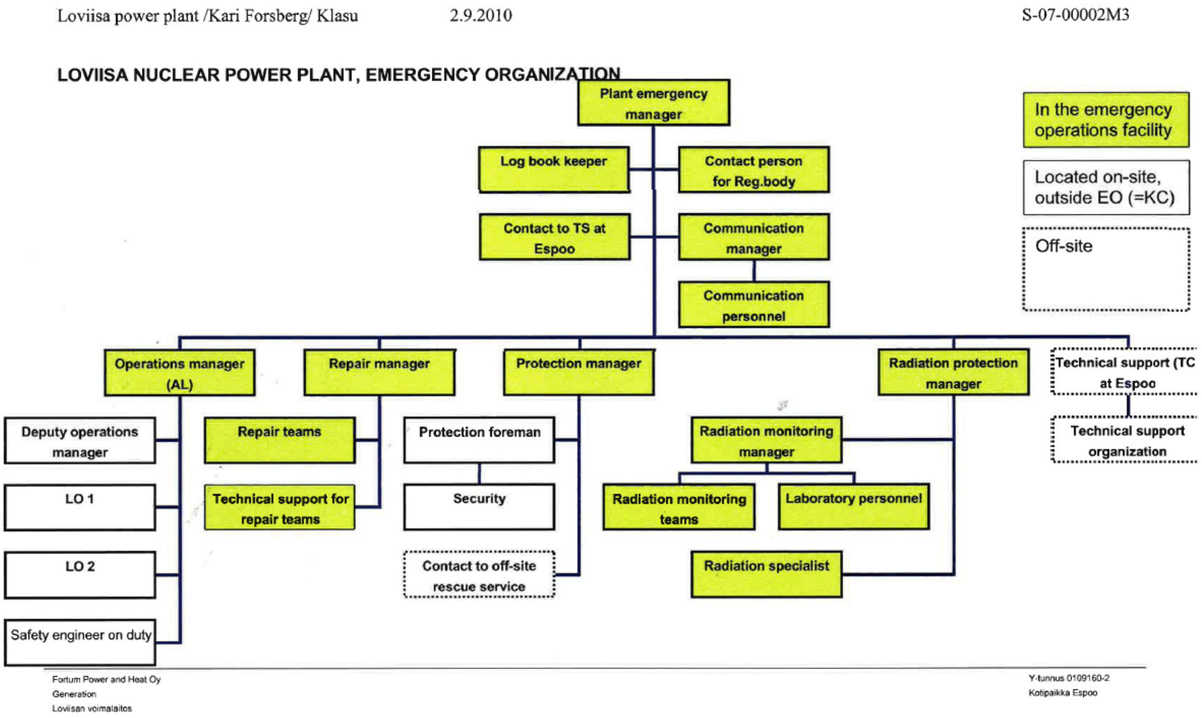


Figure 6. EPO at Loviisa NPP

A comparison of the emergency Command Central (CC) positions is given in table 1.

Role category	**Ringhals**	**Forsmark**	**Loviisa**
OL	Områdesledare	Områdesledare	Plant emergency manager
	Personaladm. stöd		Contact person STUK
			Contact person technical support
AL	Anleggningsled	Anleggningsledare	Operation manager
	Anleggningsled	Spesialistgrupp - Reaktorsäkerhet	Repair manager
	DI-KC (Driftsingeniør)	Spesialistgrupp Radiologi	Technical support
	Expertgrupp		
INFO	INFO	INFO-redaktør	Communication person
	INFO-ass	Informationssamordnare	Communications manager
		Informatør/Presscenter	
		Presstalesmann	
LOGG	Stabsassistent	OL-sekretærare	Log book keeper
RADPROT	Monitoreringsledare	Monitoreringsledare	Laboratory personell
	Strålskyddsledare	Strålskyddsledare	Radiation monitoring manager
			Radiation protection

Role category	**Ringhals**	**Forsmark**	**Loviisa**
			manager
			Radiation specialist
SBL	Sambandslede	KC-expedition	
	SBL-ASSISTENT	Sambandsledare	
	SBL-tekn.		
PROT			Protection manager

Table 1. Comparison of CC positions between Ringhals, Forsmark and Loviisa

A short description of each position responsibility is presented below.

Plant emergency manager: The task of the plant emergency manager (OL) in an accident is to coordinate and direct rescue and recovery work at the plant, and maintain formal contacts with the authorities.

Operation manager: The task of the operation manager (AL) in an accident is to coordinate the technical work at the power plant unit to achieve a safe operating mode of the affected unit.

Information manager: The task of the information manager (INFO) in an accident is to compile and coordinate power plant information, develop information materials for the county board, monitor news reports and be responsible for information within the plant.

The information staff in the CC at Ringhals and Forsmark has quite similar tasks and function in the organisation. Forsmark has a mobile information centre, Loviisa has a different divison between CC and the 3rd line level in the organisation. Handling of media at Loviisa is primarily at the corporate level.

Staff assistant: The role of the Staff Assistant (SA, log book keeper) in an accident is to assist the Plant emergency manager, collect information needed for management activities and coordinate team work.

Radiation protection manager: The task of the radiation protection manager (SL) in an accident is to coordinate the radiological work at the plant, prepare the basis for protective measures within the power plant and prepare material for the County Board on protective measures outside the plant.

Radiation monitoring manager: The radiation monitoring manager (ML) leads the CC protection group, and helps the radiation protection manager to compile data on radiation levels reported from the block and external monitoring.

Communication manger: The task of the communication manager in an event that leads to the manning of CC, is to be responsible for the technical and functional maintenance of communications.

Protection manager: The protection manager has both an internal safety function for the CC and plant evacuation, in addition to responsibility for the telecommunication. This function is specific for the Loviisa organisation.

Expert group: The expert group (EG) is a technical resource that supports the affected unit and work on the plant level.

Staff administrative assistance: The task of the staff administrative assistance (PAS) is, in case of accidents and deaths, to act as a support for the organization in terms of contacts with relatives and to provide emergency support to the staff.

The process engineer: The process engineer (DI) is part of the expert group in CC, and their task is to assist the operations manager (AL) in case of an accident, by collecting data from the process by way of the process engineer in the technical assistance group (TS). The tasks also include making summaries of the process and present to the operations manager (AL).

On duty engineer: The on duty engineer position (VHI) plays a central role in mobilising the emergency organisation. After the initial phase, he returns into being a member of the technical support organisation.

4.2 Governing documentation

The governing documentation for the EPO organisation looked at in this study cover:

- Responsibilities, organisation and operation
- Operational support documentation
- Education and Training
- Equipment

The main focus has been on the responsibilities and operation in a situation with emergency handling.

4.2.1 Command centre procedures structure

In an emergency situation the command centre staff work is guided by a set of work instructions.

There is a slightly different way of describing the work tasks for each of the CC-staff. One way is to have a 2-3 line summary for each position in the start of each procedure, and the other is to collect the information in a common document and describe the task together with the principles for the work.

For all NPPs the procedures are divided by “initial tasks” and recurring tasks.

The way the instructions are built with regard to handling different emergency levels differ.

4.2.2 Personell selection and callout

All organisations studied have a similar way of callout routines. Personnel for the emergency organisations are recruited from relevant positions at the utilities. The selection of personnel is done on basis of competencies needed to build an organisation with the capabilities required for handling an emergency situation.

The emergency organisation is mobilised on basis of decisions by the operations management. The decision is based on a number of pre-defined safety related criteria. In these extraordinary situations the staffing of the emergency organisation is prioritised, allocating staff from units not affected by the accident.

4.3 Command centre way of working.

The initial work carried out of the CC staff is governed by a set of procedures for the respective responsible positions in the emergency organisation.

The plant emergency manager is leading the CC work. The form of cooperation is formalised due to the needs for documentation of information flow and decisions. The various responsible staff are the Operation manager, Information manager, Radiation protection manager and the Communication manager.

The work in the CC relies very much on direct contact between staff and discussion and work within and between disciplines. The main shared information source is the event-log, which is projected on a wall. For the Swedish utilities the secretary to the plant emergency manager or the staff assistant updates the log. Loviisa use a common document updated by the key staff positions in the CC.

Each staff position is the owner of a whiteboard where important information is written and updated by the responsible person.

The switchboard personnel are used for the communications by telefax.

4.3.1 Staff briefing

Status updates (staff briefings) for the CC staff are done on regular basis or depending on the actual situation.

The briefings are a short status meetings used as an instrument for exchange of information within the staff and allocation of new work tasks. A number of fixed criteria decide when and how the briefing shall be carried out. The participants are primarily the management group and local representatives for the authorities.

4.3.2 Technology for communication and information sharing

Telephone communication through safe lines is the backbone for the command centres.

Loviisa has an internal mobile phone communication net. It is also possible to call out from the CC mobile telephones to external locations.

At Loviisa, E-mail can be used in addition to telephone for status updates between CC and the reactor units or external 2nd line cooperation partners. Telefax is used for backup.

Loviisa uses a common overview presented in 3 different rooms in the CC. This is the common screen for visualisation of the overview information.

At Loviisa, screens in the different rooms can be used for presentations from local computers within the same room. There is no way to present information from an EG computer in the other rooms.

At Forsmark and Ringhals, collaboration and shared situational understanding is mostly developed through the staff briefings and whiteboards. Some information is displayed using projectors. E.g., Forsmark is currently testing an overview picture for use in the CC. This picture gives an overview of key reactor parameters like reactivity, core cooling, barriers, heat removal and power supply.

5 Summary of input from workshop with utilities and authorities

Based on an interpretation of common needs and important areas, the workshop (see chapter 2) answered a number of questions relevant for the reporting and further work.

In the group work discussions, the following topics were discussed:

1. Pros and cons of alternative division between KC and 3rd line?
2. Evaluation of training and how to provide feedback to training participants
3. Good practice for the information function?
4. What are the important areas for further work?

A summary of the group discussions follows, divided in sequence of the topics discussed:

1. Pros and cons of alternative division between KC and 3rd line?

Media must as far as possible be handled at corporate level. Technical information must be handled internally at the plant.

Technical support is to some extent available externally. One example is the O3 and F3 reactors, which are similar. OKG has in addition to local competence, technical staff in Germany and a small group in Malmö, which could be used to handle technical questions.

Radiation protection: SSM has high competence and can provide support.

2. Evaluation of training and how to provide feedback to training participants

Good practice for evaluation after exercise:

- Immediate evaluation after the exercise
- Reference group with one observer per role
- Evaluation of exercise management
- Evaluation report to be followed up on next exercise
- Longer time used on evaluation
- Feedback, use the experiences and ensure actions based on experiences

The plants should give priority to the feedback after training issues.

3. Good practice for the information position

- One spokesperson at the press center near the plant
- Common information system for the county board and the plant

- Information boards at muster points
- Information editor
- Collect all text on the web - leads to less workload on the media organisation

4. Important areas for further work

Topic 1 - alternative division between CC and 3rd line - could be part of a follow-up project.

Study the interface between CC and internal (radiation protection, muster points, affected plant, field, HQ) cooperation partners will be important. The most important external connection will be to the authorities both locally and centrally.

Look at communication between CC and media (press conference) and the communication between other external / internal and media

6 First interpretation of data material

The table below gives an overview of relevant observations from interviews and workshop. The first table is a common table for Ringhals, Forsmark and Loviisa.

All utilities	
MTO – FOCUS	INTERPRETATION
Man	
The EPO organisations are well trained and with a high competence within each persons respective specialised areas	High degree of correspondence between tasks in the daily work and tasks the emergency organisation
Training is planned and performed by a professional staff within each utility	Typically 2-3 positions are doing development and planning of training scenarios as part of their full time position in the EPO
Scenario based rehearsals with duration less than one day	The realistic scenario for a large-scale event has a time frame from up to 4 weeks. Handover training?
How to handle technical language. Only a few understand this fully. What does this mean for others in the command central who shall translate and provide information externally?	Communication training for development communication skills across disciplines may be relevant
Should use more time on evaluation of the exercise (now use much more time on planning than evaluation).	The evaluation part of the exercises may be improved. Professional staff for measurement and debrief?

Get more feedback about the measurements made, about the reporting. Get feedback on how did we perform compared to the plans for the exercise.	
Familiarisation with the CC procedures and equipment could be done by more regular visits.	If single staff or groups of staff could have easy ways of agreements for accessing the CC, this may improve their competence.
Technology	
All utilisation of technology is restricted by security and probability for breakdowns in the power supplies for a larger area around each plant	Conservatism with regard to implementation of new systems not validated as safe in situations with loss of power supply in a larger area.
Telephone and telefax is the main tool for communication	Sharing and visualisation of information is the main topic. Improvements possible even by using the "safe" analogous lines. Email 2 fax could be an effective way of handling digital information without relying on internet services.
Procedures are paper-based	Possibilities for improvements use and maintenance by electronic presentation.
Need for a more updated continuous picture of the situation and a better overview of important events and decisions that are made in the operations room. Visualisation of data, process parameters, process, weather, pre-programmed trends. Shared visualization surface for collaboration with e.g. BL, SSM, DI-KC/EG to support information quality and create a common correct situation picture. Same common work space with Technical support. Using computer-based information may help to eliminate communication errors. Simple circulation pictures of the process Information coming through different resources (phone, email, some data not simulated), makes it difficult to get an	The need for common information presentation if data, trends and status information is an issue common for all utilities. Identification of key process indicators and development of good visual representations for common information.

overview (especially in training). Trends useful. The log-book is a good way to get and provide a common understanding of the situation. One should not disturb the emergency plant manager (and other managers) too much.	
Organisation and Governance	
The organisation is – and needs to be – strictly hierarchical.	Network-based principles may be applied by IO-principles for sharing problem solving outside the CC, given that data are provided for external resources.
Each member in the organisation has a detailed procedure with stepwise description of all responsibilities and tasks	Possible weakness in the initial phase of an event.
Each role in the command central has a high degree of specialisation.	Flexibility is restricted
The command centre organisation has a technical support group that works with calculations and support the core CC team	Communication and information issues that could be looked into for all three plants.
The organisations are built and extended over time, with experience for what positions are needed, and involves a quite high number of people	This development has lead to increased number of people in the CC and the efficiency potential by utilisation of better tools and less people should be investigated. Distribution of sub-tasks out of the CC could be done by providing data for resource groups outside the CC.

Focus national and international media – all utilities	
MTO – FOCUS	INTERPRETATION
Man	
Lack of relevant understanding of figures and concepts in media	Available material for easy understanding and explanation can be improved. Development of the public understanding of radiation is a relevant to avoid unnecessary spread of fear, uncertainty and doubt.

Lack of trustworthy sources of information. Current IAEA services are bound to presenting 100% correct information and will be to late and to slow to provide the right time information to media.	Necessary to compare information from a number of sources to get an overview. One trustworthy non official channel could be established with sufficient expertise to do qualified interpretations.
Total lack of competence within national newspapers, television is a better medium due to more nuanced information when experts are interviewed. The interviews are not so much misinterpreted by the reporter.	A need for translation of standard nuclear industry notations and concepts.
Technology	
Internet is the main information source.	Efficient and agile tool. How can internet be used for "right level" information
Common logging systems within the national information systems exist.	Smart features to feed the public with updated and relevant information
Organisation and Governance	
Lack of standardisation for measurements and time.	Problems with old presentation material not updated with SI units. Lack of understanding of radiation as function of time. Figures presented in media are often peak measures.
Different approach to division between 2nd and 3rd line functions	What is the best solution?
A template for press releases	Development of a set of templates for press releases for different common situations. Preparing these in advance will both improve quality, save time and increase speed of press releases.
The INFO personnel will typically spend time writing up general information	Could be an advantage to prepare a set of information from operation manager and radiation protection manager, (repair manager later in the process). Possible that others have a need for the same information.

The table below gives an overview of relevant observations from interviews and observation of an emergency training situation at Ringhals.

Focus group Ringhals	
MTO – FOCUS	INTERPRETATION
Man	
The EPO organisation at Ringhals is well trained and with a high competence within each persons respective specialised areas	
Training evaluations are done directly after the rehearsals and has the form of a debrief	This area has (as confirmed by the PONPP workshop February 2011) a potential for improvement. New tools and procedures
The senior staff in the Ringhals organisation seems open for improvement and has contributed with a number of ideas for how to improve the EPO	
Use ZLK model from KSU. Prepare before exercise, then exercise, then evaluate. Preparation phase can be improved to give increased effect of training. Make it possible to split more, put more of the situation exercises to unprepared personnel.	
Technology	
Compared to the two other plants, Ringhals lies a little behind in KC technology. They are however planning for an upgrade	
Better control of status reports. These end up as more and more pieces of paper.	Change to electronic status reporting
Would like a visual picture of what is going on outside Command central	Ringhals BC already has ITV-cameras that can be used for this purpose.
Shared logging system with the county board and SSM	
Organisation and Governance	
High number of people in the control room with lack of overview and shared common situation understanding	The high number of people in the control room can be a function of “legacy positions”

Communication manager is currently the position with the lowest workload, while the Staff assistant has the highest workload.	Reallocation of tasks between staff.
Logistics coordination is an ara that require a lot of work. Is there a need for a dedicated position for this area.	Reallocation of tasks between staff could be done to prioritise the logistics responsibility.
All positions in KC have a responsibility to inform the INFO function about development.	Development of procedures and skills within this area could be relevant.
To handle all tasks, radiation protection staff should be doubled.	It should be possible to solve the tasks with the current manning in the CC given optimal division of tasks within the CC. Another option is also to look at technical solutions and external support.

The table below gives an overview of relevant observations from interviews and observation of an emergency training situation at Loviisa.

Focus group Loviisa	
MTO – FOCUS	INTERPRETATION
Man	
The senior staff in the Loviisa organisation gave the impression of skilled personnel with high competence.	
Training. Could be useful to have more frequent exercises training part-tasks of the scenarios with smaller groups.	Useful for training basic skills within the staff functions.
Technology	
Look into using video communication with external parts	Video meetings will contribute to better quality of the communication. It also allows for more use of shared collaboration surfaces and redundancy in the presentation understanding.
What additional data could be provided to the emergency room in Espoo to provide a common picture of the situation?	Limitations by analogous lines for data transfer, need smart solutions to get the most out of the line capacity

Are using the same procedures, independent of what incident occurs or in normal situation. Using the same toolboxes (PCs etc.) independent of situation.	This is a good practice for avoiding the training needs for multiple tools.
Organisation and Governance	
Division between 2nd and 3rd line work tasks related to the information handling are not the same as in the Swedish utilities. Loviisa has more handling of media and journalists from the Fortum central location.	This division seem to be in line with the general trend from other industries.
Plant communicates everything that happens within the fence. Authorities communicate what happens outside the fence.	A similar division was done very strictly between IFE and the Norwegian Radiation Protection Authority during the first days of the Fukushima accident. This division seem to have been a success due to the fact that it makes a clear division between process and radiation.
Using the same toolbox and procedures independent of normal or alarm situation.	Effective for maintaining the skills and competence in tools and procedures.
High workload in the communication group.	Wish to have at least 3 positions within this area.
Need to know what is happening outside the plant. Two-way communication with the outside.	Need for improved feedback from cooperation partners outside the plant to get a good picture of the grid and the logistics situation for spare parts and supplies.
The pressure in Espoo can be lower than in the emergency centre at Loviisa, so that some tasks can be easier to do in Espoo.	This is one of the main potentials for use of knowledge from the integrated operations area. Development of safe and efficient work sharing has been one of the main focus areas in the Norwegian oil and gas industry.
Improve handling of the first two hours - tools and equipment. Enable to start handling the situation before you are on site.	See preceding point
Has prepared a flowchart / checklist to be used instead of procedures	Taking this even one step further would be to digitalise checklists to track missed actions and give automatic notice.

Need more support from operation to know the situation in the process and the influence to the process.	Supporting

The table below gives an overview of relevant observations from interviews and observation of an emergency training situation at Forsmark.

Focus group Forsmark	
MTO – FOCUS	INTERPRETATION
Man	
The EPO organisation at Forsmark is well trained and with a high competence within each persons respective specialised areas	
The senior staff in the Forsmark command centre organisation seems to be more restrictive towards technological changes compared with the other utilities	Senior staff seems to have high competence in the existing tools and routines and find the supporting tools well integrated with the way they currently perform the work.
Technology	
Forsmark has recently started to use a shared overview picture for central process parametres.	
Organisation and Governance	
A significant part of the SG-S and AL time is spent writing situation reports (lägesrapportering).	
Provide frequent information to the press centre both in the situation when new information is available, and when the situation not has changed.	Ubiquitous tools for information gathering, mechanisms for the press-centre people to ensure that they have the most updated information.
Sharing of information within the CC-staff (log visualisation etc.).	The CC staff consist of different disciplines. Not all information is relevant for sharing by the large screen principle. Development of position relevant information screen may me feasible. (Pull, not push principles for information exchange, possibilities for each position to configure relevant information pictures.)

7 Data analysis

7.1 General assumption for all discussions about use of new technology

All discussions and proposals for use of new communication technology and automation of data flow assumes that a fallback system is maintained for a situation with a total blackout and lack of power to the communication systems outside the CC.

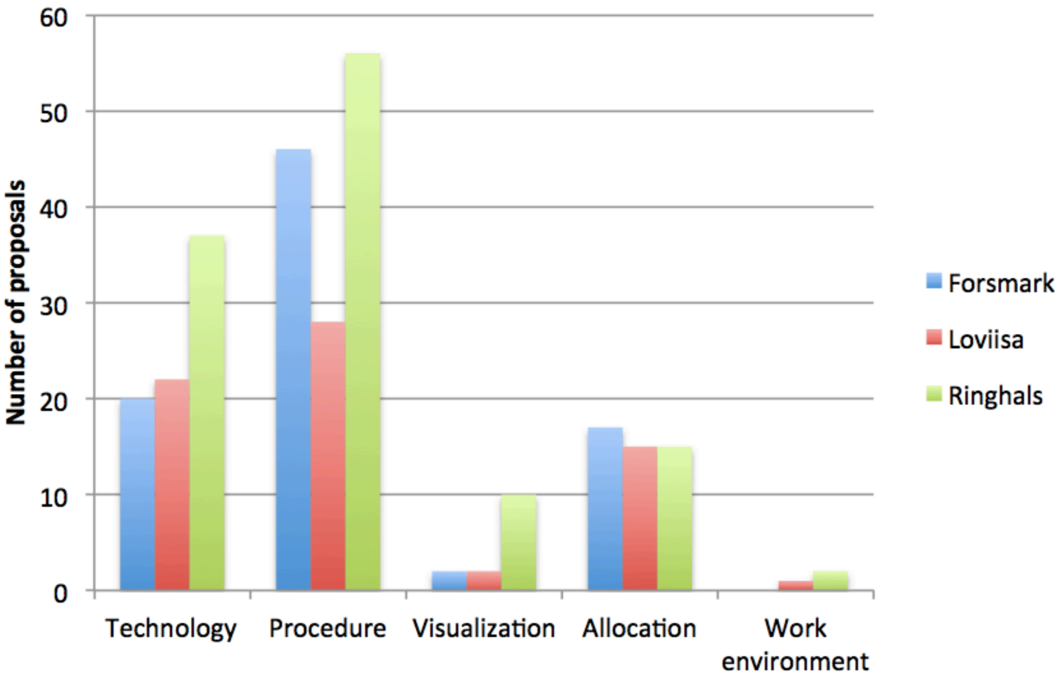


Figure 7. Improvement proposal categories

Based on the first interpretation of data, improvement proposals were divided into 5 categories. The categories are allocation, work environment, procedure, technology and visualisation. The number of proposals within each category is in not any way meant to be interpreted as a statistical expression of needs or deficits. However, the do to some extent reflect the researchers impression of where the emergency organisations could place their short horizon improvement work. Improvements within allocation are mainly about how to distribute workload in an optimal manner, while the procedure category is typically detailed improvements and minor corrections to the CC procedures. The technology category is also dominated of minor modifications and proposals small steps to improvement.

A detailed listing of improvement proposals is reported back to each utility based on the same categorisation. The official part of the report will only cover general observations across and within categories.

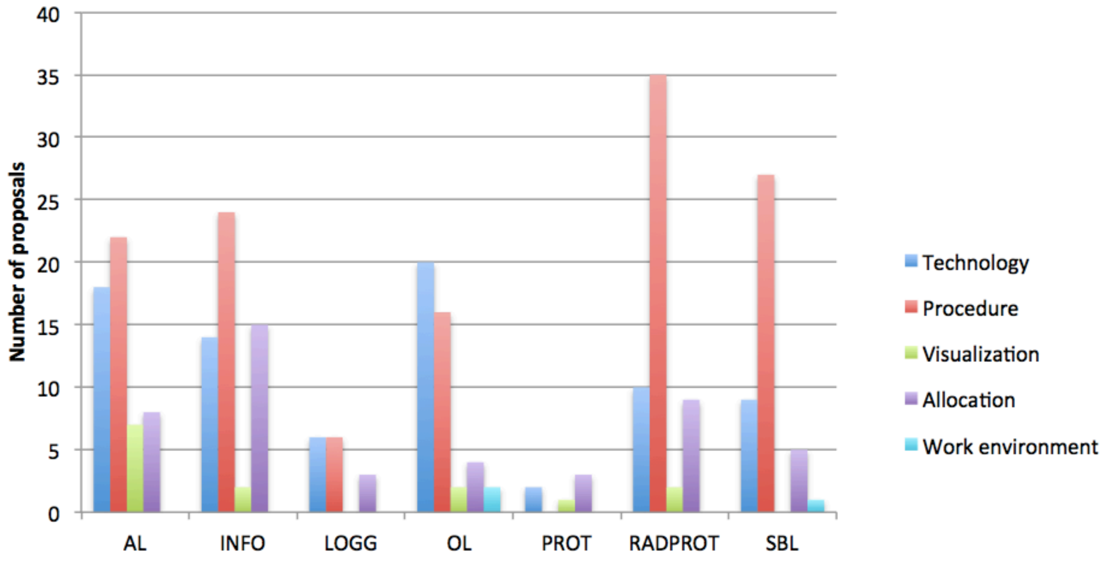


Figure 8. Improvements proposal categories divided by position

The improvement proposal categories were split into positions. The graphics shown in

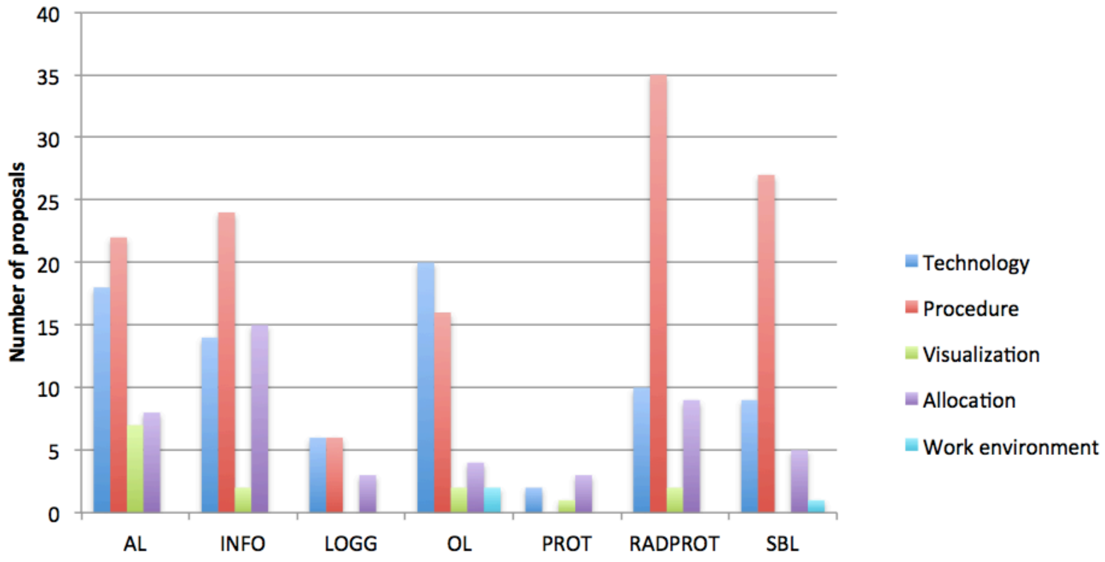
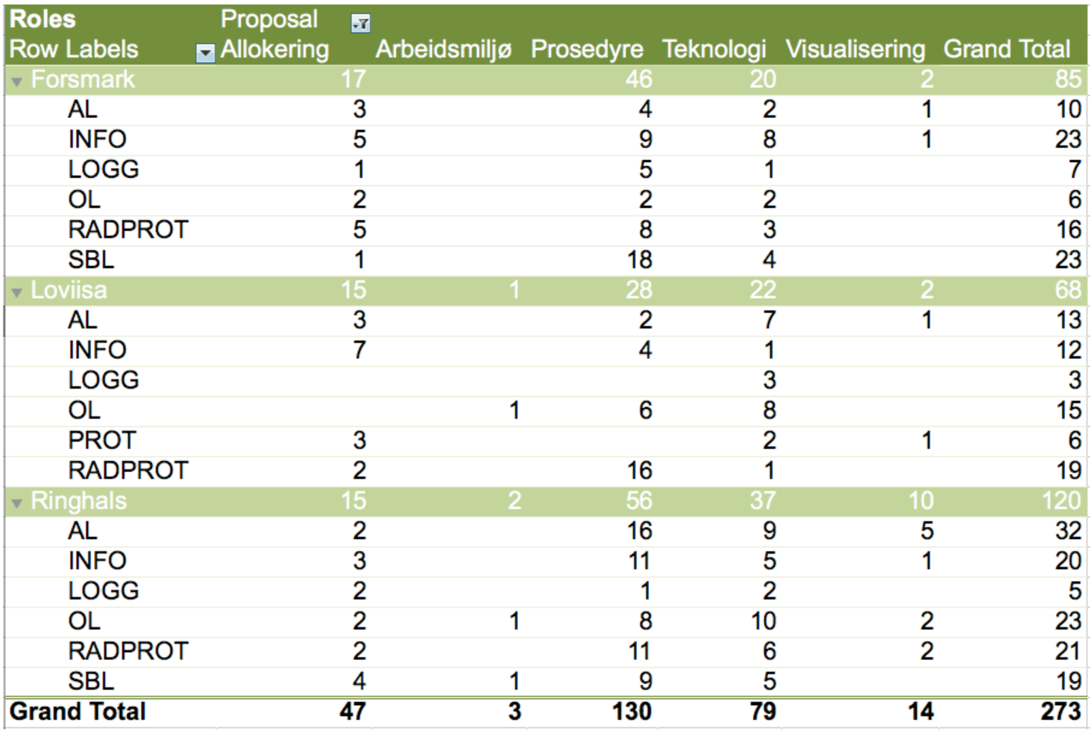


Figure 8 presents which positions (grouped according to Table 1) forms the basis for Figure 7, above. Figure 9 shows the same distribution divided by plant. The data has been used for judgement together with the insights presented in chapter 6.



Roles	Proposal					
Row Labels	Allokering	Arbeidsmiljø	Prosedyre	Teknologi	Visualisering	Grand Total
Forsmark	17		46	20	2	85
AL	3		4	2	1	10
INFO	5		9	8	1	23
LOGG	1		5	1		7
OL	2		2	2		6
RADPROT	5		8	3		16
SBL	1		18	4		23
Loviisa	15	1	28	22	2	68
AL	3		2	7	1	13
INFO	7		4	1		12
LOGG				3		3
OL		1	6	8		15
PROT	3			2	1	6
RADPROT	2		16	1		19
Ringhals	15	2	56	37	10	120
AL	2		16	9	5	32
INFO	3		11	5	1	20
LOGG	2		1	2		5
OL	2	1	8	10	2	23
RADPROT	2		11	6	2	21
SBL	4	1	9	5		19
Grand Total	**47**	**3**	**130**	**79**	**14**	**273**

Figure 9. Improvements proposal categories divided by position and plant

The use of technology for supporting communication within the emergency organisation was of particular interest in the analysis. Figure 10 below, show the distribution of proposals divided by utility.

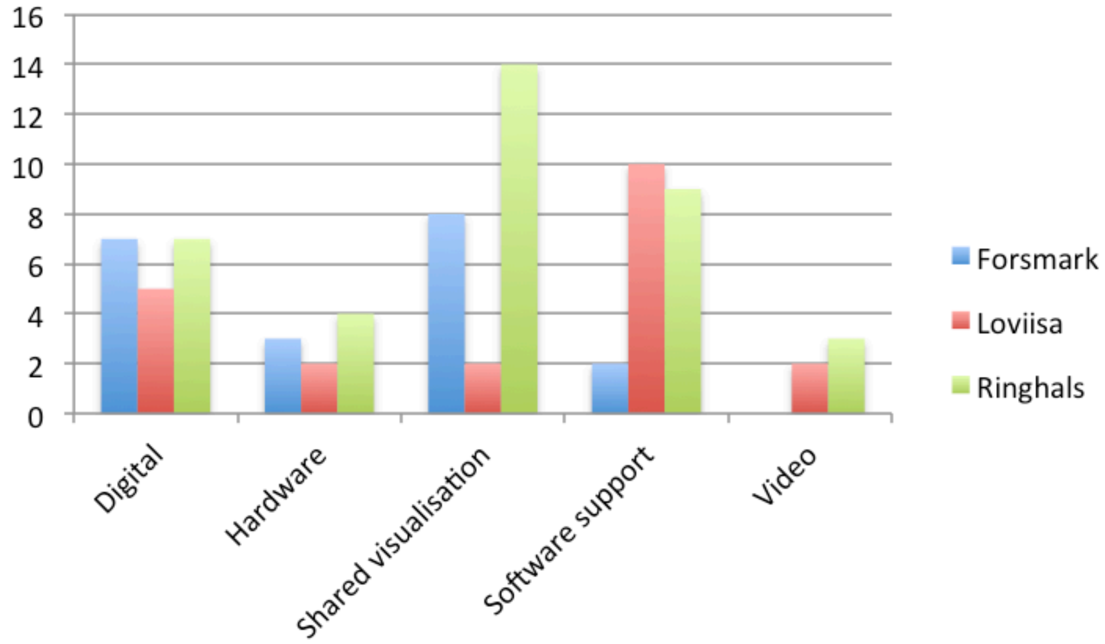


Figure 10. Distribution of technical improvement categories

7.2 Physical layout of the CC

The basic layout for the CC is in principle the same for all CCs in the project.

As shown in Figure 11, typically five rooms are used.

- Operation management room
- Expert group room
- Conference room
- Communication and technical support
- Information and personal administration

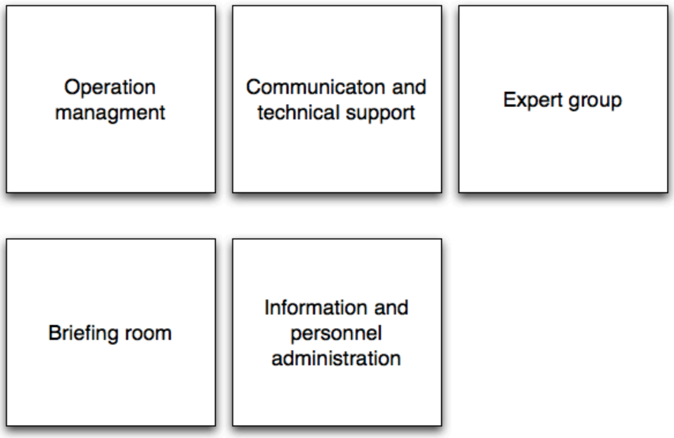


Figure 11. Sketch of typical room layout for the CC

Different philosophies are used for placement of external representation from radiation authorities and police. The authority representatives are either in the operation management room, together with the expert group or in a separate room together with representatives for the police.

The communication personnel are either located in the operation management room or together with the switchboard.

The information personnel do also have different localisations in the different plants. They are either gathered in the operation management room or divided between the operation management room and an information and personnel administration room.

Function	Operation management	Communication and tech support	Expert group	Information and personnel administration
Leader	F,L,R			
Radiation protection	F,L,R		F,L,R	
Info	F,L,R			L,R
Communication	F, L	R		
Personnel				R

External rep.	L		F	R
Switchboard		F,R		

The improvement potential seems to be within the combination of information exchange and location of the different functions.

7.3 Gathering and use of input parameters

For all plants a significant part of the data are manually punched from telefax, e-mail and telephone/radio into software used for calculations and status overview. In the information flow the same data can be punched several times by different levels in the EPO and also by different users at the same level. For example data can first be filled into forms by the 1st line technical support group, then transferred from telefax form to a computer by the CC operational management and CC technical support group.

In the current situation much of the time is spent punching the data into the different calculation programmes used for decision support. The technical solution for improvement would be automatic or semi automatic data input to calculation software codes. I.e. the calculation software request parameters or parameters is transferred to the calculation software by a central agent.

An example would be the coupling between core damage information, weather information and the gas and dissipation programme. In these calculations there are a high number of manual entries with a potential for human error in the punching.

The organisational improvement would be to ensure that only one end-user handles data and deliver processed results to the other users.

7.3.1 Use of tools and technology

A number of software tools are used for calculations and different types of forecast. One observation from the interviews is that use of these tools require good understanding and familiarity with the interfaces. The frequency of exercises is normally not more than maximum twice per year and normally the use of tools will not be trained between the exercises. The current philosophy is to have dedicated tools for dedicated problems. But the downside of having tools more dedicated to different situations, is that this may lead to less training with the tools. Going in the other direction would maybe be a better solution. Having the same tools applied for all tasks, maybe splitting in modules, but with a common interface and seamless exchange of data between modules could support both training needs and efficiency when using the tools. The ultimate solution would be if emergency organisation tools could be more integrated with the tools used for everyday work. A solution like that would lead to more training with the tools and make it less cumbersome to use the tools when the emergency situation occurs.

Input to common log seems feasible and it could be a recommendation for all utilities to look into if a common updated document – like the one in Loviisa - could give valuable input to improved overview and shared situational understanding by the CC staff.

7.3.2 Organisation and Governance

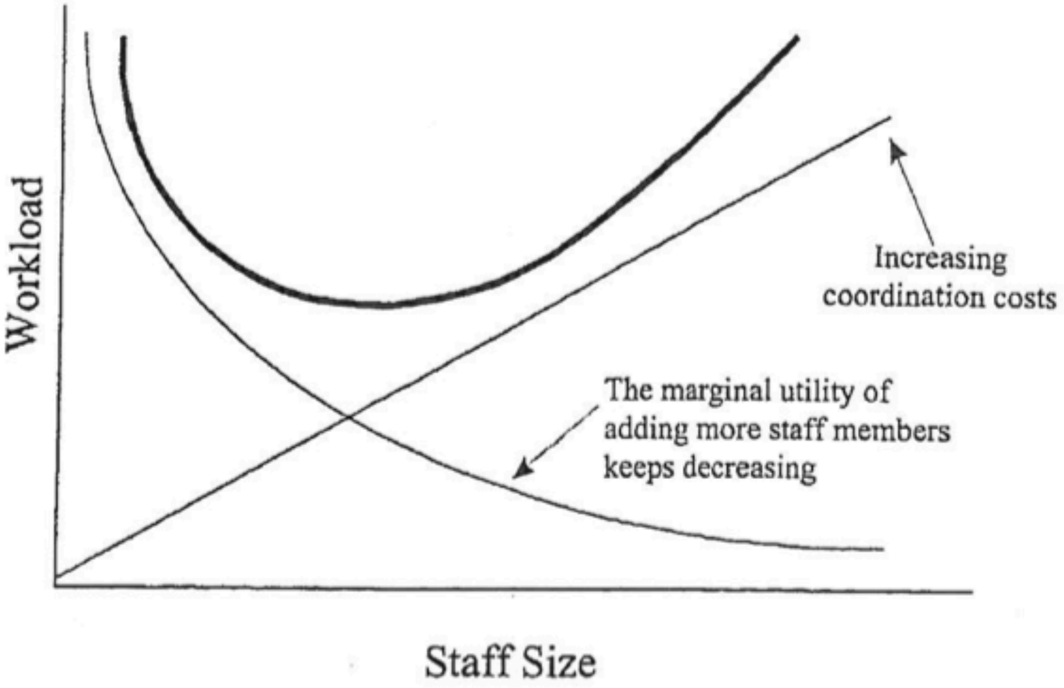


Figure 12. The Klinger and Klein curvilinear effect of increasing staffing on workload

The organisations under study have been built and extended over time with experience for what positions are needed. As shown in the Figure 12 above, increasing the staffing also increases the cost of transactions. Information exchange, handovers, updates of staff steals time and resources from the CC work [12].

The number of people in the CC and the efficiency potential by utilisation of better tools and less people should be investigated. Distribution of sub-tasks out of the CC could be done by providing data for resource groups outside the CC. Improved tools could reduce both transaction cost and the need for positions.

8 Conclusions and future work

Emergency preparedness at nuclear facilities is of high importance and the organisations studied have given an impression of high quality and competence.

This project has been looking for potential areas of improvement. Input to this work has been the experience and methods utilised in the Norwegian oil and gas industry.

The interview material from the various emergency management teams which has been be collected reveal common issues, some different ways of organizing the work/teams and possible improvements both in work processes, organization and enhanced technical solutions. A total of about 900 tasks were mapped during the data collection phase. A total of 270 items for possible improvements were collected.

The analysis of the data identified four main categories where further studies could contribute to improvement.

Communication and exchange of information

Necessary exchange of information within the CC is mostly done by face-to-face communication, and frequent staff briefings are used to ensure a common understanding of the situation. Communication in and out on the CC is mostly done by telephone or telefax. Possible areas for further research could be pros and cons of using more visualisation technology within the CC and more use of digital support for the communication in and out of the CC.

Tools and technology

Software tools are in many cases dedicated for different areas of the CC work. Having the same tools applied for all tasks, maybe splitting in modules, but with a common interface and seamless exchange of data between between modules could support both training needs and efficiency when using the tools. Automation of data transfer from 1st line, integrated in the tools could reduce time consumption and increase accuracy.

Staffing and organisation

Current organisations seem to have the necessary manning. However, there may be a potential for optimisation with regard to function allocation and workload. Smart use of technology and task allocation may even allow for a staff reduction.

Procedures

Paper procedures are currently standard. Typically most of the improvement comments were focused on small corrections to the procedures. Looking into use of computerised checklists and guidance may contribute to both reduces maintenance and improved status overview for remaining tasks to be carried of in the checklists.

During the interview phase both Forsmark NPP, Ringhals NPP and Loviisa NPP got some input from the PONPP project to correct/improve the their work procedures (“Initiella- og Återkommande Uppgifter”), also discovering some overlapping activities between personnel in different categories.

Discussions about what are common, what is different and possible improvements were presented in a workshop at IFE Halden, February 2011. The participating organizations (Forsmark NPP, Ringhals NPP and Loviisa NPP) have shown great interest in continuing the PONPP project.

The usefulness of this method in analysing the emergency management decision-making process within the authorities was considered as an interesting issue for continuation of the project. As an example of proposal from utilities is further MTO analysis of:

- Study the interface between CC and internal (radiation protection, muster points, affected plant, field, HQ) cooperation partners will be important. The most important external connection will be to the authorities both locally and centrally.

- Alternative division between CC and 3rd line i.e., communication between CC and media (press conference), and the communication between other external and internal parties (authorities) and media.

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Karoliina Myllymäki
Programme Manager NKS-R

Board meeting, Copenhagen, May 31st 2011

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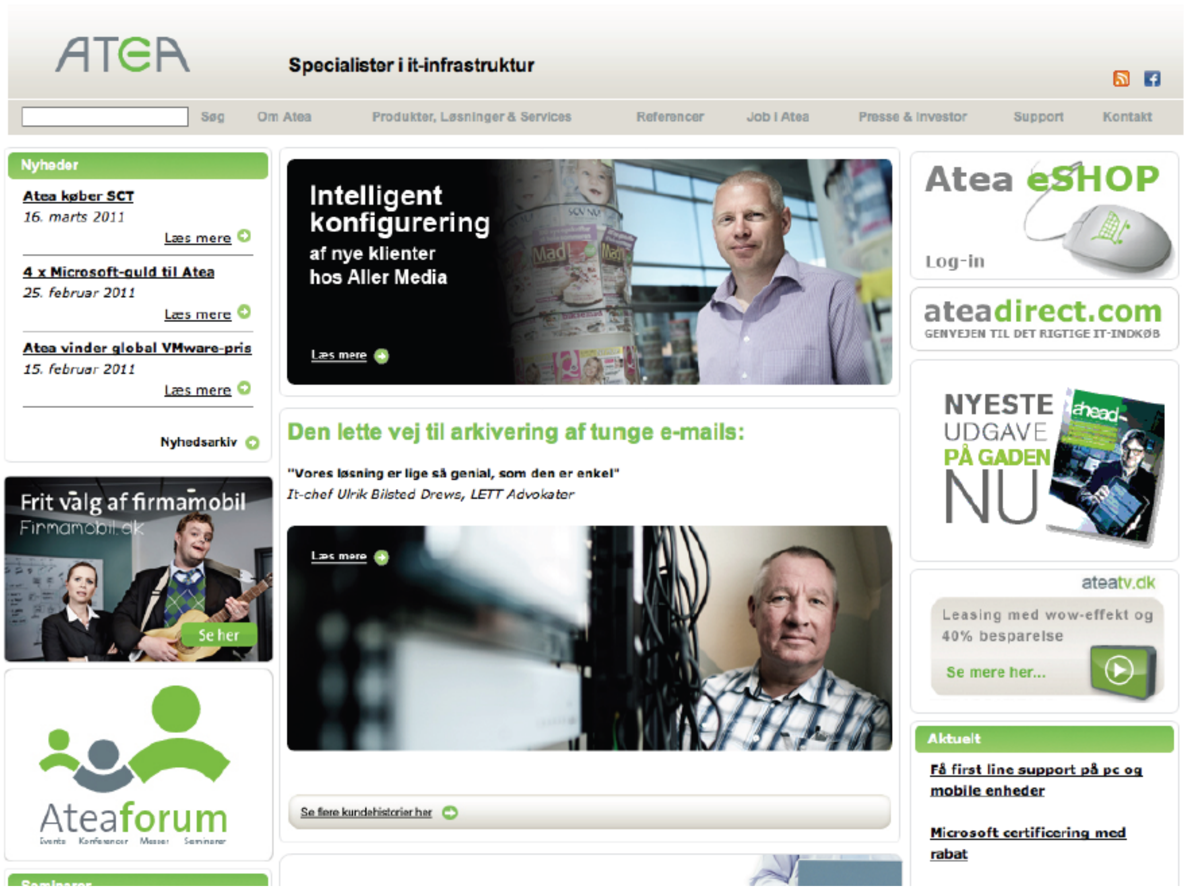

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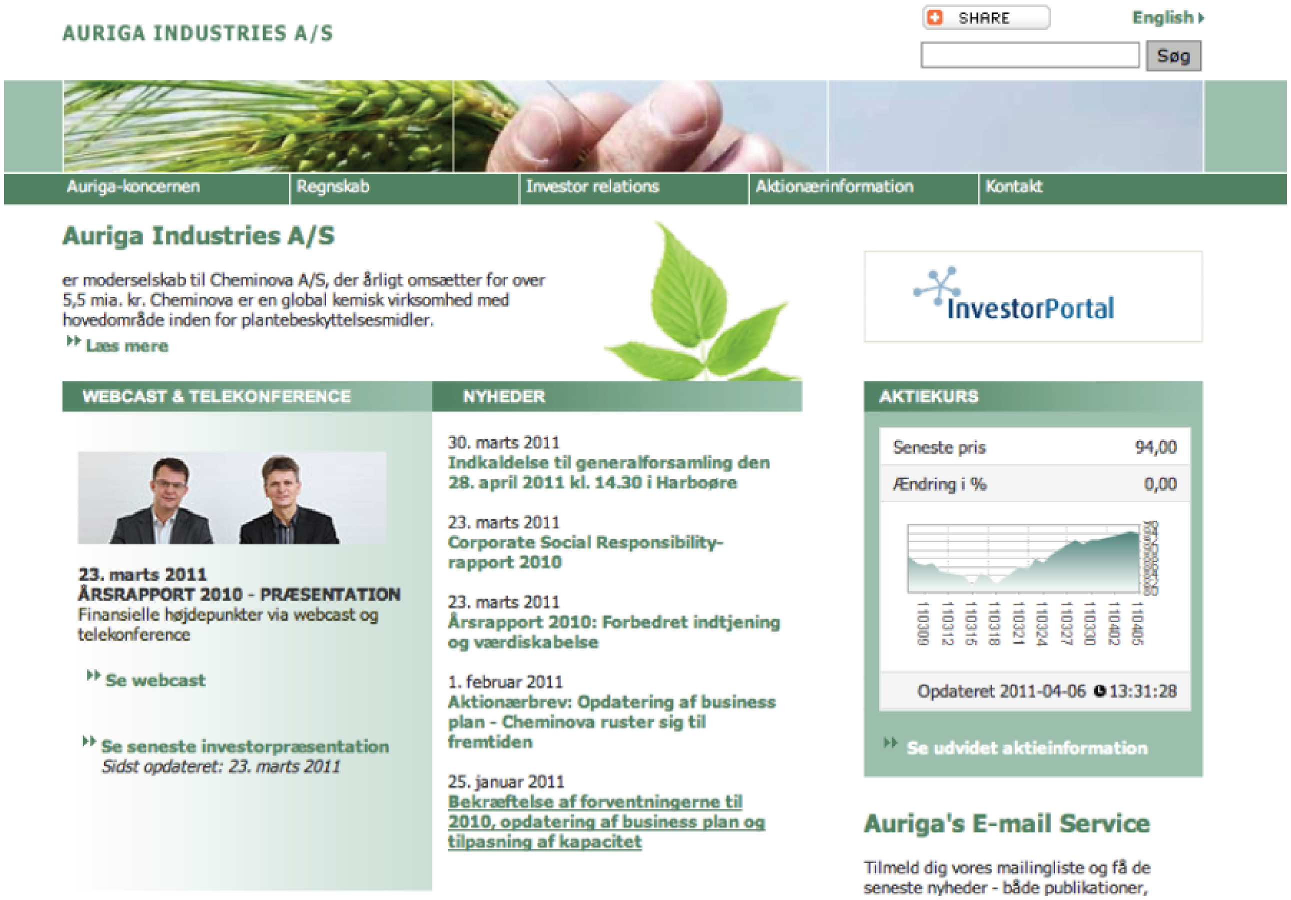

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March 2011: 35
April 2011: 29

Record months have been October 2010 and January 2011 of more than 44.000 hits.

Website renewal including redesign and new report function will be presented by the PC's for the Board.

Only English: OK

NewsLetters og NewsFlashes

Since the board meeting in January two NewsFlashes have been distributed. The one from January 13 was a short report from the board meeting, and the one from March 4 included B and R activity reporting. Besides this a NewsLetter is under preparation for distribution before the board meeting May 2011.

There is a list of more than 300 e-mail addresses, to which our electronic letters are forwarded.

Other kinds of info material – pamphlet and DVD

A new and updated English version of the pamphlet "Nordic Nuclear Safety Research" has been published.

The Secretariat

Finn Physant
18-05-2011

Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
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Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

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Evaluation of NKS Research Activities during 2002 - 2005

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December 2006

Abstract

NKS research work during the years 2002 – 2005 and its results have been evaluated against a set of criteria defined by the NKS Board. The evaluation encompassed the NKS-R (reactor safety) and NKS-B (emergency preparedness) programs and was conducted by two persons per program. The mode of work of the two evaluation teams was adapted to the special conditions of the program at hand, one being aimed more at the nuclear industry and the other at a more academic surrounding; in both cases, however, with great involvement of relevant national authorities. The findings of the evaluators are presented in this report. Financing and participating organizations, end users, deliverables, quality aspects, cost-benefit issues, time schedules, budgets and related issues are discussed. Finally, the sections on NKS-R and NKS-B, respectively, include conclusions and recommendations for future NKS work.

Key words

accidents; ageing; application; automation; call for proposals; competition; contamination; control room; cost calculation; criteria; decision support system; decommissioning; deliverable; dose assessment; emergency preparedness; end user; environment; evaluation; funding; indicator organisms; in-kind contribution; intercomparison; interview; measurement; monitoring; network; Nordic dimension; nuclear safety; objectives; organizational issues; plant lifetime management; probabilistic safety analysis; program manager; protection; quality assurance; questionnaire; radiation; radioactive; radioecology; release; remediation; risk analysis; safety culture; sampling; spectrometry; thermal hydraulics; waste

Disclaimer

The views expressed in this document remain the responsibility of the authors and do not necessarily reflect those of NKS.

In particular, neither NKS nor any other organization or body supporting NKS activities can be held responsible for the material presented in the report.

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This is NKS

NKS (Nordic Nuclear Safety Research) is a scientific cooperation program in nuclear safety, including emergency preparedness and radiation protection. It is an informal forum, serving as an umbrella for Nordic initiatives and interests. Its purpose is to carry out joint activities producing seminars, exercises, scientific articles, technical reports, manuals, recommendations, and other types of reference material. This material offers guidance to concerned ministries, authorities, research establishments and enterprises in the nuclear field in their decision-making.

The work is divided into two main branches:

NKS-R	Reactor Safety including Decommissioning and Radioactive Waste
NKS-B	Emergency Preparedness including Radioecology and Emergency Preparedness Related Information and Communication Issues

Normally, only activities of interest to financing organizations and other end users are carried out. The results should be practical and directly applicable. The main financiers are:

- The Danish Emergency Management Agency
- The Finnish Ministry for Trade and Industry
- The Icelandic Radiation Protection Institute
- The Norwegian Radiation Protection Authority
- The Swedish Nuclear Power Inspectorate
- The Swedish Radiation Protection Authority

Together with support from a number of additional financiers in the nuclear field, the total NKS budget for 2005 was some €1.0 million (DKK 7.5 million). To this should be added contributions in kind by participating organizations, worth approximately the same amount, without which this program would not be possible.

The region in question is the five Nordic countries, i.e., Denmark (including the Faroe Islands and Greenland), Finland, Iceland, Norway and Sweden. With a total population of some 24 million people, and a common cultural and historic heritage, the Nordic countries have cooperated in the field of nuclear safety for approximately half a century. Informal networks for exchange of information have developed throughout the years, strengthening the region's potential for fast, coordinated and adequate response to nuclear threats, incidents and accidents. NKS has served well as a platform for such activities.

This Nordic interest in cooperation and pooling of resources via NKS is due to the large number of nuclear installations and activities in the region. There are four nuclear power reactors in operation in Finland, and one (Olkiluoto 3) is under construction. Sweden has 12 nuclear power reactors. Of these, 10 will continue operation and two have been permanently shut down (Barsebäck 1 and 2). Preparations are being made to decommission the Barsebäck reactors. There are research reactors in Denmark, Finland, Norway and Sweden. The three Danish reactors have been closed and decommissioning work has started. The reactors in Finland and Norway are still in operation. The two Swedish research reactors have been shut down recently and face decommissioning. In Sweden there is also a nuclear fuel production plant in operation. All five Nordic countries have interim storages for radioactive waste. Finland, Norway and Sweden have final repositories in operation for low and medium level waste. In Finland and Sweden work is in progress to allow construction of final repositories for spent fuel. Apart from nuclear installations in the Nordic countries, there are commercial, research and naval nuclear reactors and other nuclear installations in surrounding eastern and western countries.

Therefore, NKS with its program for nuclear safety including radioactive waste, environmental issues, emergency preparedness, radiation protection and information is of common interest to all five Nordic countries. The hallmark of NKS is a spirit of sharing – all results are available free of charge, not only to the NKS family but worldwide. When quoting NKS material, a reference to the source will be appreciated.

A historical overview is given in a book entitled “Half a Century of Nordic Cooperation. An Insider’s Recollection.” The author is Franz R. Marcus and the book can be ordered free of charge from the NKS Secretariat.

About this report

The NKS-R program has been evaluated by Risto Sairanen (STUK) and Per Persson (independent consultant), and the NKS-B program was evaluated by Per Hedemann Jensen (DD) and Tore Lindmo (NTNU). The material has been compiled by Torkel Bennerstedt (NKS) and edited by Annette Lemmens (FRIT). On behalf of the NKS Board, additional information on NKS policy and activities has been supplied by Lars Gunsell (SKI) and Sigurður M. Magnússon (GR), as needed. NKS is grateful for the significant contributions made by the authors to evaluate and help improve the overall NKS structure and mode of work as well as programs and activities.

Summary

Following an NKS Board decision in November 2005, NKS work and results from the years 2002 to 2005 have been evaluated. The two programs, NKS-R (reactor safety) and NKS-B (emergency preparedness) were evaluated separately and according to a set of criteria adopted by the Board. See Appendix 1.

NKS-R: The reactor safety program

In the case of NKS-R, the criteria were translated into a list of 14 questions by the evaluators. Answers to the questions were collected from three sources:

- interviews of persons from Finland and Sweden having experience of working with NKS-R
- a survey sent to end users of the NKS-R research results, and to activity participants
- review of NKS-R deliverables by the evaluators

Considering the limited level of funding, the achievements of the NKS-R work in 2002-2005 have been very good. Only a few delays have been observed. In a vast majority of cases, the activity leaders have conducted their activities according to plans and in a cost-effective way. The end users have considered the results applicable. All finished activities have fulfilled the formal NKS requirement of producing final documentation.

Some NKS objectives have not been completely fulfilled in NKS-R. Building of Nordic networks has been only occasionally achieved. Most of the activities have been mainly conducted by the leading organization. Contacts with power plants and with other relevant established Nordic cooperation groups have been scarce in some cases.

The NKS-R evaluators recommend that the Nordic cooperation aspect should be enhanced in the future. Contacts with other established Nordic cooperation groups, with the end users and with NKS-B should also be reinforced.

Distribution of the NKS-R results should be improved, e.g., by arranging seminars presenting the results of the program activities.

Education activities, especially for the younger generation, could be a regular feature of NKS-R. The education could efficiently utilize the facilities available in various Nordic countries.

NKS-B: The emergency preparedness program

The NKS-B activities have been evaluated against activity proposals and against their scientific merits. The quality of the deliverables varies considerably. Also, the cost-effectiveness, i.e., the “return of the investment” in the different activities varies, as do the scientific perspectives of the activities. Many of the activities, however, have the potential of being further developed within Nordic research programs.

Activities on *measurement technology* have been a very valuable part of the NKS-B program portfolio. Nordic countries possess expert competence in this field, which is also appreciated on the European level. Nevertheless, radiological measurements constitute an expertise only mastered by few institutions in each of the Nordic countries. Activities within NKS therefore constitute an opportunity to further develop and maintain this competence as well as to work out common protocols and procedures that will ensure coordinated actions within the Nordic countries in case of an emergency. The activities on field measurements and laboratory-based analyses are highly relevant and very valuable results have been obtained from both field exercises and laboratory intercomparisons.

The purpose of the *radioecology* activities has been to establish reliable data for prediction of possible dose to humans from different ecosystems, to be used in decision-support systems, and to search for new organisms accumulating radionuclides in various ecosystems. From the published reports of NKS activities in this field, it is not always clear how the results will be utilized in a systematic manner to further strengthen the expertise within these two areas of radioecology. To improve decision-support systems, critical analyses to identify which data are most needed to strengthen system performance should be made and the data be acquired through focused activity work. The search for new accumulating indicators should be limited to a few species relevant for the Nordic countries and the effort then focused on a systematic long-term monitoring of such species.

The *emergency preparedness* activities have been well-anchored. In general, all activities have been relevant for emergency preparedness and they fulfil the criteria set up in the NKS-B program. The activities have contributed to maintain and building up competence and to maintain and building Nordic networks between scientists in emergency preparedness disciplines. Transverse collaboration between closely related activities seems to have been rather low but might be improved in the further work on integrating the activity results into broader decision-support systems.

Challenges for future NKS work on emergency related activities will be careful considerations on the balance between research-oriented and more practical-/routine-oriented activities, more clear communication of the activity results, integration of such results into decision-support systems, better integration of NKS activities with relevant EU activities, and inclusion of university departments in research activities.

Sammanfattning

I november 2005 bestämde NKS' styrelse att NKS-arbetet och dess resultat mellan åren 2002 och 2005 skulle utvärderas. De två forskningsprogrammen, NKS-R (reaktorsäkerhet) och NKS-B (beredskap), utvärderades var för sig och i enlighet med direktiv från styrelsen. Se Appendix 1.

R-delen utvärderades av Risto Sairanen (STUK) och Per Persson (fristående konsult), och B-delen utvärderades av Per Hedemann Jensen (DD) och Tore Lindmo (NTNU). Utvärderarnas rapporter har sammanställts av Torkel Bennerstedt (NKS) och redigerats av Annette Lemmens (FRIT). Lars Gunsell (SKI) och Sigurður M. Magnússon (GR) har vid behov och på styrelsens vägnar lämnat kompletterande information om NKS' policy och verksamhet under utvärderingens gång.

NKS-R: Reaktorsäkerhetsprogrammet

Utgående från utvärderingskriterierna utarbetade utvärderarna en lista med 14 frågor. Svar inhämtades på följande vis:

- Personer i Finland och Sverige med erfarenhet av arbete inom NKS-R intervjuades
- En enkät sändes till slutanvändare av forskningsresultaten, och till deltagare i NKS-aktiviteterna
- Rapporter, seminariematerial och annan information från NKS-R studerades av utvärderarna

Med tanke på de begränsade resurserna är resultatet av arbetet i NKS-R under åren 2002 – 2005 mycket bra. Förseningarna har varit få. I de allra flesta fall har de aktivitetsansvariga följt de uppgjorda planerna och arbetat kostnadseffektivt. Slutanvändarna har bedömt resultaten som användbara. Alla avslutade aktiviteter har i enlighet med NKS-kraven avrapporterats i en slutrapport.

Vissa NKS-mål har inte uppfyllts till fullo. Nordiska nätverk har skapats bara i en del fall. De flesta aktiviteter har huvudsakligen genomförts av den organisation som haft ledningsansvaret. Kontakterna med kraftindustrin och andra relevanta etablerade nordiska samarbetsgrupper har varit knappa i en del fall.

Utvärderarna av NKS-R rekommenderar att det nordiska samarbetet utökas i framtiden. Kontakterna med andra etablerade nordiska samarbetsgrupper, med slutanvändare och med NKS-B bör också stärkas.

Spridningen av resultat från NKS-R bör förbättras, t ex genom att arrangera seminarier där resultaten av programaktiviteterna presenteras.

Utbildningsaktiviteter, särskilt för den yngre generationen, skulle kunna vara ett återkommande inslag i NKS-R. Utbildningen kunde på ett effektivt sätt använda sig av de faciliteter som finns tillgängliga i de nordiska länderna.

NKS-B: Beredskapsprogrammet

Aktiviteterna inom NKS-B har utvärderats mot aktivitetsförslagen och mot deras vetenskapliga förtjänster. Kvalitén av levererade produkter varierar avsevärt. Även kostnadseffektiviteten (det vill säga hur stor nytta man haft av de nedlagda resurserna) i de olika aktiviteterna varierar, och det gäller även aktiviteternas vetenskapliga perspektiv. Men många av aktiviteterna har potential att utvecklas ytterligare inom nordiska forskningsprogram.

Aktiviterna rörande *mätteknik* har varit en mycket värdefull del av NKS-B. De nordiska länderna besitter expertkompetens, vilket uppmärksammas även på europeisk nivå. Men bara ett fåtal organisationer i vart och ett av de nordiska länderna behärskar radiologiska mätningar. Aktiviteter inom NKS ger därför en möjlighet att upprätthålla och utveckla denna kompetens. Samtidigt kan gemensamma protokoll och procedurer utarbetas i Norden, som underlättar koordinerade nordiska insatser i ett beredskapsläge. Insatserna avseende fältmätningar och laboratorieanalyser är mycket relevanta, och mycket värdefulla resultat har uppnåtts både vid övningar på fältet och vid jämförelsemätningar på laboratorier.

Aktiviteterna inom *radioekologiområdet* har haft två syften. Det ena har varit att få fram vederhäftiga data för att kunna förutsäga dosen till människa från olika ekosystem, att användas som underlag i system till stöd för beslutsfattare. Det andra har varit att kunna studera nya möjliga organismer som ackumulerar radionuklider i olika ekosystem. Av de publicerade NKS-rapporterna på detta område framgår inte alltid klart hur resultaten ska användas på ett systematiskt sätt inom dessa två delar av radioekologin. För att förbättra systemen för stöd till beslutsfattare borde kritiska studier genomföras för att identifiera vilken typ av data som mest behövs för att förbättra systemen, och sådana data borde sedan tas fram genom fokuserade insatser. Studierna av nya ackumulerande organismer borde begränsas till ett fåtal arter som är typiska för de nordiska länderna och arbetet inriktas på långtidssudier av dessa arter.

Aktiviteterna på *beredskapssidan* har varit väl förankrade. I allmänhet har alla aktiviteter varit relevanta för beredskapen och de uppfyller kriterierna som gäller för NKS-B. Aktiviteterna har bidragit till att upprätthålla och utveckla såväl kompetens som nordiska nätverk mellan vetenskapsmän inom olika delar av beredskapen. Gränsöverskridande samarbete mellan närliggande fackområden tycks ha varit sällsynt men skulle kunna utökas i ett kommande arbete med att integrera resultaten i bredare beslutsstödssystem.

En utmaning för framtida beredskapsarbete inom NKS är balansen mellan forskningsaktiviteter och aktiviteter inriktade på praktiska frågor och rutiner. Andra utmaningar är tydligare resultatspridning, implementering av de uppnådda resultaten i beslutsstödssystem, bättre integration av NKS-aktiviteter med EU-projekt, och ett ökat deltagande av universitetsinstitutioner i forskningsarbetet.

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Introduction

The NKS structure and activities are evaluated fairly regularly. The last evaluation was reported in NKS-66 of November 2002 and encompassed research results as well as organization and administrative support regarding the years 1998 – 2001. As a consequence of this evaluation, the Board decided to reorganize NKS activities and administration. The new structure and procedures are described below. In November 2005 the Board laid down the directives for an evaluation of the results and new mode of operation of the last 4 years (2002 – 2005). This report presents the findings of the evaluators.

NKS research was reorganized in 2001 in order to improve overall flexibility, transparency and efficiency. The old structure of a handful of rather bulky 4-year projects was abandoned in favor of a structure with a large number of smaller activities divided into two main program areas, each led by a program manager:

- NKS-R: reactor safety, including decommissioning and radioactive waste
- NKS-B: emergency preparedness, including radioecology and emergency preparedness related information and communication issues

Suggestions for new activities are invited through a procedure of Call for Proposals, initiated by the NKS-R and NKS-B program managers. Proposed activities should be well defined and limited in objectives, duration and costs. The proposals are evaluated by the respective program manager and one or more experts and presented at the NKS Board meeting in November each year. Normally, NKS activities are planned and financed for one year at a time and can be prolonged or extended by the Board as appropriate. Thus, the content, duration and funding of the activities will vary over time and between activities, and an element of competition in applying for NKS research funding has been introduced.

The main source of financing of NKS activities is national institutions in the five Nordic countries. The total financing for the years 2002 to 2005 is shown in Table 1, together with main expense items in the same period.

Table 1. NKS financing and expenses for the period 2002-2005 (in DKK, based on yearly accounting reports)

Financing		**Expenses**	
National institutions	27 665 952	Remainder costs 1998-2001	5 428 839
Other sources	2 329 949	Funding of R activities	10 701 768
		Funding of B activities	10 486 930
		Other costs	5 417 630
Total income	29 995 901	Total costs	32 035 167

Thus, unused funds from previous years have been spent to cover the costs. If activity spending in each of the Nordic countries is compared with the financial contributions from the respective countries, as shown in figure 1, it seems that Sweden has a significantly lower "return" than other member countries.

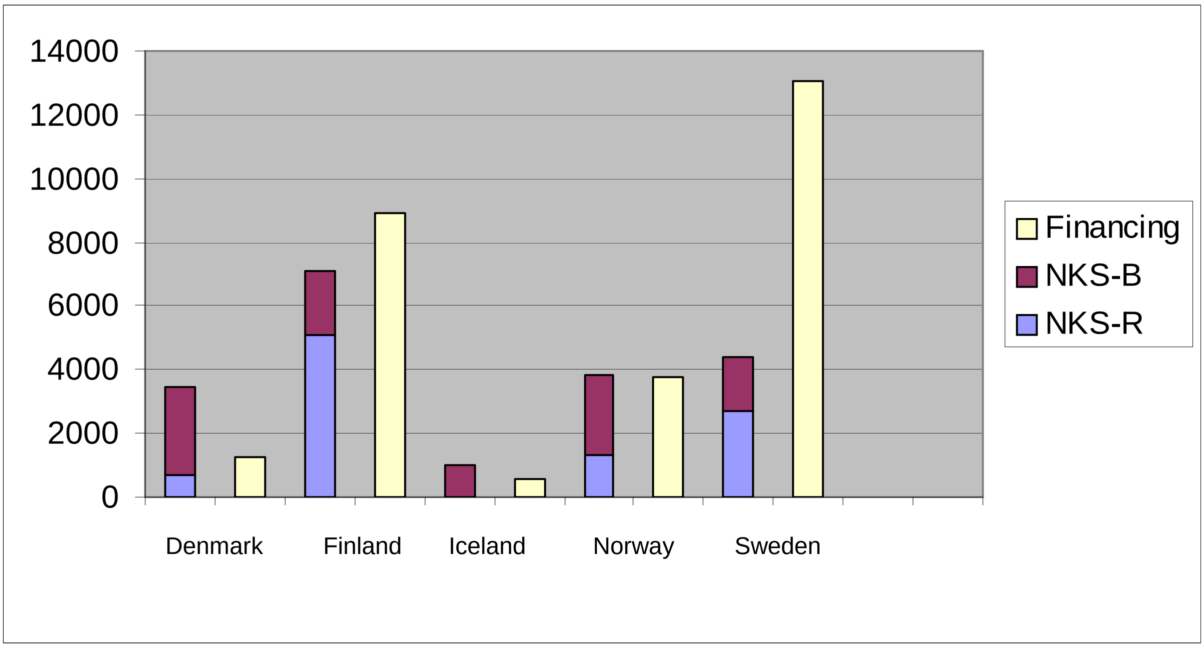


Figure 1. NKS program spending (in 1000 DKK) in individual Nordic countries, compared to financial contributions from the respective countries, based on break-down of data in Table 1 country by country. (NKS-R expenses are allocated to activity leader's country, NKS-B activity expenses have been distributed on participating countries in each activity.)

Since the activities are funded on a yearly basis, all funding decisions and contracts between NKS and the organizations that carry out the work are made for a maximum period of one year. Activities that have a longer duration must apply for a continuation of the NKS funding annually. A final report should be available immediately after finishing the activity. These arrangements ensure that all activities are constantly supervised and evaluated at least once a year.

Program managers were nominated from the beginning of 2002 for the respective areas. Administratively, the two program managers in the new structure replaced the former six project leaders of the NKS 1998 – 2001 program, and "projects" are now normally referred to as activities (although the old term project is still used occasionally). The responsibilities of the present program managers include:

- Managing the activities and proposing new ones
- Ensuring that the program is conducted according to the decisions of the Board
- Interacting with the Nordic end users
- Interacting with the activity leaders, ensuring that the activities are running and being reported according to plans (including budget)
- Reporting to the Board at its meetings

Background information and instructions for the NKS work are given in the Program Handbook (NKS(06)3) and Administrative Handbook (NKS(06)4). In addition, the NKS-R and NKS-B program managers have issued and updated Framework Reports for detailed instructions on the R and B research work.

All NKS activities must be led by an organization based in Denmark, Finland, Iceland, Norway or Sweden. It is allowed and even encouraged to link an NKS activity to other national or international research programs. Non-Nordic partners are not excluded from the program, but they cannot be the leading organization. All results of an NKS funded activity are public and published in the NKS series. No funding can be given to proposals producing confidential results. The reports produced by the activities are published electronically on the NKS website, and the final reports are also printed.

It is intended to keep NKS work open and dynamic by regularly announcing new calls for proposals, and encouraging candidate activities to apply for NKS funding. Applications can be submitted at any time. Practically, most of the applications are received during the first funding round launched in August every year with a deadline for proposals in September. All running activities must also participate in the annual evaluation process if they are to be prolonged.

Applications are submitted to the program manager, who coordinates the evaluation process and presents a funding proposal to the NKS Board. Each proposal is evaluated by experts representing intended end users of the research results. The funding decisions are made by the NKS Board in a meeting usually held in November. The program manager presents the Board with the evaluation results and a proposal for funding distribution, including documented justification of the proposal.

After the Board meeting, the program managers contact the activity leaders who are expected to give their acceptance of the terms given by the Board. If accepted by the end of December, the activities can be contracted and start at the beginning of the following year.

Usually, a small part of the total NKS funding has been reserved for a second round in May.
The basic requirements that all activity proposals, and of course the activities should fulfil are:

- The activity should have a well defined organization.
- Each activity must have a responsible activity leader.
- There must be a detailed financing plan for each activity. All funding sources and in-kind contributions must be indicated in the proposal. For research activities, the NKS funding can normally be no more than 50% of the total funding.
- Each activity must produce documented results.

The organization proposing an activity must submit a plan for the activity. The format of the activity plan is free, but there is a recommended structure given in the framework reports. The activity plan should give a detailed description of the activity as regards the evaluation criteria listed below. In addition, a signed proposal summary form must be submitted to document basic contact information of the activity.

The program manager invites a team of experts to assist with the evaluation. The evaluation team members perform their evaluation independently of each other for each proposal in their research area. The evaluation is done by assigning numerical scores and justification for the scores using the six evaluation criteria listed below.

1. The proposals should demonstrate the Nordic dimension. The Nordic dimension is interpreted here as creation or maintenance of Nordic networks, transfer and build-up of Nordic competence, and involvement of young Nordic researchers and research teams.
2. The technical/scientific content of the proposed activity should meet high international standards, and new developments should be highlighted.
3. There should be distinct and measurable goals both for technical/scientific development and for efforts related to information exchange.
4. The results should be highly relevant for the end users and financing organizations.
5. Participation of young experts in an activity provides additional merit.
6. Linking NKS activities to other international programs or work within, e.g., EU, IAEA and OECD/NEA provides additional merit.

1. Evaluation of the NKS Reactor Safety Program, NKS-R, 2002-2005

1.1 Introduction: Overview of NKS-R activities

1.1.1 Activities in the period 2002-2005

The NKS-R program in the current form started in 2002. At that time it was decided to divide the R program into two themes:

1. Development and Validation (DELI) of assessment methods and new technology. The theme covers challenges related to plant safety assessment and introduction of new technology into the plants.
2. Management and organisation (MANGAN) of safety and quality assurance. The theme covers the challenges related to implementation and assessment of effective safety and quality management, and human performance in different situations.

Seminars can be considered as a third theme.

The present NKS-R program has evolved from activity proposals received in the annual process of Call for Proposals. The objectives and the application process of the NKS-R program are described in the NKS-R Framework report (NKS(05)4).

The bases for funding decisions are the proposal evaluation scores given by the proposal evaluation teams. In addition to the scores, it is a responsibility of the program manager to consider factors influencing the balance of the program. Factors listed in the NKS-R framework report are:

- The program - as a whole - must be balanced geographically. There may be individual activities without a strong showing of co-operation between Nordic countries, but the program must be balanced overall.
- Important Nordic organisations - utilities, authorities, and research institutes - should be involved in NKS-R activities.
- There should be a fair representation of various technical research areas and themes.
- Proposals to ongoing activities can be accepted, on condition that the preceding activity has been well-managed and successful.
- New activities are generally not initiated with activity leaders who have severely delayed NKS activities pending. New activities may be considered after concluding and reporting the delayed activity.

The NKS-R activities during 2002-2005 can be grouped into six research areas:

1. Thermal hydraulics and severe accidents.
2. Organisation issues, safety culture
3. Risk analysis
4. Automation and control room
5. Radioactive waste and decommissioning
6. Plant lifetime management and ageing

The research area of thermal hydraulics and severe accidents has included experimental work and analyses. Experimental activities have focused on condensation phenomena in pressure suppression pools, fission product transport in severe accidents, ex-vessel debris coolability and interactions between molten fuel and coolant. Condensation phenomena and their loads to structures have also been analytically studied. A different kind of activity in this field was a preparatory project with the objective of establishing a Nordic thermal hydraulic and nuclear safety network.

Organisational issues and safety culture has been a significant research area in the NKS-R program. Three relatively large research projects have been conducted. A contextual assessment of maintenance culture safety and efficiency in Finland and Sweden has been conducted, using the Olkiluoto and Forsmark plants as examples. Safety management in a non-nuclear context has been studied, with the objective of finding relevant insights to nuclear applications. There has also been a research project to define the central reactor safety concepts in a fundamental, logically sound way.

Common cause failure models used in calculations of high redundant systems have been investigated in the risk analysis area. Another activity in the area has been development of a framework for the risk-informed decision making process, also assessing the status of risk-informed decision-making in Sweden and Finland. A relatively new risk analysis activity has the goal to better understand system requirements on the shutdown systems and control rod function in different abnormal situations.

The main NKS-R research project in the automation and control room has focused on traceability and communication of requirements in digital I&C systems development. It has later been succeeded by an activity to facilitate industrial use of the results produced in the first project.

Radioactive waste and decommissioning was introduced to the NKS-R program by a seminar on decommissioning in 2005. At the same time, a research activity was begun to investigate cost calculations with regard to decommissioning and dismantling of nuclear facilities.

Plant lifetime management is another topic that has been added to the program only lately. Two activities have been started in 2005: One for wire system ageing, another for corrosion fatigue of the primary system, especially the reactor pressure vessel.

During the evaluation period 2002-2005, the NKS-R program has consisted of 23 activities. They are listed in Table 2

Table 2. Summary of the NKS-R activities during 2002-2005

Acronym	**Activity name**	**Total NKS funding kDKK 2002-2005**	**Duration**	**Leader(s)**
PrePool & DeliPool	Condensation pool experiments	1385	2002 -	Antti Timperi, VTT Heikki Purhonen, LUT
Main Culture	Maintenance culture and management of change	1900	2002 - 2005	Teemu Reiman, VTT
SafetyManagement	Safety management in non-nuclear contexts with potential relevance for the nuclear power industry and regulators	720	2002 - 2005	Ola Svenson, Stockholm Univ
3DTransientSeminar	Seminar on 3D BWR Transient Analysis Methodology	280	2002 - 2003	Antti Daavittila, VTT

Acronym	Activity name	Total NKS funding kDKK 2002-2005	Duration	Leader(s)
BarriersControlManagement	Barriers, control and management - An analysis of concepts with applications in nuclear power plant safety	695	2002 - 2004	Morten Lind, DTU
RutheniumReleases	Ruthenium behaviour in severe accident condition	900	2002 -	Ari Auvinen, VTT
PreDeliMelt	DELImelt pre-project	180	2002	Bal Raj Sehgal, KTH
CCFModels	CCF model comparison	101	2002	Ralph Nyman, SKI
DigitalRequirements	Traceability and communication of requirements in digital I&C systems development, TACO	950	2002 - 2005	Terje Sivertsen, IFE Atoosa P-J Thunem, IFE
RiskInformedDecisions	Framework for systematic approach and documentation for risk-informed decision making, pre-project	100	2002	Kaisa Simola, VTT
Valdor2003	VALDOR 2003: the 3rd symposium addressing transparency in risk assessment and decision making	100	2002	Kjell Anderson, Karinta Konsult
AutomationSeminar	Nordic seminar on nuclear automation	118	2002	Karl-Erik Erikson, OKG
RegulatorySeminar	Nordic seminar on nuclear regulatory work on reactor safety	-	2003	Lars Gunsell, SKI
DecommSeminar	Nordic seminar on plant decommissioning	100	2004	Karin Brodén, Studsvik RadWaste AB
ShutdownSequences	Evaluation of reactor shutdown sequences with partly failing of shutdown systems	250	2004	Göran Hultqvist, Forsmarks Kraftgrupp
NOTNet	Nordic thermal-hydraulic and nuclear safety network	300	2004	Jari Tuunanen, VTT
ExCoolSE	In-vessel and ex-vessel coolability and energetics of steam explosions in boiling water reactors	800	2004 -	Hyun Sun Park, KTH
ImprovementPrgSeminar	Seminar on experience from Nordic safety improvement programs towards NPPs in Russia and Eastern European countries	100	2004	Thorbjörn Björlo, IFE
KnowledgeManagement	Workshop on knowledge management in Nordic NPPs	90	2004	Svein Nilsen, IFE
CorrosionFatigue	Corrosion fatigue	200	2005 -	Urpo Sarajärvi, VTT
CableAging	Wire system ageing assessment and condition monitoring	200	2005 -	Paolo Fantoni, IFE

Acronym	Activity name	Total NKS funding kDKK 2002-2005	Duration	Leader(s)
MORE	Management of requirements in NPP modernisation projects	150	2005 -	Terje Sivertsen, IFE Atoosa P-J Thunem, IFE
CostCalculation	Cost calculation and related issues with regard to decommissioning and dismantling of nuclear research facilities	200	2005 -	Rolf Sjöblom, Tekedo AB

1.1.2 NKS-R Funding

Annual NKS funding to NKS-R is shown in Figure 2. The total costs of the NKS-R program during 2002-2005 have been 11.7 MDKK, of which the activities have received 9.8 MDKK and the program manager 1.9 MDKK (16%). Funding of the program manager consists of the fees, program manager’s travel costs and co-ordinating costs such as arranging internal seminars for the activity leaders.

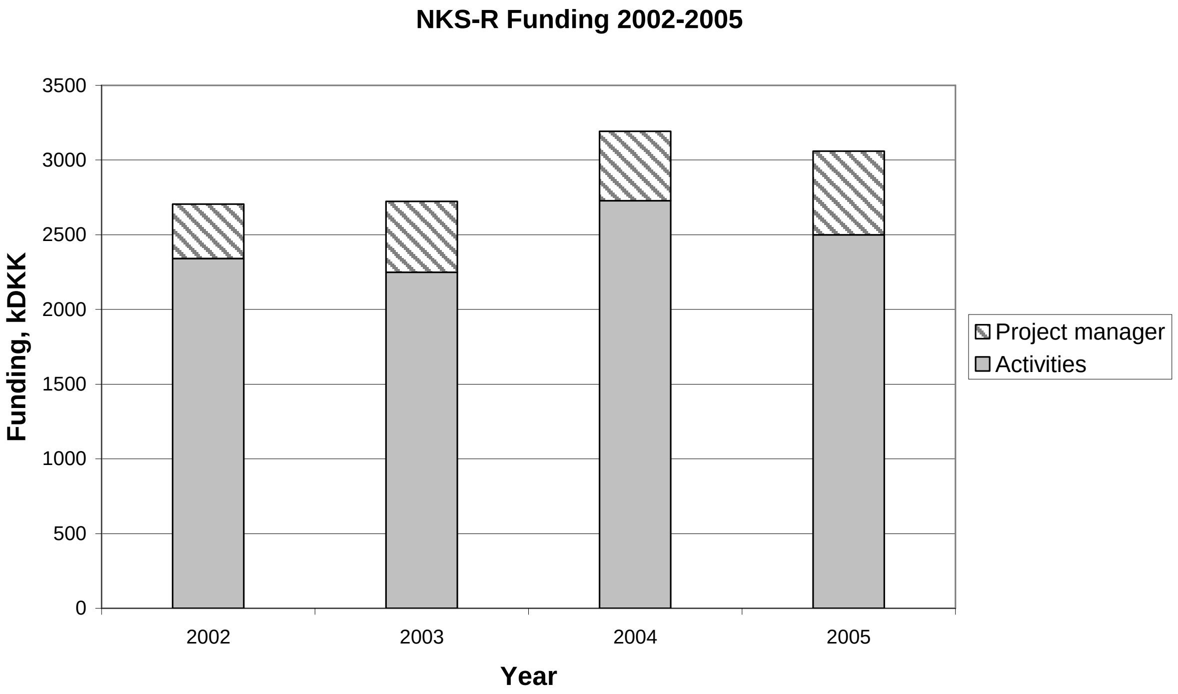


Figure 2. Annual NKS funding to NKS-R in 2002-2005, thousands of Danish kroner (kDKK).

NKS annual funding to individual activities has varied from about 0.1 to 0.6 MDKK. Research projects have usually received 0.3-0.4 MDKK annually, whereas a typical sum granted for arranging a seminar has been 0.1 MDKK. It must be pointed out that the NKS-R funding is not the main funding source for the activities. A majority of the resources is provided by national or other funding.

Of the 23 NKS-R activities, seven have received a substantial NKS funding, over 0.5MDKK, in 2002-2005:

- MainCulture (1.90 MDKK),
- DeliPool (1.385 MDKK),
- ExCoolSE (0.80 MDKK, PreDeliMelt 0.18 MDKK, in total 0.98 MDKK),
- DigitalRequirements (0.95 MDKK),
- RutheniumReleases (0.90 MDKK),
- SafetyManagement (0.72 MDKK) and
- BarriersControlManagement (0.695 MDKK).

All activities listed above were started in 2002 and were continued at least for three years.

Development of the NKS funding to the themes DELI and MANGAN, and to NKS-R seminars is shown in Figure 3. The numbers in the Figure show the year of the funding decision, which causes small inconsistency. For example, the funding decision for the decommissioning seminar was made in 2004, but the seminar was arranged in 2005. It is hence shown in the 2004 column.

Figure 3 illustrates the dynamic nature of the current NKS program structure. Focus on different themes has varied considerably during the evaluated period. Summing over the four years 2002-2005, both themes have received almost equal NKS funding (48% to Management and organisation, 44% to Development and validation). Total NKS-R funding for arranging of seminars has been 0.8 MDKK in 2002-2005, i.e. ~8%.

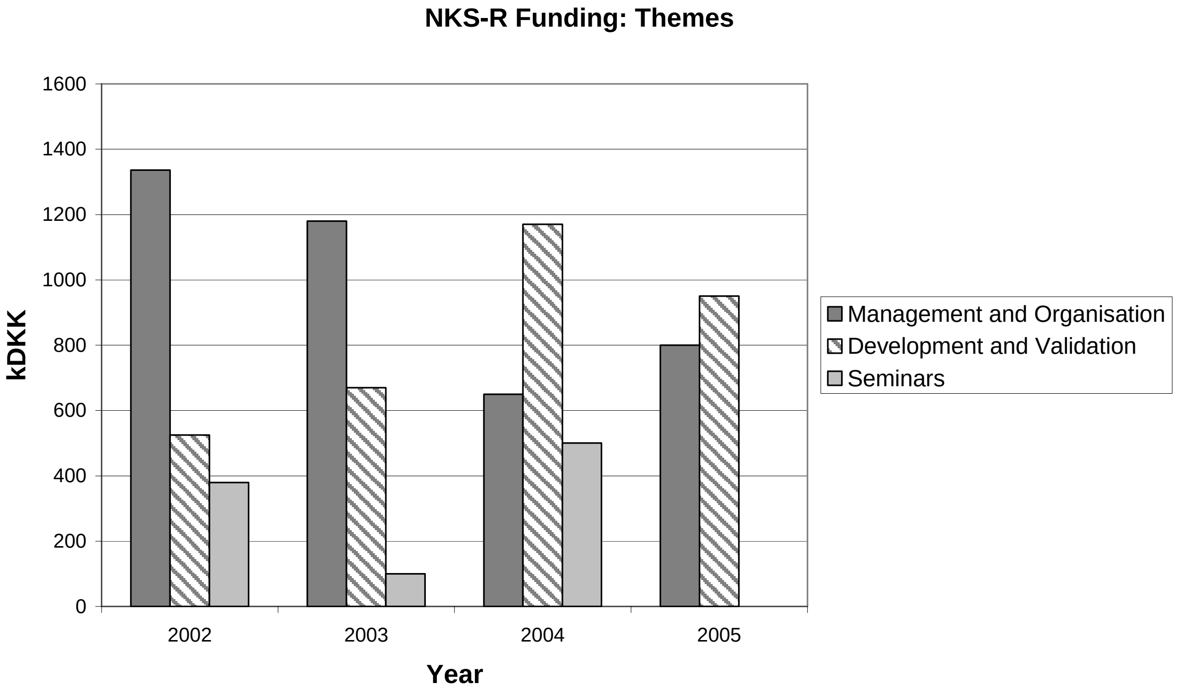


Figure 3. Distribution of NKS-R funding to activity themes and to seminars.

Funding distribution to research areas in 2002-2005 is shown in Figure 4. Two focus areas can be seen:

- thermal-hydraulics / severe accidents and
- organisational issues / safety culture,

which both have received approximately a third of the total. The remaining third has been allocated to the other five areas. The distribution reflects the history of the NKS-R program since 2002. Activities in the two larger were part of the program already in 2002 and have continued to 2005. Radioactive waste and decommissioning as well as plant lifetime management are newcomers to the program, having activities started in 2005.

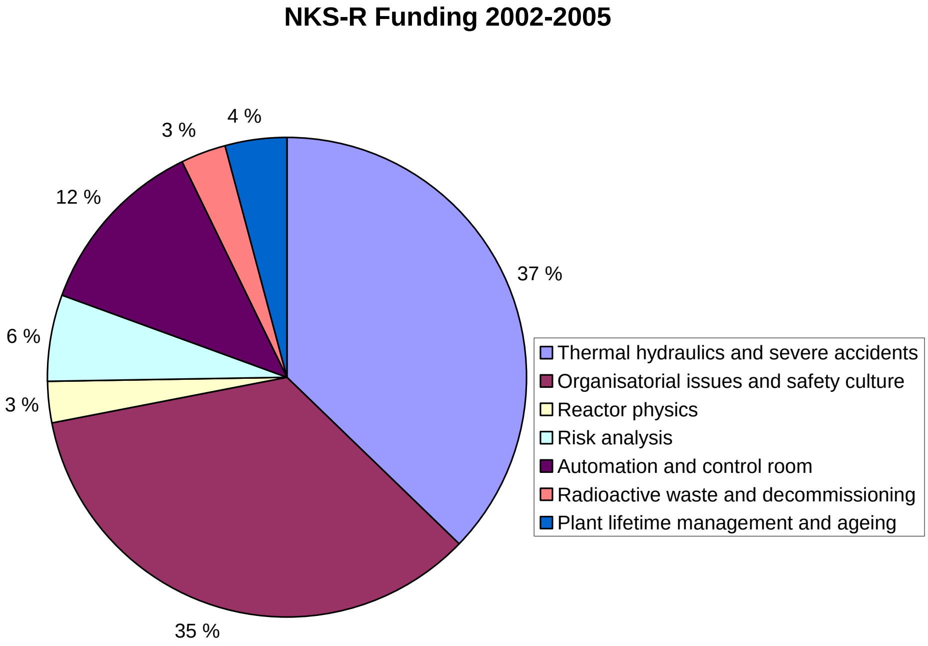


Figure 4. Distribution of NKS-R funding (total 2002-2005) to research areas.

Leading organisations of the NKS-R activities in 2002-2005 are listed in Table 3, which shows also the total NKS funding for their activities. There is a significant difference in organisation of nuclear safety research between the Nordic countries, illustrated also by the number of NKS-R activity leading organisations per country: Sweden had 8 organisations managing 10 activities, whereas the Finnish 7 activities have been managed by VTT, and the Norwegian 5 by IFE.

The activities managed by VTT have received by far the largest share of NKS-R funding in 2002-2005, about 45% of the total. The VTT led activities have in fact received a larger sum than the activities of the next four organisations (IFE, KTH, SU, DTU) together.

Table 3. NKS-R Funding to organisations. Thousands of DKK (kDKK). Total 2002-2005

Country	**Organisation**	**Number of activities**	**NKS funding to activities 2002-2005 (kDKK)**
Finland			
	VTT	6½	4372,5
	LUT1)	½	692,5

Country	**Organisation**	**Number of activities**	**NKS funding to activities 2002-2005 (kDKK)**
Sweden			
	SU	1	720
	KTH	2	980
	SKI	2	101
	Karinta Konsult	1	100
	OKG	1	118
	Studsvik RadWaste	1	100
	Forsmark	1	250
	Tekedo AB	1	200
Norway			
	IFE	5	1490
Denmark			
	DTU	1	695
Total		23	9819

[1)] Funding for the DeliPool activity has been equally divided between LUT and VTT

The total funding received in 2002-2005 grouped by the country of the leading organisation is shown in Figure 5. Finnish (VTT) led activities have received 52% of the NKS-R funding, Swedish 27%, Norwegian 13% and Danish 7%. The pattern has remained approximately the same also in funding decisions for 2006 activities.

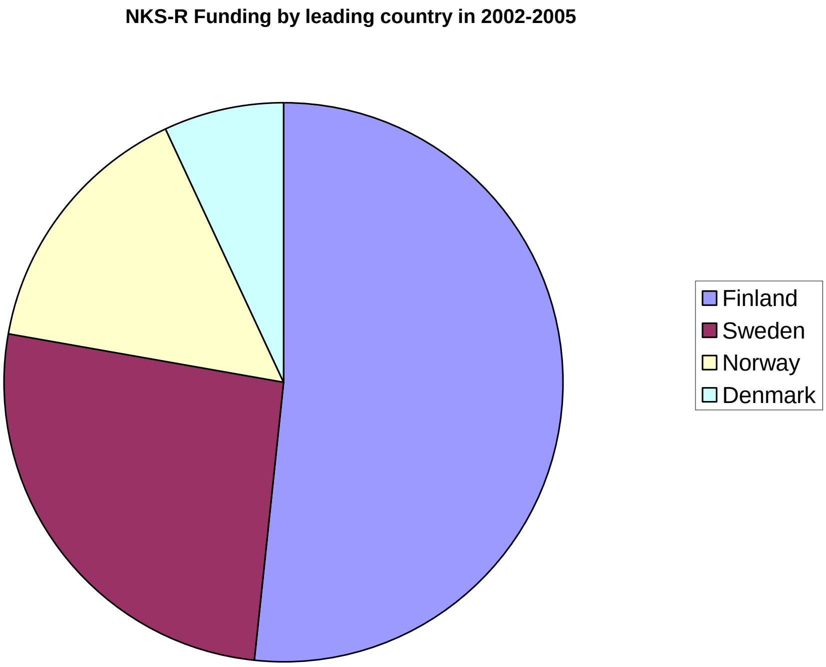


Figure 5. NKS-R Funding in 2002-2005 per country of the leading organisation.

Considering the size of the reactor safety programs in the Nordic countries, Swedish activities have obviously been underrepresented in NKS-R.

1.1.3 NKS-R publications

NKS-R publication activity has been prolific. 28 reports have been published in the NKS publication series alone, listed in Table 4. In addition, numerous reports have been published in scientific journals, at conferences and as national research publications.

Table 4. Summary of NKS-R publications in the NKS series, 2002-2005

Activity name and acronym	**Project publications in NKS series**
Condensation pool experiments (PrePool & DeliPool)	A. Timperi *et al.*: *Numerical analyses of a water pool under loadings caused by a condensation induced water hammer.* NKS-96. Mar 2004
	J. Laine, M. Puustinen: *Preliminary condensation pool experiments with steam using DN80 and DN100 blowdown pipes.* NKS-97. Mar 2004
	Timo Pättikangas et al*: Fluid-Structure Interaction Analysis of a Water Pool under Loading Caused by a Condensation-Induced Water Hammer.* NKS-104. Apr 2005
	J. Laine & M. Puustinen: *Condensation Pool Experiments with Steam Using DN200 Blowdown Pipe.* NKS-111 Aug 2005
Maintenance culture and management of change (Main Culture)	T. Reiman *et al.*: *Contextual assessment of maintenance culture at Olkiluoto and Forsmark.* NKS-94 Apr 2004
	Teemu Reiman et al: *Maintenance culture and management of change. - Intermediate report 2004.* NKS-108 Apr 2005
Safety management in non-nuclear contexts with potential relevance for the nuclear power industry and regulators (SafetyManagement)	O. Svenson, I. Salo: *Safety Management: A Frame of Reference for Studies of Nuclear Power Safety Management and Case Studies from Non-Nuclear Contexts.* NKS-88 Sep 2003
	O. Svenson, I. Salo, P. Allwin: *On safety management and nuclear safety.* NKS-95 Mar 2004
	Ilkka Salo and Ola Svenson (Coordinators)*: A summary of the Nordic-group conference on safety management, Lund, Sweden, October 28-29, 2004.* NKS-106 Apr 2005
Seminar on 3D BWR Transient Analysis Methodology (3DTransientSeminar)	A. Daavittila (ed.): *3D Analysis Methods - Study and Seminar.* NKS-89 Oct 2003
Barriers, control and management - An analysis of concepts with applications in nuclear power plant safety (BarriersControlManagement)	M. Lind: *Barriers, Control and Management. Report from the pilot phase.* NKS-87 Sep 2003
	Johannes Petersen: *Countermeasures and Barriers* NKS-113 Oct 2005
	Morten Lind: *Modeling Goals and Functions of Control and Safety Systems -theoretical foundations and extensions of MFM.* NKS-114 Oct 2005
Ruthenium behaviour in severe accident condition (RutheniumReleases)	U. Backman *et al.*: *Ruthenium behaviour in severe nuclear accident conditions - progress report.* NKS-92 Mar 2004
	U. Backman *et al.*: *Ruthenium Behaviour in Severe Nuclear Accident Conditions - Final Report.* NKS-100 Aug 2004
DELImelt pre-project (PreDeliMelt)	B.R. Sehgal, H.S. Park: *Final Report on PRE-DELI-MELT, Pre-Project (PRE) on Development & Validation (DELI) of Melt Behavior (MELT) in Severe Accidents.* NKS-99 Jun 2004
CCF model comparison (CCFModels)	U. Pulkkinen: *CCF Model Comparison.* NKS-90 Apr 2004
Traceability and communication of	T. Sivertsen *et al.*: *Traceability and Communication of Requirements in Digital I&C Systems Development. Project Report 2003.* NKS-91 Mar 2004

Activity name and acronym	Project publications in NKS series
requirements in digital I&C systems development, TACO (DigitalRequirements)	Terje Sivertsen et al*: Traceability and Communication of Requirements in Digital I&C Systems Development - Project Report 2004.* NKS-103 Apr 2005
	Terje Sivertsen et al: *Traceability and Communication of Requirements in Digital I&C Systems Development. Final Report.* NKS-115 Oct 2005
Framework for systematic approach and documentation for risk-informed decision making, pre-project (RiskInformedDecisions)	K. Simola, U. Pulkkinen: *Risk Informed Decision Making – a Pre-Study.* NKS-93 Apr 2004
VALDOR 2003: the 3rd symposium addressing transparency in risk assessment and decision making (Valdor2003)	K. Andersson (ed.): *VALDOR 2003. VALues in Decisions On Risk. Proceedings.* Jun 2003
Nordic seminar on nuclear automation (AutomationSeminar)	K-E Eriksson (ed.): *Proceedings of the Nordic Seminar on Nuclear Automation.* NKS-101 Aug 2004
Nordic seminar on plant decommissioning (DecommSeminar)	Karin Brodén (ed.): *Seminarium om avveckling. Risø, 13-15 September 2005.* NKS-116 Dec 2005.
Nordic thermal-hydraulic and nuclear safety network (NOTNet)	Jari Tuunanen and Minna Tuomainen*: Final Report of the "Nordic Thermal-Hydraulic and Safety Network (NOTNET)"- Project.* NKS-107 Apr 2005
In-vessel and ex-vessel coolability and energetics of steam explosions in boiling water reactors (ExCoolSE)	H. S. Park et al: *Ex-Vessel Coolability and Energetics of Steam Explosions in Nordic Light Water Reactors - EXCOOLSE Project Report 2004* NKS-112 Oct 2005
Seminar on experience from Nordic safety improvement programs towards NPPs in Russia and Eastern European countries (ImprovementPrgSeminar)	Thorbjörn Björlo (ed.)*: Nordic Nuclear Safety Research (NKS) Seminar on “Experience from Nordic Safety Improvement Programmes towards Nuclear Power Plants in Russia, Central- and East-European Countries” Park Hotel, Halden, Norway 25th-26th November, 2004. - Seminar proceedings.* NKS-105 Apr 2005
Workshop on knowledge management in Nordic NPPs (KnowledgeManagement)	Svein Nilsen: *Knowledge Management in Nordic NPPs. Summary report of the findings from the workshop.* NKS-102 Apr 2005

1.1.4 NKS-R Seminars

Nine seminars have been arranged by NKS-R during 2002-2005.

- 3D BWR Transient Analysis Methodology April 8, 2003, Otaniemi, Finland.
- Values in Decisions on Risk, VALDOR 2003, June 9-13, 2003, Stockholm, Sweden.
- Nordic Seminar on Nuclear Regulatory Work on Reactor Safety, November 3-4, 2003, Stockholm, Sweden.
- Nordic Seminar on Nuclear Automation, April 5-7, 2004, Oskarshamn, Sweden
- Knowledge management in Nordic NPPS's, October 7-8, 2004, Halden, Norway
- Nordic-group conference on safety management, October 28-29, 2004, Lund, Sweden
- NKS Seminar on Safety Improvement Programs in Russia and Eastern Europe, November 25 - 26, 2004, Halden, Norway
- Traceability and Communication of Requirements in Digital I&C Systems Development, 2nd TACO Industrial Seminar, December 8, 2004, Helsinki, Finland
- Decommissioning Seminar, September 13-15, 2005, Risø, Denmark

The seminar participants have considered the NKS-R seminar activity useful.

1.2 Evaluation methods

Evaluation of the NKS-R part was conducted by Per Persson and Risto Sairanen. When assigning the evaluation task, the NKS Board determined a set of evaluation criteria. The criteria were formulated by the evaluators as a list of questions shown in Table 5. Information to answer the questions was collected from three sources.

- interviews of selected persons from Finland and Sweden
- a survey sent to NKS-R research result end-users and to the project participants
- review work by the evaluators

The source used for a particular question is indicated in Table 5.

Table 5. The criteria used in the NKS-R 2002-2005 evaluation

No	**Question**	**Source of information**		
		Interview	**Survey**	**Review**
1	How well is the NKS-R research program known?	✓	✓	
2	To what extent are the results utilised?	✓	✓	
3	How useful have the NKS-R seminars been?	✓	✓	
4	Has the NKS-R program created and maintained Nordic networks in reactor safety?	✓	✓	
5	Has the NKS-R program built new competence or transferred competence within the Nordic countries?	✓	✓	✓
6	Has the program provided possibilities for young scientists?	✓	✓	✓
7	What has been the scientific level?	✓	✓	✓
8	Has the program been balanced? Especially, • Have important organisations been involved? • Have there been enough information spreading activities in form of seminars, etc?	✓	✓	
9	Are the priorities the correct ones? Are any important activities missing?	✓	✓	
10	How relevant are the proposal evaluation criteria?	✓		
11	Did the projects that were selected for funding have clear goals? Did the project leaders follow the project plans and timetables?	✓		✓
12	Has the program been conducted in a cost-effective way?	✓		✓
13	What are the positive and negative experiences from the NKS-R 2002-2005 work?	✓		
14	Is the overall quality of the results satisfactory	✓		✓
15	What are recommendations for future work?	✓	✓	✓

1.2.1 Interviews

The objective of the personal interviews was to get information that would be impossible to obtain by other means. Important persons in this respect were the former and current program managers. Questions 10 and 11, for example, are of the type for which the program managers have much more background information and experience than others.

The persons interviewed in Finland were:

Petra Lundström, Fortum,	former NKS-R program manager
Nici Bergroth, Fortum	former NKS-R program manager
Jorma Aurela, Ministry of Trade and Industry	owner representative, NKS board member
Heikki Raumolin, Fortum	NKS board member
Ulla Ehrnstén, VTT	NKS board member
Olli Vilkamo, STUK	former NKS board member

In addition, Timo Okkonen, a former NKS-R program manager sent written comments to the questions.

The Swedish persons interviewed were:

Jesper Kierkegaard, Vattenfall	current NKS-R program manager
Karl-Fredrik Ingemarsson, Vattenfall	NKS board member
H. S. Park, KTH	NKS-R activity leader (ExCoolSE)
Ola Svensson, Stockholm University	NKS-R activity leader (SafetyManagement)
Lars Gunsell, SKI	owner representative, NKS board member

The interviews were documented in summary reports that were sent for comments and approval to the interviewed persons.

1.2.2 Opinion survey

Information from the end-users and activity participants was collected by a web-based opinion survey. The question sheet used in the survey is shown in Appendix 1. The survey was sent to 41 addressees in the following 22 organisations. The response was moderate, 15 answers from 10 organisations were received by May 5 2006, when the survey page was closed.

Table 6. Distribution of the NKS-R questionnaire

Organisation	**Number of answers**
Denmark	
Beredskabsstyrelsen	-
Forskningscenter Risø	-
Danish Radiation Protection Institute, SIS	-
Danish Decommissioning, DD	-
Ørsted DTU	-
Finland	
Ministry of Trade and Industry	1
Radiation and Nuclear Safety Authority	3
Teollisuuden Voima Oy	1
Fortum	1
Technical Research Centre of Finland	-
Lappeenranta University of Technology	-
Posiva Oy	-
Iceland	
Geislavarnir ríkisins	-
Norway	
Statens strålevern	2
Institutt for Energiteknikk	1
Sweden	
Vattenfall AB	1
SwedPower AB	-
Kärnkraftsäkerhet och Utbildning AB, KSU	-
Ringhals AB	-
OKG AB	1
Forsmarks Kraftgrupp	2
Statens Kärnkraftinspektion	2

1.2.3 Evaluator reviews

A third source of information was review of selected NKS-R activities by the evaluators themselves or by persons from the Finnish and Swedish regulatory organisations. Activity reports published in the NKS series were the main source of information.

The objective of the reviews was to assess the scientific level of the activity reports, connections to international research, the value of the results to the end users, and the overall quality of the results. The eight NKS-R activities that had received the largest NKS funding in 2002-2005 were reviewed in this way. They are listed in Table 7.

Table 7. NKS-R activities selected for evaluator review

Activity name (Acronym)	**Leading organisation**	**Reports reviewed**
Maintenance culture and management of change (Main Culture)	VTT	NKS-108
Condensation pool experiments (DeliPool)	VTT	NKS-104
In-vessel and ex-vessel coolability and energetics of steam explosions in boiling water reactors (ExCoolSE)	KTH	NKS-112
Traceability and communication of requirements in digital I&C systems development, TACO (DigitalRequirements)	IFE	NKS-91, NKS-103, NKS-115
Ruthenium behaviour in severe accident condition (RutheniumReleases)	VTT	NKS-92, NKS-100, NKS-118
Safety management in non-nuclear contexts with potential relevance for the nuclear power industry and regulators (SafetyManagement)	Stockholm University	NKS-88, NKS-95
Barriers, control and management - An analysis of concepts with applications in nuclear power plant safety (BarriersControlManagement)	Ørsted DTU	NKS-87, NKS-113, NKS-114
Nordic thermal-hydraulic and nuclear safety network (NOTNet)	VTT	NKS-107

1.3 NKS-R Evaluation results: The survey and the interviews

Information from the survey answers and from the interviews is collected and summarised here under the criteria from Table 5.

1.3.1 How well is the NKS-R research program known?

The question was asked in the survey in a numerical form using 5 as the highest, and 1 as the lowest score. The fractional distribution of the results is shown in Fig. 5.

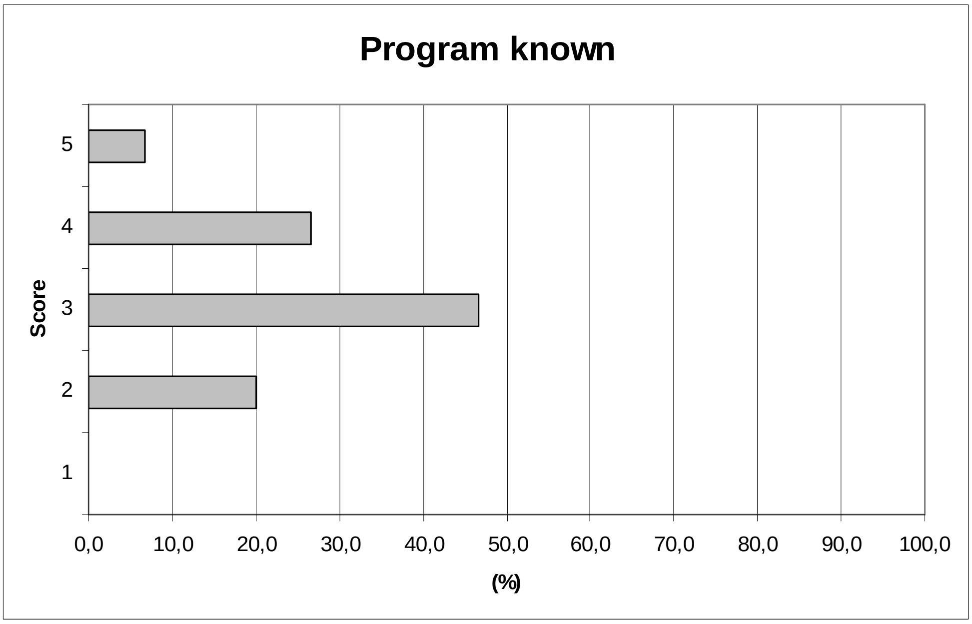


Figure 6. Survey results: familiarity of the NKS-R program.

The result indicates that the program is quite well known, at least within those organisations and by the persons who answered the survey. A remark was added in one question, that in his organisation the program is well known within a small group of people, but most of the persons working in the organisation did actually know very little of the NKS programs. Similar opinions were also given from some interviewed persons.

1.3.2 To what extent are the results utilised?

The numerical results given in the survey are shown in Figure 7. There is considerable spread, but the overall score is fairly good. It was pointed out in interviews and in the comments given in the survey, that the NKS-R activities normally are part of a larger entity, for example part of a national research project. Utilisation of results is usually an important criterion for national research. By complementing the national or international project, the NKS-R results become useful at least for some end users.

Utility representatives pointed out that in order to ensure that the results are in a form that they can use, the utilities should be involved in the activities from early stage. Strong connection to the needs of power plants was recommended.

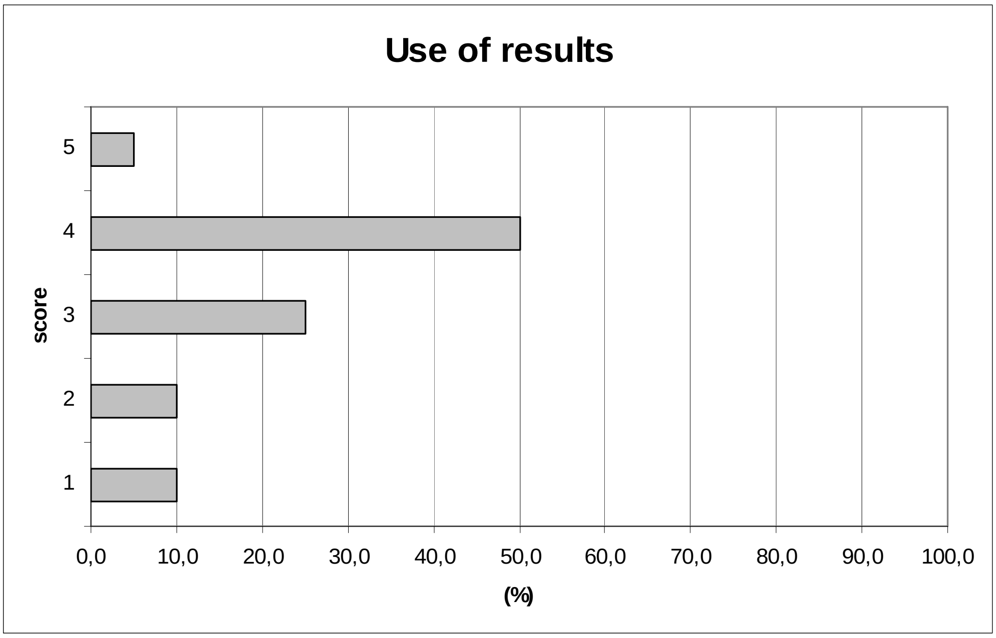


Figure 7. Survey results: Utilisation of the NKS-R program results.

1.3.3 How useful have the NKS-R seminars been?

From interviews and from the survey results it is obvious that arrangement of seminars is a very important form of NKS activity. The seminars could cover one specific subject or several minor topics. In this way there is an active distribution of the research results and there is a possibility to meet experts and to generate discussions.

The NKS-R seminars have undoubtedly been successful. Nine seminars have been arranged within four years. The survey scores were all high numbers 3-5, averaging over 4. During interviews, the Automation seminar in Oskarshamn, the seminar on Nuclear Regulatory Work in Stockholm, and the Decommissioning seminar in Risø were mentioned as examples of useful and well organised NKS-R seminars.

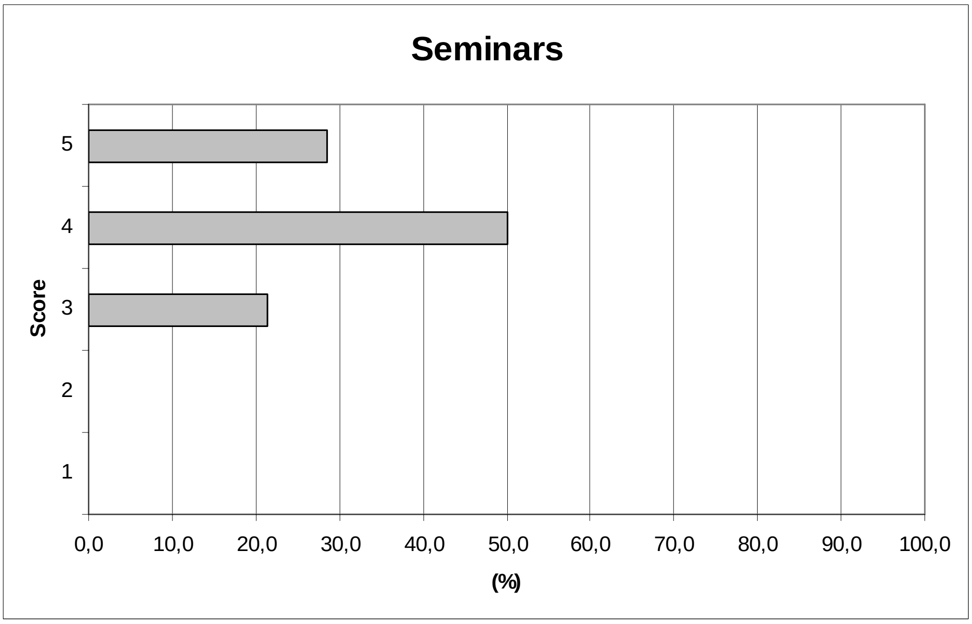


Figure 8. Survey results: NKS-R seminars.

The seminars up to date have focused on a specific topic, not on NKS-R research. There has been no general NKS-R seminar to give information of the total program results in 2002-2005. It was recommended to arrange also this kind of seminars at certain intervals. A 4-year interval was considered suitable, because enough results should be available to arrange a seminar.

Some internal seminars for NKS-R activity leaders have also been arranged. The persons who actively participated in the program (managers, activity leaders) considered this type of joint discussion necessary for effective conduction of the program.

1.3.4 Has the NKS-R program created and maintained Nordic networks in reactor safety?

The question on Nordic networks received maybe the most complex response in the list of questions The numerical results for the question were fairly good, as shown in Figure 9. Criticism was expressed in the written comments, however. It was pointed out that there had been a lack of contacts to the established Nordic co-operation groups like NPSAG, NORTHNET or APRI.

In most of the NKS-R activities the main work has been conducted by the leading organisation alone. An indication of this can be seen in the reporting. Only two of the NKS-R activities have produced reporting having authors from more than one country.

There have been cases, where networking has undoubtedly been good. MaintenanceCulture and DigitalRequirements were mentioned in interviews as successful examples of network building activities. Indicative, these are the NKS-R projects that have produced reports by authors from several countries.

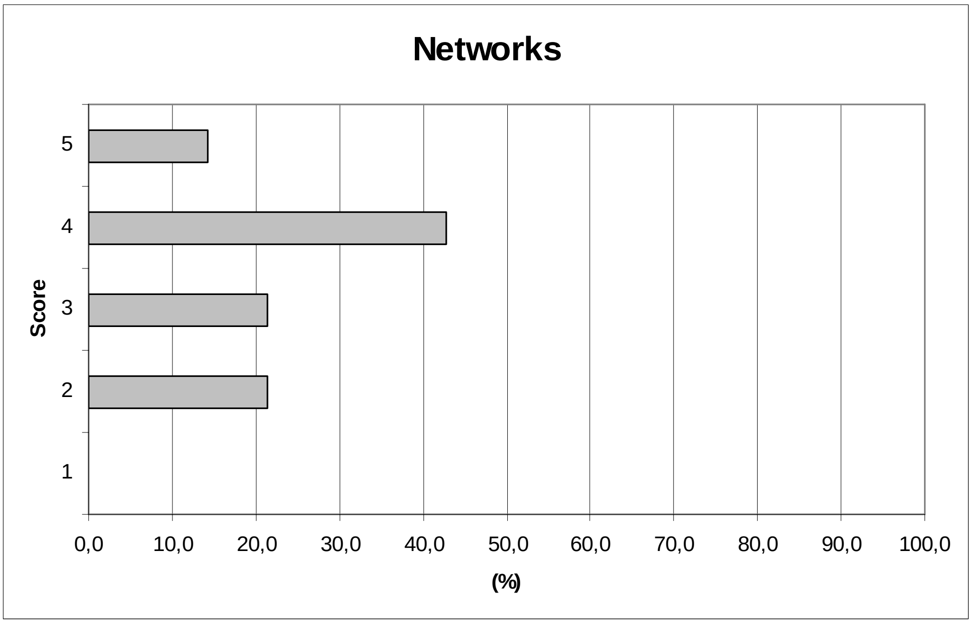


Figure 9. Survey results: Network creation.

It was recommended in one survey answer that to improve the co-operation each NKS-R research activity should have participants from at least two Nordic countries. Another suggestion was that a mechanism could be established, by which the program manager could merge activity proposals having similar contents into one joint activity.

There has been an activity in NKS-R with a particular objective to create a Nordic network, NOTNet. NOTNet produced a plan for Nordic thermal hydraulic and safety network, including detailed research plans. The next step has been taken late 2005 with the NORTHNET kick-off meeting. The new NORTHNET co-operation is separate from NKS. It could be considered to include NORTHNET supporting or co-ordinating activities in the future NKS-R, too.

1.3.5 Has the NKS-R program built new competence or transferred competence within the Nordic countries?

The numerical survey results, as shown in Figure 10, are again good. It was pointed out, that the NKS-R research has been linked to the national research programs having as one objective to build new competence. In most cases, it is impossible to separate the NKS-R part from the nationally funded part.

It was stressed in the interviews that the development of competence is an important factor for the Nordic countries. It was suggested that organized education, as a series of seminars and/or regular education in relevant subjects might be an activity supported by NKS. In such an activity the research results could be presented and explained together with more fundamental information. Possibly, existing Nordic facilities could be used, like research reactors and full scale simulators.

The question is linked to the next question on the possibilities for young scientists.

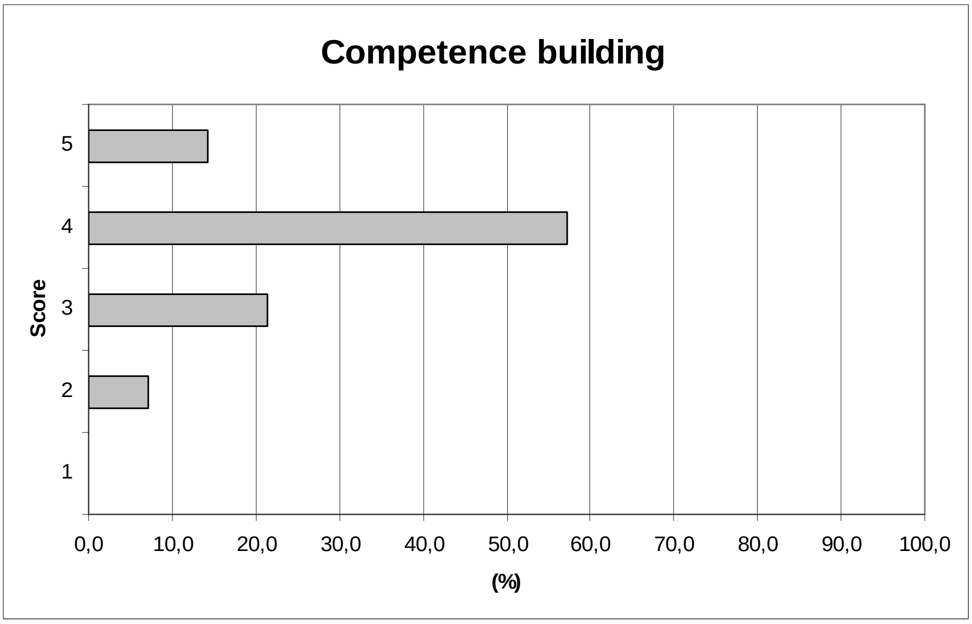


Figure 10. Survey results: Competence building.

1.3.6 Has the program provided possibilities for young scientists?

The score in the survey was quite good also in this respect. Participation of young scientists is one of the evaluation criteria for applications. Therefore it has been considered in most of the activities. On the other hand, the program has not been targeted at young persons. Most of the activity leaders have been experienced scientists.

The generation shift is a concern for all Nordic countries. In Finland and Sweden the generation who participated in the building of existing reactors is retiring within some years. In was suggested that NKS could initiate some activity focused especially on young scientists.

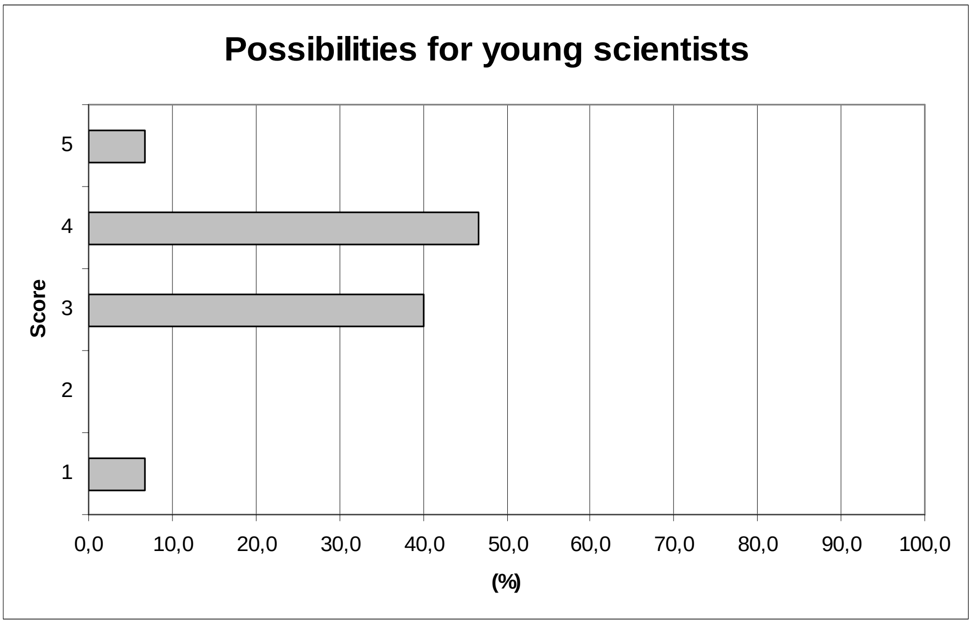


Figure 11. Survey results: Possibilities for young scientists.

1.3.7 What has been the scientific level?

The survey results gave rather good scores on this question. The interviewed persons considered the scientific level high in the areas they were familiar with. Of the projects that have received the highest NKS-R financing, many have produced results of high scientific quality. Some examples mentioned in this respect were: DeliPool, ExCoolSE, MainCulture, RutheniumReleases and DigitalRequirements.

There was also a recommendation to encourage some visionary work, even if it does not produce immediate results.

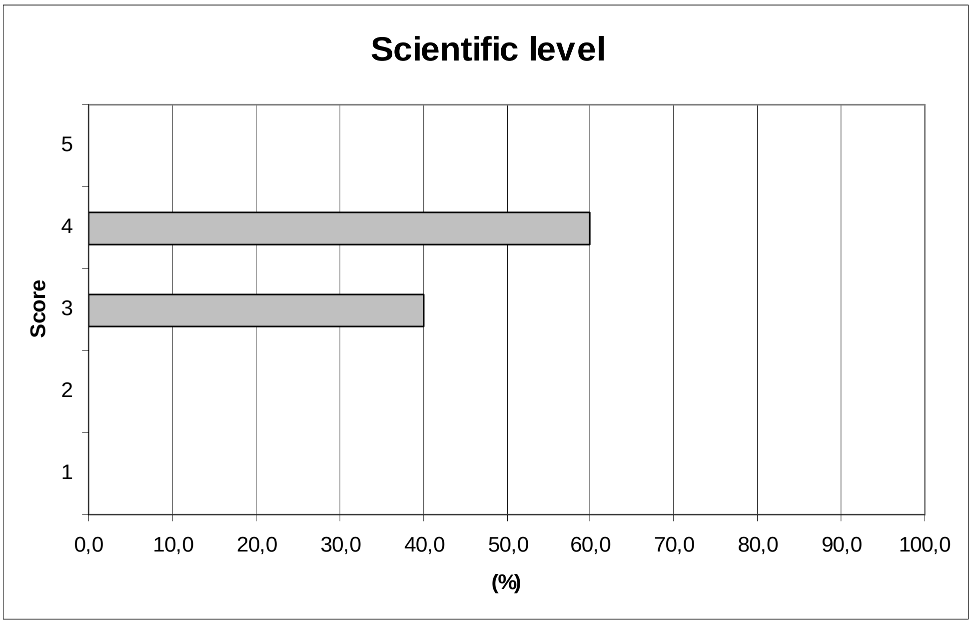


Figure 12. Survey results: NKS-R scientific level.

1.3.8 Has the program been balanced?

Written comments were given on this topic in the survey questionnaire. The balance of the NKS-R research topics and the themes was considered relatively good by the persons that answered the survey. The interviewed persons were also satisfied with the balance.

An increase in seminar activity and information meetings was requested in several answers. On the other hand, it was pointed out that there is a limit to the frequency of seminars that would be attended, and that there should be a need for a Nordic seminar. It must be pointed out, that the current NKS method of working has decreased the direct influence of the governing bodies. A seminar will be arranged only if some organisation submits a proposal for it. The program manager can influence proposals in an indirect way by contacting suitable organisations and encouraging project proposals for seminars. The Board can also play an active role within their own country.

The current NKS organisation allows for dynamics, as the annual evolution of the NKS-R themes shows in Fig. 2. Eventually, the content of the program is based on the activity proposals. For example, automation and plant ageing are topics that could have had more weight but applications in these areas have been few up to recent years. The weight of decommissioning is increasing, which was generally considered positive.

Most of the activity proposals came from universities and research organisations. The utilities have been involved in the activities but have not acted as activity leaders except in a few cases. It was pointed out, that utility involvement was necessary for rendering the results applicable at the power plants. Without direct power plant contacts, the research was easily considered “academic” by the end users, and not relevant for practical application.

1.3.9 Are the priorities the correct ones? Are any important activities missing?

The NKS-R instructions for Call for Proposals do not rank the research topics. Some interviewed persons considered that NKS should specify the research objectives more precisely. More weight should be put on the applicability of the result by defining the end users and discussing with them in advance, before submitting a proposal.

It was also admitted that a small program can not cover everything. On particular topics, the response varied widely between the answers. Some examples are:

- Decommissioning is an interesting new opening
- More waste issues
- Waste issues are not important
- Modernisation of I&C should have a higher volume
- More PSA
- Keep organisation and human factors in focus
- Focus on nuclear specific issues
- More projects on safety assessment of design and operation
- There is a good balance now, which should be kept in the future

It was mentioned in one of the interviews, that the NKS program should not give an impression that the current structure (the projects themselves, types of projects, research topics) will continue unchanged for ever. It was therefore recommended, that NKS reviews the whole program at certain intervals and changes the structure if considered appropriate.

1.3.10 How relevant are the proposal evaluation criteria?

This question was only put to persons, who have been involved with the activity proposals, i.e. the program managers and activity leaders. They were generally satisfied with the present application process and the evaluation criteria. The NKS-R framework report has been revised a couple of times with improvements. It was considered that the current criteria reflect well the objectives of the NKS-R program.

A common practise in EU research projects is that the participating organisations must come from several EU countries. This is not required in NKS-R considering individual activities. The overall program should be geographically balanced, but ensuring this has been left to the program managers and to the NKS board.

As an evaluation criterion, the term "Nordic dimension" has been applied. The term has enabled funding of activities conducted by single countries, even by single organisations, if the activity topic has been of common Nordic interest. All the reviewed NKS-R activities have fulfilled this, quite flexible, evaluation criterion. Even if the research has been conducted by a single organisation, the results have been applicable for more than one country.

1.3.11 Did the projects that were selected for funding have clear goals? Did the project leaders follow the project plans and timetables?

The question was put to the program mangers. They considered the quality of the projects good and managing of the NKS-R program relatively problem free. Generally, the activity leaders kept the schedules and budgets. In those few cases, where a delay in reporting was observed, funding has been frozen until the missing document has been delivered.

1.3.12 Has the program been conducted in a cost-effective way?

This question was asked in the interviews but not in the survey. The main comment was that NKS-R has produced good results with a small budget. The cost basis of the activity proposals has been regularly checked, and the costs have been acceptable.

Program management requires a large effort. The former project managers considered that the work can not be done with less than the volume they have used, 50% of their working hours. They recommended that the NKS Board should take a more active role in reviewing the applications and discussing the program manager background information paper.

NKS-R funding is given in two rounds: a larger sum is distributed in autumn; a part is reserved for distribution in spring. The former NKS-R program managers considered the spring round unnecessary. Their opinion was that it complicates the project proposal evaluation and conduction of the program. The main body of activities receives financing in the autumn, starts work at the beginning of the next year and can provide measurable results within the same year. The projects with a funding decision in May make contracts early summer and generally begin their work only after the summer vacations. The results they have produced by the end of the year are therefore very limited.

The end users pointed out that all NKS-R program managers have been effective, but that the system is also quite dependent on the capability of the program manager. Some of them also felt that NKS organisation is heavy considering the volume of the program.

1.3.13 What are the positive and negative experiences from the NKS-R 2002-2005 work?

During the interviews this question was put to the program mangers and activity leaders. The former program managers considered their work interesting, a good opportunity to learn of different research topics, and a valuable way to meet persons working in nuclear safety on Nordic countries. Before their assignment their impression of the NKS research had been vague, but their appreciation of the value of the NKS activities increased during the work. The method of working was considered generally efficient.

Two activity leaders were interviewed who both had NKS-R funding as complement to other funding sources. The ExCoolSE activity belonging to the DELI part did not have any participants from other countries whereas the SafetyManagement activity in MANGAN had participants from Finland and Norway. Both leaders had a positive experience of cooperation with NKS.

Concerning the experimental ExCoolSE project it was stressed that it is difficult to get funding for projects to such an extent that a ”critical mass” can be obtained and ”real research” can be carried out.

1.3.14 What are recommendations for future work?

Most of the survey results and interviews were positive with regard to the present NKS-R program. There are some comments, however, that were mentioned several times:

- efforts should be made to get a better distribution of the NKS-R activities and research results,
- a strong connection to the needs of power plants is needed,
- the work should be connected to the established Nordic working groups, as well as with EU-research,
- Nordic co-operation within activities should be better,
- a review every 4 or 5 years is needed

1.4 Detailed review of selected activities

The eight NKS-R activities that had received the largest NKS funding in 2002-2005 were reviewed by the evaluators and by persons from the Finnish and Swedish regulatory organisations. Activity reports published in the NKS series were the main source of information.

1.4.1 BWR condensation pool experiments

Title	**Condensation pool experiments**
Identification number and Acronym	NKS_R_2002_01, PrePool/DeliPool
Duration	Started 2002, continues in 2006
NKS funding 2002-2005	1.385 MDKK
Leader	Antti Timperi, VTT (FI)
Participants	VTT (FI), LUT (FI)
Deliverables	A. Timperi et al.: Numerical analyses of a water pool under loadings caused by a condensation induced water hammer. NKS-96, March 2004. J. Laine, M. Puustinen: Preliminary condensation pool experiments with steam using DN80 and DN100 blowdown pipes. NKS-97, March 2004. Timo Pättikangas et al: Fluid-Structure Interaction Analysis of a Water Pool under Loading Caused by a Condensation-Induced Water Hammer. NKS-104, April 2005. J. Laine & M. Puustinen: Condensation Pool Experiments with Steam Using DN200 Blowdown Pipe. NKS-111, August 2005.
Evaluated deliverables	NKS-104

BWR suppression pool studies were started in 2002 by a pre-project PrePool and later continued with the DeliPool activity. VTT has been the leading organisation. The activity includes experiments (POOLEX) conducted at LUT and analyses of the experiments done at VTT. During the time under review, 2002-2005, PrePool/DeliPool has received 1.385 MDKK total NKS funding. In addition, the national funding to the project has been substantial.

Connections to other Nordic organisations have been few. No organisations outside Finland have participated. The Nordic dimension criterion has been justified by the objective of the investigation, which is common and judged important for all Nordic BWRs. By the end of 2005, the activity has published four reports in the NKS series.

The recent report *Fluid-Structure Interaction Analysis of a Water Pool under Loading Caused by a Condensation-Induced Water Hammer, NKS-104,* contains a description of a fluid-structure interaction analysis of a water pool caused by condensation induced water hammer. Advanced CFD and structural analysis codes have been used and the need for coupling such methods is emphasized. So called smart methods have been applied to couple commonly used codes from the two areas.

Three different methods for estimation of pressure loads in a pool from steam condensation have been tried. In one a Method of Images method based on POOLEX experiments was used to estimate chugging loads. The second was based on a homogeneous two-phase model for the CFD-application. In the third method the loads because of collapse of a circular cavity at constant pressure in an incompressible liquid (Rayleigh bubble) were evaluated. The situation was modelled as a mass sink based on the velocity of the bubble radius. The second part of the report was devoted to application of fluid-structure interaction code making use of Star-CD and ABAQUS FE.

The study had the character of testing the applicability rather than revealing more in-depth results. The objectives with the study were not clear and conclusions were rather vague. It was stated that the method of images was successfully applied but that the source term would need to be developed. The homogeneous method was inadequate. It was only stated that the loads of the collapsing bubble had been compared to previous calculations.

It appears that the objectives and results of the study are rather limited. Conclusions are based on experience with the numerical performance rather than the ability to simulate the physics of fluid-structure interaction. The study would have benefited from more extended comparisons with experiments or analytical solutions. The scientific content is judged as moderate. It needs to be significantly extended to be useful.

In the conclusions some pool wall displacement results were judged to be unrealistic. This was coupled to the limited degree of freedom. This and other conclusions would need a stronger substantiation and quantification to be useful. In the conclusions a reference is made to a previous analysis of a PWR core barrel during LOCA. No comments are made to potential relevance for this study.

1.4.2 Assessment of maintenance culture safety and efficiency in Finland and Sweden

Title	**Maintenance culture and management of change**
Identification number and Acronym	NKS_R 2002_02, MainCulture
Duration	2002-2005
NKS funding 2002-2005	1.9 MDKK
Leader	Teemu Reiman, VTT (FI)

Participants	VTT (FI), Mälardalen University (S)
Deliverables	T. Reiman et al.: Contextual assessment of maintenance culture at Olkiluoto and Forsmark. NKS-94, April 2004 Teemu Reiman et al: Maintenance culture and management of change. - Intermediate report 2004. NKS-108, April 2005
Evaluated deliverables	NKS-108

MainCulture, Contextual assessment of maintenance culture safety and efficiency in Finland and Sweden, was started in 2002 and continued until the end of 2005. VTT has been the leading organisation. Of all NKS-R activities, MainCulture has received the highest NKS funding in 2002-2005: 1.9 MDKK.

There has been an essential Nordic dimension in the activity. A network has been created between the researchers at VTT and MU. Distribution of competence has been done by a common research methodology created in the study and by the use of case studies from both Finland and Sweden. The activity reports have been jointly written by VTT and MU personnel.

The project has a considerable new value with regard to the organizational changes which have been made during later years at Swedish and Finnish nuclear power plants as a consequence of the deregulation of the electric power market. The activity has published two reports in NKS series during 2002-2005, and then the final one in 2006. The report *Maintenance culture and management of changes- Intermediate report 2004, NKS-108* has been used as basis of the NKS-R evaluation. This study is unique since it is the only one which has studied the consequences of changes in the nuclear field in a systematic way. The nuclear power industry in Sweden has learnt a lot of its major organisational changes during recent years, especially by follow ups/evaluations and the by improving routines and ways of working.

It has been judged that there is a substantial use of the study both by the plants and by the authorities because of creation of deepened knowledge. The study emphasises important factors which should be considered when organizational changes are to be done in a safe way.

The researchers, especially at VTT, are young and are in the beginning of their careers.

1.4.3 Safety Management

Title	**Safety management**
Identification number and Acronym	NKS_R_ 2002_04, SafetyManagement.
Duration	2002-2005
NKS funding 2002-2005	0.72 MDKK
Leader	Ola Svenson, Stockholm University
Participants	SU (S), Lund University (S), IFE (NO), VTT (FI)

Deliverables	O. Svenson, I. Salo: Safety Management: A Frame of Reference for Studies of Nuclear Power Safety Management and Case Studies from Non-Nuclear Contexts. NKS-88, September 2003 O. Svenson, I. Salo, P. Allwin: On safety management and nuclear safety. NKS-95, March 2004 Ilkka Salo and Ola Svenson (Coordinators): A summary of the Nordic-group conference on safety management, Lund, Sweden, October 28-29, 2004. NKS-106, April 2005 Seminar: Nordic-group conference on safety management, October 28-29, 2004, Lund, Sweden
Evaluated deliverables	NKS-88, NKS-95

The objectives of SafetyManagement were first to create a theoretical framework, to use this framework for analyses of non-nuclear industries, and to investigate the potential relevance of the results for the nuclear power industry and nuclear regulators The purpose of this activity was also to exchange knowledge between researchers in Nordic countries in the field of safety management and safety culture. SafetyManagement was conducted in 2002-2005 and received from NKS 0.72 MDKK funding during that time.

Stockholm University was the leading organisation. The activity had an essential Nordic dimension because it created a network between researchers from VTT, Lund University, Stockholm University and the Halden project Group. The network has arranged meetings on several occasions. The research topics which have been discussed in the project are within two highly actual fields: safety management and safety culture related to nuclear power. The findings are new. Several of the participants are young researchers.

One seminar has been arranged, from which the presentations have been documented in NKS-106. Two other NKS reports have been published. The main achievement to distribute knowledge has been writing of the book: “Nordic perspectives on safety management in high reliability organisations” (Akademitryck, Valdemarsvik 2005). This book can be used in education (competence development) and in that way it is useful for the end users.

1.4.4 Barriers, Control and Management

Title	**Barriers, Control and Management**
Identification number and Acronym	NKS-R 2002_07, BarriersControlManagement
Duration	2002-2004
NKS funding 2002-2005	0,695 MDKK
Leader	Morten Lind, DTU (DK)
Participants	DTU (DK), VTT (FI), SwedPower (S), Forsmarks Kraftgrupp (S)
Deliverables	M. Lind: Barriers, Control and Management. Report from the pilot phase. NKS-87, September 2003 Johannes Petersen: Countermeasures and Barriers NKS-113, October 2005 Morten Lind: Modeling Goals and Functions of Control and Safety Systems -theoretical foundations and extensions of MFM. NKS-114, October 2005
Evaluated deliverables	NKS-87, NKS-113, NKS-114

The objective of the activity: Barriers, Control and Management was to investigate how formalized concepts can be used to define concepts that can be used in design and assessment of nuclear power plant safety systems and procedures. The activity was conducted by Technical University of Denmark in 2002-2004. The total NKS-R funding to the activity was 0,695 MDKK. Three reports have been published in NKS series: *Barriers, Control and Management, Report from the pilot phase, NKS-87, Countermeasures and Barriers, NKS-113* and *Modeling Goals and Functions of Control and Safety Systems -theoretical foundations and extensions of MFM, NKS-114.*

The activity was started by a pilot phase, during which a large number of meetings and workshops were arranged to discuss the work between the other Nordic organizations (SKI, VTT, Forsmark, Linköping University, Risø). The pilot phase was reported in NKS-87, which is a compilation of separate summaries describing the research issues and hypotheses, the selected theoretical foundation, and an application example. The case study used as an application example: modeling of the Forsmark nuclear power plant modification and safety review processes was maybe too ambitious for the pilot phase. The report gives first a good, structured analysis of the plant modification process. The main theoretical novelty by the activity is application of Von Wright's action concepts to the plant modification and review processes. Here the pilot phase report is quite thin: the main part presents the formalism, whereas the application examples are simple. Conducting the case study in the beginning of the work has merit for the activity, because it has guided the investigation in the main phase of the work.

The report NKS-113 describes investigation of theoretical issues connected to Haddon's strategies for reducing and avoiding damages. The strategies (countermeasures) have been classified and analysed in a way that clearly illustrate their internal structure. The report continues with an analysis of the barrier concept, which is widely used in connecting with nuclear safety. Suggestions for more precise terminology have been given. Finally, the role of communicative actions in countermeasures has been discussed. The work reported in NKS-113 is useful in pointing out ambiguous terminology and explain ways to improve it. It is also quite theoretical, however.

The main phase of the activity has been reported in NKS-114. The report focuses on showing that a theoretical basis to model goals and functions in multilevel flow modeling can be constructed from the Von Wright action theories, already discussed in the pilot phase. The main part of the work is theoretical; the example is in this case quite simple: regulation of level in a tank.

The work done within the activity gives interesting theoretical insights to the concepts routinely used in the nuclear safety work. On the other hand, the methods are quite far from being applicable to practical cases. Significant additional work would have been required for the method to have added value in practise.

1.4.5 Experiments on Ruthenium behaviour in severe accident conditions

Title	**Ruthenium releases**
Identification number and Acronym	NKS_R 2002_12, RutheniumReleases
Duration	Started in 2002, continues in 2006
NKS funding 2002-2005	0.9 MDKK
Leader	Ari Auvinen, VTT (FI)
Participants	VTT (FI), STUK (FI)

Deliverables	U. Backman et al.: Ruthenium behaviour in severe nuclear accident conditions - progress report. NKS-92, March 2004 U. Backman et al.: Ruthenium Behaviour in Severe Nuclear Accident Conditions - Final Report. NKS-100, August 2004
Evaluated deliverables	NKS-92, NKS-100, NKS-118

Ruthenium releases is an experimental project that has been conducted by VTT. The activity has been part of NKS-R since 2002, and is still continuing in 2006. During 2002-2005, it has received 0.9 MDKK NKS funding.

The project deals with the behaviour of ruthenium in the primary system. Ruthenium can be released in situations where air comes in contact with the reactor core. The question is relevant for PWRs and BWRs during maintenance shut down. The work is thus of interest for all LWR reactors. The results of the work will later have impact on work on PSA level 2 and at the development of different calculation tools and will thus be used by authorities and industry. Furthermore the work has developed and maintained Nordic competence.

The project has published two reports in 2002-2005 and a third one in 2006. The reports are considered to have high international standard. Substantial parts of the work have been done by PhD students and the work has a Nordic dimension through the research subject.

A minus is that the work has not created or maintained Nordic network. Except VTT and the end user STUK, no other Nordic organisations have participated in the work. The activity results have been discussed in international, not in Nordic forums.

1.4.6 Traceability and communication of requirements in digital I&C systems development

Title	**TACO**
Identification number and Acronym	NKS_R_2002_16 DigitalRequirements
Duration	2002-2005
NKS funding 2002-2005	0.95 MDKK
Leader	Terje Sivertsen, IFE (NO)
Participants	IFE (NO), VTT (FI), Ringhals AB (S)
Deliverables	T. Sivertsen et al.: Traceability and Communication of Requirements in Digital I&C Systems Development. Project Report 2003. NKS-91, March 2004. Terje Sivertsen et al: Traceability and Communication of Requirements in Digital I&C Systems Development - Project Report 2004. NKS-103, April 2005 Terje Sivertsen et al: Traceability and Communication of Requirements in Digital I&C Systems Development. Final Report. NKS-115, October 2005 Seminar: Traceability and Communication of Requirements in Digital I&C Systems Development, 2nd TACO Industrial Seminar, December 8, 2004, Helsinki, Finland
Evaluated deliverables	NKS-91, NKS-103, NKS-115

Traceability and Communication of Requirements in Digital I&C Systems Development (DigitalRequirements, TACO) has been conducted by IFE in 2002-2005. During that time the activity received 0.95 MDKK from NKS. The project work has been reported in three administrative reports.

The number of participating organisations was quite limited (IFE, VTT and Ringhals) and the number of young scientist was low.

Distribution of the TACO results has been made at “Industrial seminars”, one in Sweden (SKI) and a larger public seminar in Finland (STUK). The seminars have been considered well planned and carried out. It was pointed out, that this type of result distribution should also be done in other NKS projects.

Evaluation done in SKI considered that the project subject is important and interesting, and that the value of the work was good. The evaluator regarded the developed structure as new but pointed out that it should be tested in some practical case in order to evaluate its usefulness.

The SKI evaluation recommended that even if the seminars increased the distribution of the results, the end users should be involved in a more active way in the future. This should increase the possibilities to test developed methods and strategies on real cases and demonstrate the practical applicability. It was further commented that a theoretical model may look good and be structured but when it is applied on real cases, it fails and interface problems are discovered. Eventually this means that the theoretical model has to be modified in order to increase the applicability.

A STUK reviewer considered the scientific level of DigitalRequirements average, or slightly above, compared to other similar projects, methods or approaches in the international field.

The STUK review observed that the project had produced distinct and measurable goals in the requirements documentation scheme itself (“TACO Shell”) and the associated “TACO Traceability Model”. They can serve as platforms for a structured requirements representation and tracing in lifecycle oriented project work.

The reviewer pointed out that TACO has sought international contacts by being presented on relevant international forums, however, being limited to those with direct proximity to the Halden Project.

A common judgement of the reviewers was that requirements engineering is central to the utilisation of digital technology in safety critical or safety relevant applications (nuclear and other). Future NKS-R work in the area was warranted, but more emphasis should be placed on practical implementation / utilisation of results in actual power plant and/or regulatory work.

1.4.7 Nordic thermal hydraulic and nuclear safety network

Title	**Nordic thermal-hydraulic and nuclear safety network**
Identification number and Acronym	NKS_R_2004_35 NOTNet
Duration	2004
NKS funding 2002-2005	0.3 MDKK
Leader	Jari Tuunanen, VTT (FI)
Participants	Westinghouse Atom (S), KTH(S), LUT (FI)
Deliverables	Jari Tuunanen and Minna Tuomainen: Final Report of the "Nordic Thermal-Hydraulic and Safety Network (NOTNET)"- Project. NKS-107, April 2005
Evaluated deliverables	NKS-107

NotNet was a specific activity to investigate prerequisites for establishing a Nordic network in the field of thermal hydraulics. The study was financed by 0.3 MDKK and conducted in 2004.

The report *Nordic Thermal-hydraulic and Safety network (NOTNET), NKS-107* gives a summary of the study. The report is not a traditional research report and the scientific content is low. It is more documentation of the background for a decision to start a new network. The available resources for research on thermal hydraulics in Sweden and Finland are reviewed. The research needs of the stakeholders are reviewed. A possible plan for work structure in the form of roadmaps with feedback from the stakeholders is described. Potential funding sources outside the NKS are reviewed. The original three roadmaps proposed are described.

The Nordic aspect of the NOTNet was significant. One objective of the network is to support the research organisations by the stakeholders in order with useful research tasks for younger researchers.

During the review the network was in the planning state. Progress has been made in 2006 with signing of contracts for the co-operation, now called Northnet, by several Nordic organisations.

1.4.8 Ex-vessel coolability and energetics of steam explosions in Nordic boiling water reactors

Title	**Ex-vessel coolability and energetics of steam explosions in Nordic BWRs**
Identification number and Acronym	NKS_R_2004_36 ExCoolSE
Duration	Preproject 2002; Started 2004, continues in 2006
NKS funding 2002-2005	0.98 MDKK
Leader	Hyun Sun Park, KTH (S)
Participants	KTH (S)
Deliverables	H. S. Park et al: Ex-Vessel Coolability and Energetics of Steam Explosions in Nordic Light Water Reactors - EXCOOLSE Project Report 2004 NKS-112 Oct 2005
Evaluated deliverables	NKS-112

ExCoolSE is an experimental project conducted by KTH since 2004. ExCoolSE was preceded in 2002 by a preparatory activity, PreDeliMelt (NKS_R_2002_14). ExCoolSe and PreDeliMelt received from NKS 0.98 MDKK in 2002-2005.

ExCoolSE deals mainly with two questions related to Nordic BWRs. One of them is the question of coolability of a molten core in the containment and the other is related to steam explosions. The same questions are considered within the cooperation project APRI (Accident Phenomena of Risk Importance) in which the SKI and the Swedish nuclear power industry are involved.

ExCoolSe has published one report in NKS series: *Ex-vessel Coolability and Energetics of Steam Explosions in Nordic Light Water Reactors, NKS-112.* The report has high international quality and the questions concerned are central for Nordic BWRs. It has contributed to the maintenance of Nordic competence within the field, and has involved young scientists. Most of the work has been carried out by PhD students.

The work has a Nordic dimension through the objective of the study (Nordic BWRs). The work has been conducted by KTH alone. Connections to other Nordic organisations have been few, especially to organisations outside Sweden. Information of the results has been given in international and Swedish (APRI) meetings.

1.5 Conclusions by the NKS-R evaluators

The evaluation of the NKS-R activities should be seen against the background that the financial resources are very limited. Total annual funding is about 2 500 kDKK (with 2 200 available at the time for activity proposals.). It should be considered that the cost for manpower in the Nordic countries is about 100 kDKK/manmonth. This means that the NKS-R funding covers about 25 man months per year. Thus, split on the five member countries equally there are as an average 5 man months available per year. Naturally, the NKS-R activities can only have a marginal impact on the research, competence development, network building etc. In case the funding is split on many projects as during 2002-2005, (23 projects), some of them will have very limited funding, corresponding to 1-2 man months.

Considering the limited funding, the achievements of NKS-R program in 2002-2005 have been remarkable. Only a few delays have been observed in conduction of the activities. In a vast majority of cases, the activity leaders have conducted their activities according to the plans, in a cost-effective way. The end users have considered the results applicable. All finished activities have fulfilled the formal NKS requirement of producing final documentation.

Most of the interviewed persons and survey answers seem to be satisfied with the current way of working within NKS-R. There were no wishes to return to the older system, applied prior to 2002.

The reporting activity must be especially mentioned. Results of the NKS-R activities have been published in 28 reports in NKS series alone. The scientific level of the reports is considered to be on an international level.

Nine seminars have been arranged, some of them receiving a very positive feedback. Another type of NKS-R seminar activity has been internal seminars for activity leaders. These are also considered very useful for effective conduction of the program.

There is a significant difference in the number and funding of activities managed by organisations in different Nordic countries. The activities managed by VTT have received by far the largest share of NKS-R funding in 2002-2005, almost 50% of the total. The current call for proposals procedure seems to favour large national research organisations (VTT, IFE) compared to the universities.

There are some NKS objectives that have not been completely fulfilled. The NKS-R framework report requires that proposals should demonstrate so-called “Nordic dimension”. The Nordic dimension has been interpreted as creation or maintenance of Nordic networks, transfer and build-up of Nordic competence, and involvement of young Nordic researchers and research teams. All activities have shown at least some aspects of Nordic dimension. Building of Nordic networks has been only occasionally achieved, however. There are some examples of real joint Nordic activities, sharing the work with several Nordic organisations from at least two countries. On the other hand, in most of the activities the main work has been conducted mainly by the leading organisation. An indication of this can be seen in the reporting. Only two activities: DigitalRequirements and MainCulture have produced reporting having authors from more than one country.

Weak contacts of the NKS-R research to power plants and with the established Nordic co-operation groups were mentioned on several occasions in the survey and in the interviews. One reason for this may be that the activity proposals typically come from organisations, who do not have good information on the current interests at the power plants. Surprisingly, NKS-R contacts with the NKS-B part have been almost non-existent. No activities with joint objectives or joint participation have been initiated in 2002-2005.

Young scientists have been involved in the activities to some extent. The generation shift is a concern for the Nordic countries; therefore development of competence is an important factor for all. Organized education, as a series of seminars and/or regular education in relevant subjects could be considered. Possibly such facilities as the TRIGA reactor in Finland, a Full scale simulator in Sweden and facilities at Halden/Kjeller could be used.

The NKS-R seminar activity on specific topics must be considered good. It must be pointed out however, that there has been no general NKS-R seminar to give information of the total program results for a larger public. There should be a procedure to arrange such a seminar at certain intervals, e.g., 2 – 4 years.

The procedure and schedule to submit a proposal is not known to everybody. The information is easily available at the NKS www-site and has been there since 2002. Some comments still seem to refer to the old “top-down” system, in which the initiating agent was NKS, whereas the initiative now comes from the proposals having a relatively free form. Actually, several persons commented that it would be easier to submit a proposal, if NKS could better specify what it expects from the NKS research projects.

1.6 Recommendations (NKS-R)

The status of the program was found good, and most of the persons who expressed their opinion in the evaluation seem to be satisfied with the current system. Still, it is recommended to evaluate and to reconsider the program at regular, for example 4-5 year intervals.

An apparent observation is the modest Nordic co-operation within the current program. In many cases the activities have been conducted by organisations from one country only, sometimes by single organisations. Optional methods to enhance the co-operation could be:

- to initiate activities with the specific objective of creating Nordic networks and co-operation
- to enable the program manager to merge activity proposals having similar contents into a single joint activity at early stage
- to give extra credit in the activity proposal evaluation, if the proposal involves organisations from several Nordic countries
- to require that each activity must have participating organisations from at least two Nordic countries

NKS-R contacts with the established Nordic co-operation groups, with the end-users and with NKS-B should also be reinforced. More specific definition of the end-user needs should be required of the proposals. The board members could take an active role to establish ties of the NKS-R activities to the Nordic co-operation groups and to the end-users in their country.

Common activities should be established between NKS-R and NKS-B. The accident phenomena and fission products studied within NKS-R are initial conditions to the emergency preparedness in NKS-B, giving possibilities for joint projects.

Distribution of the NKS-R results should be improved. One way to this objective is arrangement of seminars presenting the results of the program activities. Arrangement of seminars can also be an efficient way for establishing Nordic networks and cooperation. They will also contribute to the development of know how for a wider group of people.

Education activities, especially for the younger generation, could be a regular feature of NKS-R. The education could efficiently utilise the facilities available in various Nordic countries.

The call for proposals and the criteria used in proposal evaluation should specify the objectives that NKS wants to see from the research activities. A practical difficulty is that the NKS funding covers only a part, maximum 50% of an activity total funding. For the activity leader, it might not be possible to lead the research in a direction given by the NKS requirements. The NKS should be active to look at projects having established funding, and to see whether the objectives coincide.

Because of the limited research budget of NKS-R, extensive research projects, requiring expensive equipment, can not be carried out without strong support from other organizations. In such cases NKS funding has a minor impact on the project. It is a question of policy whether NKS-R should support large (highly scientific) projects or concentrate on minor (less scientific) projects.

For discussion, even more far-reaching changes can be imagined:

- To streamline distribution of funds, it is possible to think that NKS only gives a preset (and relatively modest) maximum funding for a certain activity.
- To emphasise the NKS role, it could be possible to focus NKS funding for only certain types of exercises, such as seminars, literature surveys, exploration of new conferences and fields, initiation of new network building, or relatively small research exercises.
- It could also be possible to reserve a part or all NKS funding only for the young generation and/or education.

1.7 References

NKS Programhandbok, NKS(06)3. www.nks.org

NKS Administrativ håndbok, NKS(06)4. www.nks.org

Reactor Safety Part of the NKS Program. NKS-R Framework, NKS(05)4. www.nks.org

2. Evaluation of the NKS Emergency Preparedness, NKS-B, 2002-2005

2.1 Overview of NKS-B programme

2.1.1 Framework

The aim of the NKS-B programme (Ref NKS-B Framework, version 2.1. 16.8.2004) is to *strengthen radiological emergency preparedness* in the Nordic countries. Apart from activities directly targeted at emergency preparedness this also includes activities in related areas such as *radioecology* and effective *communication and information management.* Also these activities must, however, be focused on emergency preparedness related questions.

Two main aspects are given highest priority:

1. Maintaining and building up *competence*, and
2. Maintaining and building *close informal Nordic networks* between scientists in emergency preparedness related disciplines.

The programme is structured on three basic fields:

- Research activities, investigations, exercises etc.
- Seminars
- Education

Research activities, investigations and exercises fall within the following three categories:

- *M: Measurement Strategy, Technology and Quality Assurance* (e.g. systems for mobile measurements, standardisation, intercomparisons)
- *R: Radio-ecological Studies* of relevance for emergency preparedness. (e.g. transfer of radionuclides in semi-natural terrestrial environments, including forests and semi-arctic environments, marine environments of special importance, syntheses of earlier radioecological studies of Nordic interest.)
- *E: Emergency Preparedness* in general and specific tools (e.g. exercises and similar activities; harmonisation activities; handbooks on countermeasures, actions etc, improved systems for information and communication, decision support systems.)

The general criteria for evaluating proposals are described in the document NKS(06)3 NKS(02)6 “Programhandbok”. Amongst the criteria for evaluating proposals are:

- how well the proposal falls within the defined NKS-B framework
- building-up of competence and maintaining it in the future
- value for co-operation of the Nordic authorities
- the ambition shall be that at least three countries are involved in each accepted activity, where so is feasible
- potential use of results and information
- how well it falls within the focus defined jointly at the time and also by the countries the potential participants represent
- the scientific and pedagogical merits of the proposal

But emphasis must also be put on the following fundamental criteria:

- It has to be ensured that the work performed within the NKS-B programme is relevant for the authorities and others financing the programme. This is a key issue in the evaluation process.

- All activities in the new programme need not be relevant for all of the supporting Nordic authorities, but it is very important that the NKS-B programme as a whole is highly relevant for them all.
- Interest of potential end-users must be clear.

The present evaluation is based on guidelines dated December 7th, 2005, set out by the NKS Board (see Appendix). For the evaluation, the above-mentioned guidelines were interpreted into ten different criteria, firstly some that judge how well the projects fulfil the aims of the programme, secondly criteria that judge the scientific and pedagogical merits of the projects as well as their usefulness and relevance for authorities and end-users. For each project evaluation against each of the ten criteria is graded by a score ranging from “very good” to “very poor” (A to E). To obtain an overall “quality figure” for each project, a weighted sum over all ten criteria is calculated, with the following weights given to each grade mark: A=16, B=8, C=4, D=2, E=1. A main grade has been given to each project based on the weighted sum over the ten evaluation criteria. The main grade has been set from the following values of the weighted sum of grades:

Main grade	Range of weighted sum
A	> 130
A–	110 - 129
B+	90 - 109
B	70 - 89
B–	50 - 69
C	< 50

A general evaluation summary is given for each project category, whereas recommendations and conclusions are set out in a final chapter.

2.1.2 NKS-B projects in the period 2002-2005

Table 8. Projects performed during the period 2002-2005, with total NKS-funded expenses during the period, amounting to 10,01 mill DKK for the entire period. Projects continuing into 2006 are marked by *.

Acronym	Project title	Reports	Cost (kDKK)
Measurement technology:			
MGS-ModMeth	Co-ordination and modernisation of methods for AGS and CGS measurements of multi-nuclide contamination	NKS-85	85
MGS-Course	Course in advanced methods for processing AGS and CGS data and similar sets of spectral data		65
ECCOMAGS	Nordic-EU collaboration on design and evaluation of the Resume 2002 exercise	NKS-86	200
ASS-1	Area specific stripping for CGS and AGS	NKS-125	60
ASSb	Area Specific Stripping of lower energy windows for AGS and CGS NaI systems. PART 2	NKS-109	180
SampStrat	Sampling strategy and sample preparation in emergency situations	NKS-122	95
Labinco	Intercomparison of laboratory analyses of radionuclides in environmental samples	NKS-144	350
RadChem	Radiochemical analysis in emergency and routine situations	NKS-124 NKS-129	415
NorCMass	Nordic collaboration on the use of mass-spectrometers for the analysis of radioisotopes	NKS-134 NKS-135 NKS-136	610

Radioecology:

Nova Course	Additional funding of Ph.D. course in radioecology		40
Rein	Regional differences in reindeer radiocaesium contamination		85
CsKinetic	Human metabolism of caesium	NKS-120	130
RadSem	Radioecology and measurement techniques		100
Forest*	Guidance for sampling in forests for radionuclide analysis and update of the Nordic forest radioecology network		225
ECODOSES*	Improving radiological assessment of doses to man from terrestrial ecosystems	NKS-98 NKS-110 NKS-123	1010
INDOFERN	New indicator organisms for environmental radioactivity	NKS-140 NKS-143	3030

Emergency preparedness:

Irades	Internal Radiation Doses in Emergency Situations	NKS-128	100
Knowledge-base	Nuclear threats in the vicinity of the Nordic countries - A base of knowledge	NKS-121	150
NordRisk*	Nuclear risk from atmospheric dispersion in Northern Europe.		160
CommTech	Communication technology and emergency preparedness		180
UrbContSem	Urban contamination seminar		260
NucVess	Impact assessment of accidents with nuclear powered vessels - analysis of release mechanisms and source term composition	NKS-138 NKS-139	340
UrbHand*	Decision Support Handbook for remediation of contaminated inhabited areas		410
MetNet*	Nordic network of meteorological services engaged in nuclear emergency preparedness		590
EMARAD	Emergency management & radiation monitoring in nuclear and radiological accidents	NKS-137 NKS-142	1140

2.1.3 Project cost distributions

As summarised in figure 13, the 9 measurement technology projects have received 21 % of the programme funding; the largest share (46%) went to the 7 radioecology projects, of which EcoDoses and Indofern are the two larger ones, representing each 10 % and 30 % of the NKS-B programme funding in the period. Emergency preparedness received 33 % of the funding, of which EMARAD took the largest share (11 %). The Programme Manager’s funding is not included in the above figures and represents an addition of 15 % administration cost to the total project funding.

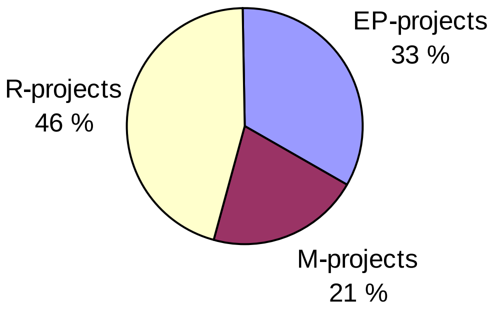


Figure 13. Distribution of NKS-B project costs on project type according to classification shown in Table 1 (ASSb is classified as Measurement Technology, CsKinetics as Radioecology, although both originally were classified as Emergency Preparedness projects.)

The distribution of project costs among various participating countries is shown in figure 14, for each of the three project types. The individual countries represent quite different participation profiles.

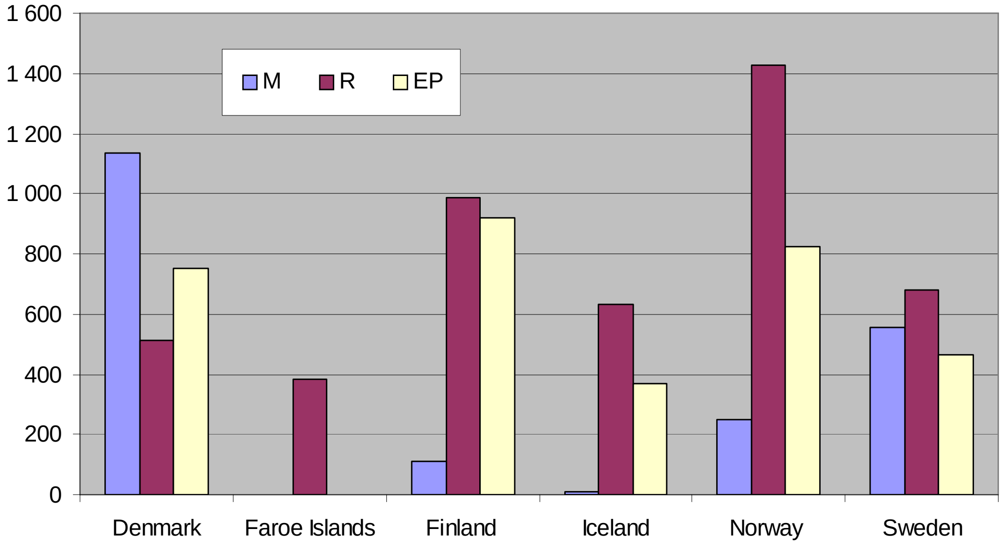


Figure 14. Distribution of NKS-B project costs (in kDKK) among participating countries for different project types: Measurement technology (M), Radioecology (R), Emergency preparedness (EP).

It should be remembered that the various countries may be engaged in bilateral programmes that are not part of the NKS programme. Thus, SSI of Sweden had for 12 years a direct collaboration with the Baltic States in much the same areas as covered by the NKS-B programme. This activity is now incorporated in the EU framework (SSI Report 2005:09).

The total project spending in each country is shown in figure 15, in percent of the total project cost of 10 010 kDKK. If these figures are combined with the distribution of spending within the NKS-R programme, a comparison can be made between funding and "return" for each of the Nordic countries (see figure 1).

As a general rule, each participating institution in a project shall contribute at least an amount of own funding equal to that received in NKS support. Thus, the NKS-B programme for the period 2002-2005 has had a project activity volume corresponding to 20 million DKK. In many cases additional financing from other sponsors have been significant, thus making it difficult to judge cost-effectiveness based on NKS funding alone.

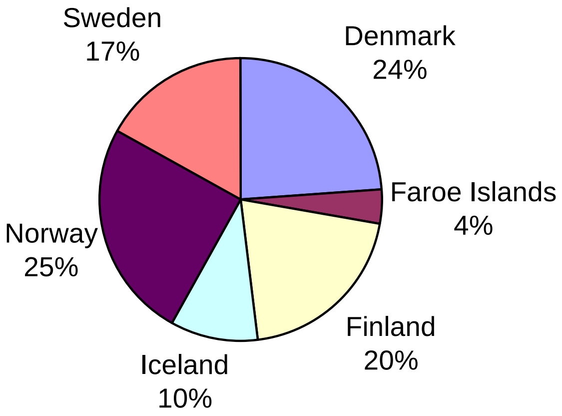


Figure 15. NKS-B Project spending in participating countries

2.1.4 NKS-B Seminars

(http://www.nks.org/nordisk/aktuelt/seminarier.htm)

- NKS-B Seminar on emergency preparedness, November 21, 2005, STUK, Finland
- NKS-B Summary Seminar, October 24 - 25, 2005, Tartu, Estonia
- NKS Seminar on decommissioning of nuclear installations September 13 - 15, 2005, Risø, Denmark

- NKS-B Seminar on Theory of Sampling (TOS) August 26, 2005, Risø, Denmark
- NKS-B CommTech Mini-Seminars, May 31 - June 1, 2005, SSI, Stockholm, Sweden
- NKS-B Mini-Seminar on Malicious Use of Radioactive Material, May 24 - 25, 2005, Stockholm, Sweden
- NKS-B RADSEM, August 19, 2004, Risø, Denmark
- NKS-B Mini-seminar on radioecology and measurement techniques, September 8-9, 2003, Risø, Denmark
- NKS-B sponsored Conference on Radioactive Contamination in Urban Areas (UrbContSem) May 7 - 9, 2003, Risø, Denmark
- NKS-B CommTech Mini-Seminar, February 27 –28, 2003, STUK, Helsinki, Finland
- NKS-B Mini-seminar on Air-borne and Car-borne Gamma-Spectroscopy, October 17 - 18, 2002, DEMA, Denmark

2.2 Measurement technology

NKS projects on measurement technology may be subdivided into two types. The first type of projects address the task of rapidly and accurately mapping the deposition of radioactivity over large areas following a fall-out situation. The second type of projects are concerned with how to obtain precise and representative measurements of radioactivity in various material matrices sampled and subsequently subjected to sample analysis in the laboratory.

In the period 2002-2005 5 projects in the first category (MGS-ModMeth, MGS-Course, ASS-1, ASSb, ECCOMAGS) have been devoted to the further establishment of Nordic competence in air-born and car-born gamma spectroscopy (AGS and CGS, respectively), with significant contribution to in-the-field analysis of such data by area-specific spectrum stripping techniques. NKS contributed to Nordic-EU collaboration on design and evaluation of the Resume 2002 exercise (ECCOMAGS).

The 4 NKS projects in the second category concentrate on laboratory techniques for radiochemical analyses (RadChem), including a laboratory intercomparison study (Labinco). Nordic collaboration on the use of mass-spectrometers for the analysis of radioisotopes was initiated (NorCMass). The important aspect of sampling strategy and sample preparation in emergency situations (SampStrat) was raised at the end of the period 2002-2005.

2.2.1 MGS-ModMeth

Earlier projects within NKS had unveiled that Nordic teams performing Airborne or Car-borne Gamma-Ray Spectrometry (AGS and CGS) used different definitions and methods for data processing and presentation. Almost all investigations have concerned caesium-137 as the only artificial nuclide that could be measured in the environment with ordinary AGS and CGS equipment. Therefore it was decided to initiate within NKS an examination of how to map other fall-out nuclides with AGS and CGS. As a first step a seminar was arranged on 17-18 October 2002.

Objectives

The following objectives were set for this project:

- Organise a 2-day seminar, Preliminary discussion of competences 17-18 October 2002

- Publish report with contributions from the participants (NKS-85)

Summary of evaluation

Title:	**MGS-ModMeth - Co-ordination and modernisation of methods for AGS and CGS measurements of multi-nuclide contamination**
NKS funding:	85 000 DKK
Co-ordinator:	Uffe Korsbech, DTU (DK)
Participants:	DTU (DK), DEMA (DK), FOI (S), SGU(S), SSI(S), NGU (NO), NRPA (NO), STUK (FI)
Evaluation material	Contract for 2002, 3 semi-annual progress reports 2002-2003, NKS-85
Published deliverables	NKS-85: “Co-ordination and modernisation of methods for AGS and CGS measurements of multi-nuclide contamination Report from a seminar”, February 2003, 30p.
Missing deliverables	None

The seminar was held at DEMA on 17-18 October 2002. Here the participants presented how they would handle the mapping of four pre-defined fall-out scenarios. The presentations and discussions at the seminar showed that carrying out the measurements for some of the scenarios would be difficult or even impossible with ordinary equipment and data processing techniques presently used by some of the teams. The seminar resulted in a list of problems deserving attention. Among those was the question on when to prefer high sensitivity NaI detectors and when to prefer high-resolution HPGe detectors. A common definition on "detection levels" was also needed. Here the generation of sets of spectra with different levels and combinations of fallout nuclides was proposed. Among the outcomes of the seminar were two proposals for future NKS projects; one concerned mapping of low levels of iodine, and the other was a method for generation of stripping factors from ordinary survey spectra.

The seminar obviously represented a good discussion on the present status of competence, and resulted in two constructive proposals for further work. One of these have been pursued by NKS and produced significant results (ASS1 and ASSb).

Fulfilment of NKS-criteria

In addition to the experience gained by participants at the seminar, the results of this project are available as

- MGS-ModMeth NKS-85 report (30 pages)

“Co-ordination and modernisation of methods for AGS and CGA measurements of multi-nuclide contamination”.

NKS evaluation criteria	**Fulfilment of NKS-criteria, MGS-ModMeth**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology and associated measurement techniques is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	Good pedagogical merits for participants at the seminar, in discussing how to handle the mapping of four pre-defined fall-out scenarios. Potential scientific merit in planned projects.	B
The application and scientific perspectives of the project	Constructive proposals for further work were generated.	B

At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	The seminar resulted in two constructive proposals for further work.	B
Project results of adequate quality	One of the resulting proposals have been pursued by NKS and produced significant results (ASS1 and ASSb).	B
Project in accordance with plans and budget	Yes.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 85,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 170,000 DKK. The cost-effectiveness appears to be at the right level.	B
Relevance for authorities and others	Results are relevant for authorities and experts.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.2.2 MGS-Course

A course was organised to give participants experience in using advanced methods for AGS and CGS data processing. Focus was on how to use the NUCSpec software system, including exercises searching for lost sources by methods based on pre-calculated area-specific stripping factors.

Objectives

The following objectives were set out in the contract for this project

- Production of course material
- Organise course at DTU, 4-8 November 2002.

Summary of evaluation

Title:	**MGS-Course - Course in advanced methods for processing AGS and CGS data and similar sets of spectral data**
NKS funding:	65 000 DKK
Co-ordinator:	Uffe Korsbech, DTU (DK)
Participants:	Total of 8 course participants from Norway (1), Denmark (2), Sweden (5)
Evaluation material	Contract for 2002, 3 semi-annual progress reports 2002-2003, report to NKS (3s)
Published deliverables	None
Missing deliverables	None

Fulfilment of NKS-criteria

NKS evaluation criteria	**Fulfilment of NKS-criteria, MGS-Course**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology and associated measurement techniques is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	Very good pedagogical merit through the learning and experience gained by the eight participants at the course. Potential scientific merit in future applications.	A

The application and scientific perspectives of the project	Training in the use of modern methods was provided.	B
At least three Nordic countries involved	Course participants from three Nordic countries.	B
Potential use of results and information	Practical experience gained considered to be of high value.	A
Project results of adequate quality	Results of this project lie in the experience gained by the course participants.	B
Project in accordance with plans and budget	Yes.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 65,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 130,000 DKK. The cost-effectiveness appears to be at the right level.	B
Relevance for authorities and others	Results are relevant for authorities and participating experts.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B+**	

2.2.3 ECCOMAGS

In the RESUME 2002 exercise (Rapid Environmental Surveying Using Mobile Equipment) areas in SW Scotland were surveyed for anthropogenic and natural radioactivity with Airborne Gamma Spectrometry (AGS), Car-borne Gamma Spectrometry (CGS) and in-situ measurements. This was part of the ECCOMAGS project (http://www.cordis.lu/fp5-euratom/src/eccomags.htm) under the 5th EU Framework Programme for European Calibration and Co-ordination of Mobile and Airborne Gamma Spectroscopy. NKS contributed to Nordic-EU collaboration on design and evaluation of the Resume 2002 exercise through the NKS-EccoMags project.

Objectives

The following items were defined in the NKS contract for ECCOMAGS:

- Participation in the ECCOMAGS Design and Evaluation Group (DEG) with statistical data processing of exercise results
- Development and reporting of an expanded NKS-format to use for exercise data.
- Presentation of project status at NKS-seminar 17-18 October 2002 in Birkerød, Denmark
- Delivery of a final report

Summary of evaluation

Title:	**ECCOMAGS - Nordic-EU collaboration on design and evaluation of the Resume 2002 exercise**
NKS funding:	200 000 DKK
Co-ordinator:	Simon Karlsson, SSI (S)
Participants:	SSI (S), Risø (DK)
Evaluation material	Contract for 2003, semi-annual progress report 2002, Final report NKS-86.
Published deliverables	NKS-86: “ECCOMAGS: Initial results from the RESUME 2002 exercise” February 2003, 34p
Missing deliverables	None

The planning phase in the Design and Evaluation Group included conducting a pre-characterisation study of the survey area and finalising measurement protocols developed under the 4th European Framework Programme. An important objective of the RESUME 2002 exercise was to validate these protocols in order to develop them as European standards for AGS following a nuclear emergency.

The RESUME 2002 exercise was carried out at the time planned, but due to restrictions in the use of helicopters, less data was obtained than had been hoped for. The partnership with the EU puts certain restriction on what reference can be made to data from the exercise before the EU publishes its own reports. Results from the exercise presented in the final report include composite maps and data produced at the exercise, and initial results from the post-exercise data analysis. The report also presents a format for processed data exchange developed by NKS experts and further refined for the exercise.

The RESUME 2002 exercise was the first European scale benchmark exercise for AGS. Initial results demonstrate the ability of European AGS teams to produce comparable results in almost real time, and the ability to co-operate for nuclear emergency response to produce composite deposition and dose rate maps of large survey areas. The Cs-137 deposition examined in the exercise included a range of activity levels, and the database generated from the measurements can be used for further investigation of data processing and mapping techniques.

Fulfilment of NKS-criteria

In addition to the direct experience gained by participants in the project, the result of the ECCOMAGS project is presented as: NKS-86: “ECCOMAGS: Initial results from the RESUME 2002 exercise” February 2003,May 2005, 31p.

NKS evaluation criteria	Fulfilment of NKS-criteria, ECCOMAGS	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology and associated measurement techniques are an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	Very good pedagogical merits through experience gained during exercise. Emergency preparedness, rather than scientific merits was the aim of the project.	A
The application and scientific perspectives of the project	Significant Nordic expertise is demonstrated, but more reference to international competence on these problems could be given.	B
At least three Nordic countries involved	Three Nordic countries participated in the RESUME2002 exercise, but the NKS project only involved two Nordic countries.	B
Potential use of results and information	Results and practical experience are of high value.	A
Project results of adequate quality	Results and practical experience are of high value.	A
Project in accordance with plans and budget	Yes.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 200,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 400,000 DKK. Fieldwork entails extra cost. The cost-effectiveness appears to be at the right level.	B
Relevance for authorities and others	Highly relevant results for experts and authorities were obtained.	A

Evaluation grade	
A (very good), B (good), C (average), D (poor), E (very poor)	**A-**

2.2.4 ASS1

This project is based on very limited NKS funding but efficient utilisation of the experience of a previously established Nordic group collaboration. NKS funding only contributes to covering the co-ordinator's cost. The project reports the results from a NKS project aiming at examining the possibilities for extracting stripping factors for Airborne Gamma-ray Spectrometry (AGS) data and Carborne Gamma-ray Spectrometry (CGS) data directly from the recorded set of data, i.e. without having to calibrate the detector systems on beforehand.

Objectives

The following items were defined in the contract for ASS-1:
1) A report describing the theoretical models, the procedures developed and the practical experiences with a limited amount of AGS data.
2) A report outlining how to eventually proceed with an extended project including several sets of input data of varying quality.

Summary of evaluation

Title:	**Ass1 - Area specific stripping for CGS and AGS**
NKS funding:	60 000 DKK
Co-ordinator:	Uffe Korsbech, DTU (DK)
Participants:	DTU (DK), DEMA (DK), SGU(S), SSI(S), NGU (NO), NRPA (NO), STUK (FI)
Evaluation material	Contract for 2003, 3 semi-annual progress reports 2003-2004, international publication Rad. Prot. Dosimetry 2006 (14p), NKS-125.
Published deliverables	H.K. Aage et al. "Experiences with area-specific spectrum stripping of Na(Tl) gamma spectra", Rad. Prot. Dosimetry, Feb 2006 (14 p) NKS-125: "Area Specific Stripping factors for AGS. A method for extracting stripping factors from survey data", 131p, April 2006.
Missing deliverables	None

An internal report was written which describes the ASS method and its practical application in necessary detail. The work in this project and ASSb is summarised in an international publication, which shows the feasibility of the approach, but also discusses some of the limitations. The project should be co-ordinated or integrated into larger programmes.

Fulfilment of NKS-criteria

The result of the ASS1 project is presented in a scientific publication in an international refereed journal, as well as in a detailed report, NKS-125.
The funding provided by NKS for this project has been 60 000 DKK. Obviously the participating partners have covered a much larger cost.

NKS evaluation criteria	**Fulfilment of NKS-criteria, ASS1**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology and associated measurement techniques is an identified project area.	B

Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	The detailed procedure set out in NKS-125 represents very good pedagogical merit by disseminating competence in application of AGS and CGS. High scientific merit through scientific publication.	A
The application and scientific perspectives of the project	Significant Nordic expertise is demonstrated, but more reference to international competence on these problems could be given.	B
At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	Results and practical experience are of high value.	A
Project results of adequate quality	Results and practical experience are of high value.	A
Project in accordance with plans and budget	Yes. NKS contributed only minor project funding	A
Cost-effectiveness of total budget	The NKS financial support of the project has been 60,000 DKK. Obviously the participating partners have covered a much larger cost. The cost-effectiveness is very high, seen from NKS point of view.	A
Relevance for authorities and others	Valuable results for science and authorities were obtained.	A
Evaluation grade	**A-**	
A (very good), B (good), C (average), D (poor), E (very poor)		

2.2.5 ASSb

This project examined the possibilities for extracting stripping factors for Air-borne Gamma-ray Spectrometry (AGS) data and Car-borne Gamma-ray Spectrometry (CGS) data directly from the recorded set of data, i.e. without having to calibrate the detector systems on beforehand.

Objectives

The following items were defined in the contract for ASSb:

- Conversion of existing data to formats that can be read by ASS software
- Processing and evaluation of data
- Final report to NKS specifications

Summary of evaluation

Title:	**ASSb - Area specific stripping for CGS and AGS, Part 2**
NKS funding:	180 000 DKK
Co-ordinator:	Uffe Korsbech, DTU (DK)
Participants:	DTU (DK), DEMA (DK), SGU(S), SSI(S), NRPA (NO)
Evaluation material	Contract for 2004, semi-annual progress report Oct 2004, NKS-109.
Published deliverables	NKS-109: “Area specific stripping of lower energy windows for AGS and CGS NaI systems”, May 2005, 100p
Missing deliverables	None

The published report NKS-109 describes the methods in necessary detail, and also contains valuable examples from application of the methods in field exercises. The report contains references to international scientific publications showing that Nordic experts have significant experience in this field.

The presented stripping problem is as a classical analysis problem that presumably has been the object of academic effort for many years. Although reference is given to some international stakeholders in this problem (IAEA, ICRU), one would expect that e.g. other European radiation protection authorities also have addressed this problem. It would be of interest to know what expertise or methods could be obtained from such sources.

The report mentions a few remaining problems, e.g. the variation in stripping factors with altitude for AGS, and the rapid changes with surrounding terrain “structure” for CGS. Others are possible confounding influences from air-transported radon with subsequent “de-localised” gamma-emissions, and the problem of detecting hidden Ra-226 sources, which will be treated as part of the Th stripping spectrum. One would, however, from analytical intuition expect that the presence of spectral components not present in the normal environmental spectrum should be detectable, e.g. as a localised deviation in the quasi-stationary relationship between the U- Th- and K-stripping factors estimated for a certain area. The linear dependence between especially Th and U, but also K stripping factors in terrain with little variability in composition could possibly be included in the model and utilised for detecting deviations from the expected relationship if an artificial source is present.

Fulfilment of NKS-criteria

In addition to the direct experience gained by participants in the project, the result of the ASSb project is presented as:

- NKS-109: Area specific stripping of lower energy windows for AGS and CGS NaI systems May 2005, 100p

NKS evaluation criteria	Fulfilment of NKS-criteria, ASSb	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology and associated measurement techniques is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	The detailed procedure set out in NKS-109 represents very good pedagogical merit by disseminating competence in application of AGS and CGS.	A
The application and scientific perspectives of the project	Significant Nordic expertise is demonstrated, but more reference to international competence on these problems could be given.	B
At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	Results and practical experience are of high value.	A
Project results of adequate quality	Results and practical experience are of high value.	A
Project in accordance with plans and budget	Yes. NKS contributed only minor project funding	A
Cost-effectiveness of total budget	The NKS financial support of the project has been 180,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 360,000 DKK. The cost-effectiveness appears to be at the right level.	B
Relevance for authorities and others	Valuable results for experts and authorities were obtained.	A

Evaluation grade	
A (very good), B (good), C (average), D (poor), E (very poor)	**A-**

2.2.6 SAMPSTRAT

The project SAMPSTRAT was started in 2005 and it has been proposed that the project should continue in the period 2006 - 2007. The aim of the project is to develop a Theory Of Sampling for the assessment of radioactivity in emergency situations and to give recommendations for the application in both emergency situations and in general environmental radioactivity studies.

Objectives

The objectives of the SAMPSTRAT-project were/are:

- to arrange a NKS-B mini-seminar on Theory Of Sampling with special emphasis on radioactivity and emergency situations
- to develop a book with recommendations on sampling strategies
- to develop courses on Theory Of Sampling for students in environmental radioactivity and for personnel in charge of sampling programmes in emergency situations

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**SAMPSTRAT - Sampling strategy and sample preparation in emergency situations**
NKS-funding:	95,000 DKK (2005), 200,000 DKK (2006 - 2007)
Co-ordinator:	Elis Holm (Lund University Hospital)
Participants:	Lund University (S), IFE (N), Risø (DK)
Evaluation materials:	Project proposal, proceedings from mini-seminar at Risø, 26 August 2005; NKS-122
Published deliverables:	Presentations at a NKS-B mini-seminar at Risø, 26 August 2005. NKS-122: “Theory of Sampling – A mini-seminar under the NKS-project SAMPSTRAT”, April 2006, 90 pp.
Missing deliverables:	None

The project has at the time of evaluation not been completed and the final project results can therefore not be evaluated. The result of the project so far is the mini-seminar on the theory of sampling that describes all errors involved in sampling of heterogeneous materials. Sampling errors of up to as much as 100 - 1000 times the specific analytical errors have been experienced. In a nuclear or radiological emergency where radionuclides have been dispersed in the environment, a lot of environmental samples are needed to assess both the radiological consequences and the need for remedial actions. The project goal of developing a sampling theory and fundamental sampling principles for the assessment of radioactive contamination is thus very important. The plan of preparing a book with recommendations as well as courses is judged to be highly relevant. The material presented at the mini-seminar would be useful as basis for this continued work.

Fulfilment of NKS-criteria

The measurable results of the SAMPSTRAT-project during the project period 2005 are:

- Project contract and project proposal of 2004

- NKS-B mini-seminar at Risø, 26 August 2005
- Presentations at the seminar

The results of the SAMPSTRAT-project have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	**Fulfilment of NKS-criteria, SAMPSTRAT**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which developing optimum sampling and measurement strategies on environmental samples is an identified project areas.	B
Nordic competence and network building and maintenance	The project has the potential to build up competence on fundamental environmental sampling strategies that are essential for assessing emergency situations.	B
The scientific and pedagogical merits of the project	The project has very good pedagogical merits in the identification of the need of developing university courses on the theory of sampling. Also the scientific merits are judged to be good.	A
The application and scientific perspectives of the project	The project results are at the end oriented towards practical application in nuclear or radiological emergency situations. The scientific perspectives of the project are judged to be good regarding the development of a comprehensive and coherent theory of sampling.	B
At least three Nordic countries involved	Three Nordic countries have been involved in the project.	B
Potential use of results and information	The end-users of the project results are those engaged in environmental sampling, e.g. university departments, research institutes and nuclear facilities as well as the Nordic emergency management authorities. The project results have a high potential of being used in emergency situations.	A
Project results of adequate quality	The quality of the mini-seminar is judged to be good.	B
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 95,000 DKK. Consequently, the results of should be judged against a total manpower effort of 180,000 DKK. The cost-effectiveness appears to be at the right level for arranging a mini-seminar.	B
Relevance for authorities and others	The result of the project would (at the end) be relevant for the Nordic authorities engaged in emergency preparedness and response.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B+**	

2.2.7 Labinco

An intercomparison between 38 laboratories on analyses of radionuclides in environmental samples was carried out. Sample types included typical environmental materials and human food items. A total of 38 laboratories were included in the study, among them 2 from Denmark, 7 from Norway, 6 from Sweden, 3 from Finland, 1 from Iceland and 12 from Baltic states.

Objectives

Participating laboratories carried out laboratory analyses and reported the results. The results of the intercomparison were presented and discussed at a seminar in Estonia, 24-25, October 2005. The intercomparison results will be reported in seminar proceedings, which will also bring the seminar presentations, conclusions and recommendations.

Summary of evaluation

Title:	**Labinco - Intercomparison of laboratory analyses of radionuclides in environmental samples**
NKS funding:	350 000 DKK
Co-ordinator:	Sven P. Nielsen, Risø (DK)
Participants:	Laboratories in all 5 Nordic countries (19), Baltic states (12) and other countries (7)
Evaluation material	Contracts for 2004 and 2005, 4 semi-annual progress reports for 2004, 2005, Draft of data report, Feb 2006.
Published deliverables	NKS-144 Intercomparison of Laboratory Analyses of Radionuclides in Environmental Samples, October 2006, 59p.
Missing deliverables	None

Conclusions from this project were still being compiled at the time of evaluation, but although some laboratories still seem to have some difficulties and some types of measurements are clearly more difficult than others, it seems nevertheless that the laboratories are performing better than they have typically done in previous intercomparisions. 14 different nuclides plus total alpha and total beta were measured in 11 different matrices, although not all combinations were used, and not all laboratories submitted results for all types of measurement. Results varied considerably, e.g. 27 out of 35 laboratories (77%) passed the evaluation criteria for ^{137}Cs measurement, but only 3 out of 20 for ^{90}Sr (15%). This project could benefit from being integrated with the RadChem project (see below), i.e. at the same time identifying which procedures were used for the different analyses. It would be of interest to look for possible correlation between deviating results and the use of particular radiochemical preparation or measurement procedures. The project should be repeated at reasonable time intervals, and co-ordinated with RadChem type investigations.

Fulfilment of NKS-criteria

Funding for this project has covered the co-ordinator's cost to administer the intercomparison, planning of the seminar, as well as travel costs for Nordic participants (20 out of total number of 38 participants) to the seminar.

NKS evaluation criteria	Fulfilment of NKS-criteria, Labinco	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology and associated measurement techniques are identified project areas.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	A
The scientific and pedagogical merits of the project	Very high pedagogical merit through focus on methodological skills. The results of this intercomparison represent scientific knowledge of very high merit.	A
The application and scientific perspectives of the project	Important project to increase quality of radionuclide measurements in ecological samples.	A
At least three Nordic countries involved	All Nordic countries have been involved in the project.	A
Potential use of results and information	Results and practical experience are of high value.	B
Project results of adequate quality	Results and practical experience are of high value.	A
Project in accordance with plans and budget	Yes.	A
Cost-effectiveness of total budget	The NKS financial support of the project has been 350,000 DKK. Consequently, the results of the project should be judged against a	A

	total manpower effort of 700,000 DKK. Laboratory work entails extra costs. The cost-effectiveness appears to be at the right level.	
Relevance for authorities and others	Valuable results for participating laboratories and for authorities relying on these laboratories.	A
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**A**	

2.2.8 RadChem

Accurate determination of radionuclides from various sources in the environment is essential for assessment of the potential hazards and suitable countermeasures both in case of accidents, authorised release and routine surveillance. Reliable radiochemical separation and detection techniques are needed for the accurate determination of alpha and beta emitters. Rapid analytical methods are needed in the case of an accident for early decision making.

Objectives

The objective of this project was to perform critical evaluation of radiochemical procedures in terms of their reliability, reproducibility, rapidity, toxicity, cost, simplicity etc. Based on this, areas that need more research were singled out and possible new procedures developed. Radionuclides that deserve special consideration include U, Pu, Am, Cm and Sr. To gather detailed information on the procedures in use, a questionnaire regarding various aspects of radionuclide determination was developed and distributed to all (sixteen) relevant laboratories in the Nordic countries. In the second year of the project an intercomparison on the analysis of natural radionuclides in ground water was performed. A more complete intercomparison analysis programme should be integrated in the project.

Summary of evaluation

Title:	**RadChem - Radiochemical analysis in emergency and routine situations**
NKS funding:	415 000 DKK
Co-ordinator:	Rajdeep Singh Sidhu, IFE (NO)
Participants:	IFE (NO), LU (S), LiU (S), ØU (S), FOI (S), Risø (DK), HU (FI), STUK (FI)
Evaluation material	Contracts for 2004 and 2005, 4 semi-annual progress reports for 2004, 2005, Draft of final report, March 2005 (30s + appendices), NKS-124, NKS-129.
Published deliverables	NKS-124: “RADCHEM Radiochemical procedures for the determination of Sr, U, Pu, Am and Cm”, April 2006, 94p. NKS-129: “RADCHEM 2005 - Radiochemical analysis in emergency and routine situations”, April 2006, 22p.
Missing deliverables	None

Valuable information was provided by the labs on their practise regarding the specified analyses, making it possible to analyse and compare radiochemical preparation procedures. It is now 20 years ago since such a study was last undertaken in the Nordic countries. Although most of the techniques in use are still the same, some deviations can be seen: Besides Pu separation using anion exchange chromatography, there was not a single procedure that was used in all labs. More labs are doing americium determination. Due to the commercial availability of extraction chromatographic resins, more labs are now using this technique.

The report refers to several standard publications on radiochemical analysis. Questionnaire response from each participating laboratory is included. Nine laboratories answered the questionnaire, while four laboratories responded that they did not perform the specified analysis. Two laboratories that perform the specified analyses did not respond to the questionnaire. The report summaries the findings and gives recommendation on suitable practice.

Results of the planned intercomparison analysis of natural radionuclides in ground water were published in the proceedings from the NKS-B Summary Seminar in Tartu, October 2005. It would seem natural that the RadChem project was integrated into an analysis programme performed at the same time. It is mentioned that a comparison of the results provided by different labs in the NKS-B LABINCO exercise will provide a direct comparison of the different procedures in use.

Fulfilment of NKS-criteria

NKS evaluation criteria	Fulfilment of NKS-criteria, RadChem	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology and associated measurement techniques are identified project areas.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	Very high pedagogical merit through focus on methodological skills.	A
The application and scientific perspectives of the project	Important project to assure quality and increase standardisation of radionuclide analysis in ecological samples.	B
At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	Results may lead to more standardised laboratory practices.	B
Project results of adequate quality	Reported analysis protocols are of limited value as long as not supported by published intercomparison measurements.	C
Project in accordance with plans and budget	Yes.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 415,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 830,000 DKK. The cost-effectiveness appears to be at the right level.	B
Relevance for authorities and others	Potentially valuable results for participating laboratories and for authorities relying on these laboratories.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.2.9 NorCMass

The project NorCMass has been performed in the period 2003 - 2005. The aim of the project was to stimulate and expand the Nordic competence in radioisotope measurement technology and radiochemistry as the actual number of people in the Nordic countries being able to perform mass-spectrometric analyses is critically small. To achieve these goals guideline materials have been produced and workshops on mass-spectrometric measurements have been performed.

Objectives

The objectives of the NorCMass-project were:

- to stimulate contact between mass-spectrometry users in the Nordic countries
- to stimulate new students to enter the field of mass-spectrometry
- to prepare reference material for mass-spectrometric analyses for Pu/^{237}Np
- to produce thorough instruction on the use of different mass-spectrometry systems
- to plan a training course in radiochemistry and mass-spectrometry for the project participants as well as for the participants of the RadChem-project

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**NorCMass - Nordic collaboration on the use of mass-spectrometers for the analysis of radioisotopes**
NKS-funding:	150,000 DKK (2003), 260,000 DKK (2004), 200,000 DKK (2005)
Co-ordinator:	Per Roos (Risø/Lund)
Participants:	Risø (DK), FOI (S), Agricultural University of Norway (N), University of Linköping (S), University of Örebro (S)
Evaluation materials:	Project proposals, project reports, guideline materials, NKS-134, NKS-135, NKS-136.
Published deliverables:	Workshops on mass-spectrometric radioisotope measurements (Örebro, Risø and Helsinki) NKS-134: “Nordic Collaboration on the use of Mass-Spectrometers for the Analysis of Radioisotopes”, April 2006, 15 pp. NKS-135: “NKS-Norcmass reference material for analysis of Pu-isotopes and ^{237}Np by mass spectrometry”, April 2006, 12 pp. NKS-136: “The NKS-NORCMASS guide to beginners in ICP-MS”, April 2006, 23 pp.
Missing deliverables:	None

The main purpose of the NorCMass-project has not been the scientific findings during the project period but merely to bring together scientists interested in the field of mass-spectrometry. Without the project this would not have been possible. The most important result of the project is that the skills on mass-spectrometric analyses among the participants have improved because of the participation in the project. Improved measuring techniques for reliable and rapid assessment of trans-uranium elements in environmental samples are important also from the aspect of emergency preparedness. In that perspective the project has contributed to improve the Nordic capabilities of a rapid assessment of, *e.g.* plutonium, in environmental samples collected in an emergency situation.

Fulfilment of NKS-criteria

The measurable results of the NorCMass-project during the project period 2003 - 2005 are:

- Project contract and project proposals of 2003 and 2004
- Workshop on radioisotope measurements with ICP-MS, Örebro, Sweden, 23 June 2004
- Workshop on ultra-low measurements, isotope ratios and necessary radiochemistry, Risø, Denmark, 18 August 2004
- Second workshop on ultra-low measurements, isotope ratios and necessary radiochemistry, Helsinki, Finland, 17 - 18 February 2005
- Working documents and reports:
  - Nordic Collaboration on the use of Mass-Spectrometers for the Analysis of Radioisotopes, NKS-134, April 2006

    - NKS-B Norcmass reference material for analysis of Pu-isotopes and ^{237}Np by mass spectrometry, NKS-135, April 2006
    - The NKS-NORCMASS guide to beginners in ICP-MS, NKS-136, April 2006
    - Schedule for “Training course in isotope ratio measurements of Pu and U at low levels using ICP-MS”
- Published papers in scientific journals and conference presentations:
    - Lanthanide phosphate interferences in actinide determination using inductively coupled plasma mass spectrometry. Journal of Analytical Atomic Spectrometry, 20, 1 - 6 (2005).
    - Isotope amount ratio measurements by ICP-MS: Aspects of software induced measurement bias and non-linearity. Journal of Analytical Atomic Spectrometry, 20, 320 - 322 (2005).
    - Rapid Method for ICP-MS Analysis of Plutonium in Sediment Samples. In: Scientific Basis for Nuclear Waste Management XXVIII. Materials Research Society, Warrendale, Vol. 824.
    - Pu-isotope measurements at femtogram levels using sector field ICP-MS. Accepted for publication in a special issue of Journal of Environmental Radioactivity.
    - Pu-isotope measurements at femtogram levels using sector field ICP-MS. International Conference on Isotopes in the Environmental Studies - Aquatic Forum, Monaco 25 - 29 October 2004.
    - Sources of plutonium in the environment and rapid methods for determination as emergency measures. 227th ACS National Meeting, Anaheim (2004).

The results of the NorCMass-project have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	**Fulfilment of NKS-criteria, NorCMass**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which developing optimum sampling and measurement strategies on environmental samples is an identified project areas.	B
Nordic competence and network building and maintenance	The project has built-up a Nordic network on mass-spectrometric measurements and has improved Nordic competence on the determination of trans-uranium elements in environmental samples using mass-spectrometric measuring techniques. The aspects of building networks and building up competences have been given the highest priority in the NKS-B programme.	A
The scientific and pedagogical merits of the project	The project appears to have good pedagogical merits, i.e. the guide to beginners in mass-spectrometry and the plan for training courses in low-level measurements of plutonium and uranium. The project is focused on practical application more than on long-term scientific merits.	B
The application and scientific perspectives of the project	The project results are oriented towards practical application in for the analyses of environmental samples, both for routine surveillance and in nuclear or radiological emergency situations. The scientific perspectives of the project are judged to be limited.	B
At least three Nordic countries involved	Three Nordic countries have been involved in the project.	B
Potential use of results and information	The end-users of the project results are those engaged in mass-spectrometric analyses of environmental samples, e.g. university departments, research institutes as well as the Nordic emergency management authorities. The improved skills on mass-spectrometric measurements from the project	B

	can be used in emergency situations where trans-uranium elements have been dispersed in, e.g. urban environments.	
Project results of adequate quality	The quality of the project is judged to be fairly good. The guideline material for ICP-MS beginners and the reference material for Pu-/Np-analyses are important deliverables; they might have been prepared in a more user-friendly form.	C
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 610,000 DKK. Consequently, the results of should be judged against a total manpower effort of 1,200,000 DKK. The cost-effectiveness appears to be somewhat low compared to the outcome of the project, i.e. high costs compared to the outcome of the project.	C
Relevance for authorities and others	The result of the project would be relevant for the Nordic authorities engaged in emergency preparedness and response and for those engaged in analyses of trans-uranium analyses.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.2.10 General evaluation of measurement technology projects

Projects on measurement technology are a very valuable part of the NKS programme portfolio. Nordic countries possess expert competence in this field, which is also appreciated on the European level. Nevertheless, radiological measurements constitute an expertise only mastered by few institutions in each of the Nordic countries. Projects within NKS therefore constitute an opportunity to further develop and maintain this competence as well as work out common protocols and procedures that will ensure co-ordinated actions within the Nordic countries in case of an emergency. Both types of projects (in-the-field measurements and laboratory-based analyses, respectively) seen within the 2002-2005 NKS programme are highly relevant and valuable. These are projects addressing the task of rapidly and accurately mapping the deposition of radioactivity following a fall-out situation, as well as projects measuring radioactivity in various material matrices sampled and subsequently subjected to sample analysis in the laboratory.

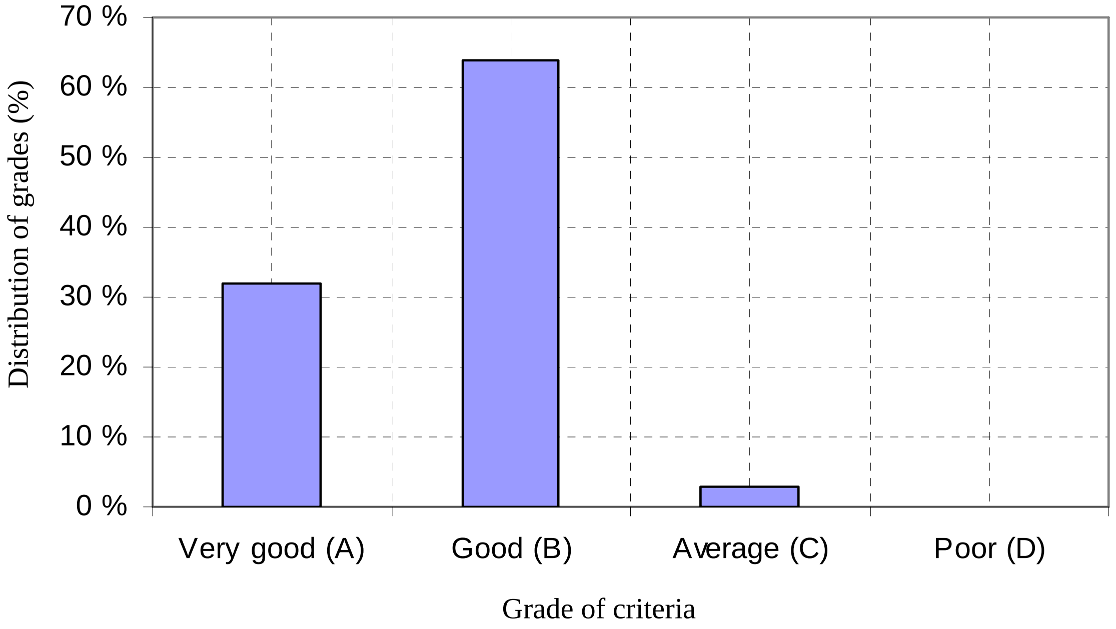


Figure 16. Distribution of grades for ten evaluation criteria over the nine measurement technology projects

Very valuable results have been obtained from field exercises and laboratory intercomparisons, respectively, for the two types of projects. Each project has been evaluated against ten criteria each of which has been given a grade (score) ranging from "very good" to "very poor" (A - E). No differential weighting has been given to these criteria and the final grade of each project is therefore a 'best judgement'. A crude averaging of the overall quality has been performed by adding (over all the projects and evaluation criteria) scores of the same grade (from very good to very poor) as shown in figure 16. The results indicate that the "average overall quality" of the nine measurement technology projects in general is quite good as more than 95% of all scores fall within the categories "very good" and "good". Despite the fairly good average score, individual differences in 'quality' exist.

To have an indication for the alleged differences in 'quality' between individual measurement technology projects the sum of grades of the same category (*A*, *B*, *C* etc.) over the ten evaluation criteria has been weighted using the following weighting algorithm:

$$\overline{G} = 2^4 \cdot N_A + 2^3 \cdot N_B + 2^2 \cdot N_C + 2^1 N_D + 2^0 \cdot N_E$$

where, *e.g.* N_A is the total number of *As* scored for the project considered, each A representing a score of 16. The weighted sum of evaluation grades, $\overline{G}$, for each of the measurement technology projects is shown in the lower panel of figure 17.

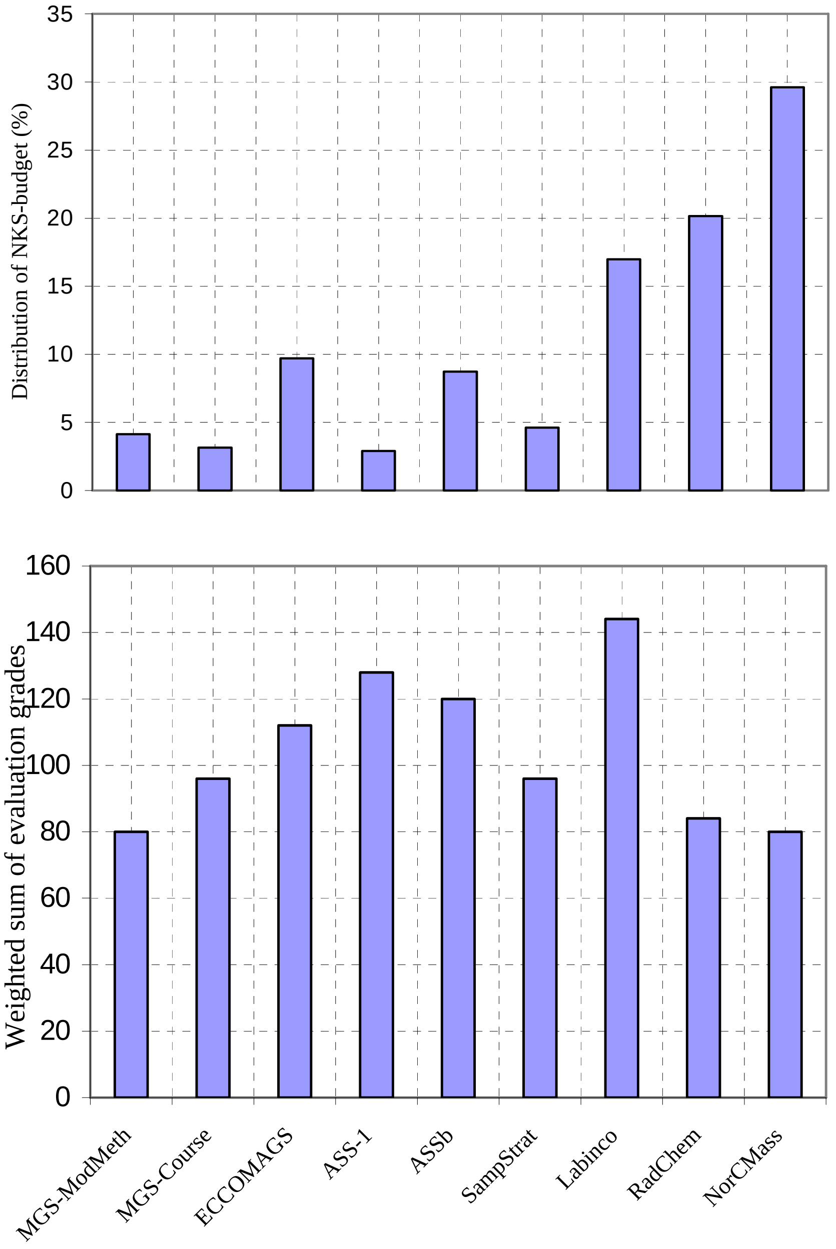


Figure 17. Relative distribution of the NKS-budget and weighted sum of grades for each of the nine measurement technology projects.

The total NKS-budget for measurement technology projects is 2 060 kDKK. The largest project is NorCMass, requiring 30% of the total funding for measurement technology projects. The relative distribution of NKS-budget on the nine projects is shown in the upper panel of figure 17. It may be noted that the two most expensive projects are not among those with the higher grades.

Challenges for the future will be to:

- Integrate project results into future activities.
- Include to a larger extent university personnel and graduate students in projects of academic interest and relevance.
- Integrate NKS activities better with relevant EU activities.

2.3 Radioecology

The NKS-B programme includes radioecological studies of relevance for emergency preparedness. Such projects may study e.g. transfer of radionuclides in semi-natural terrestrial environments, including forests, semi-arctic environments, and marine environments of special importance, as well as perform syntheses of earlier radioecological studies of Nordic interest.

The focus of NKS projects in radioecology is the possible radiation dose to man through relevant radioecological pathways. For this purpose, identification and monitoring of biological accumulation indicators in various environments becomes important. Recently the limitation of radioecology to human health protection has been questioned, and protection of the environment per se against possible effects of ionising radiation is being recognised (ICRP report 91, 2004). For this purpose biological response indicators in various environments become objects of study, as realised in the two EU programmes FASSET (Framework for Assessment of Environmental Impact) and its follow-up project in the 6th Framework Programme, ERICA (Environmental Risk from Ionising Contaminants: Assessment and Management). In order to be complete and conclusive, such studies must, however, consider the whole range of environmental stress factors, and such studies are therefore considered outside the scope of NKS-B activities.

The NKS-B activities in radioecology have supported courses (NovaCourse) and seminars (RadSem), as well as more focused activities studying radioecological aspects in ecosystems of particular Nordic interest (Rein, CsKinetic, Forest). Most of the financial support has been concentrated on two large projects, one to evaluate doses to man from various elements of the ecosystem (EcoDoses), and one to search for new useful organisms accumulating effectively and specifically radionuclides of relevance in Nordic ecosystems (Indofern).

2.3.1 Nova Course

Title:	**NOVA Course - additional funding for PhD Course in radioecology**
NKS funding:	40 000 DKK
Co-ordinator:	Brit Salbu, NLH (NO) / Klas Rosén, SLU (SE)
Participants:	one student from each of four Nordic countries
Evaluation material	Contracts for 2003, 3 semi-annual progress reports for 2003-2004.
Published deliverables	None
Missing deliverables	None

Support was given from NKS for 4 students, one from each of the countries Norway, Finland, Sweden and Iceland. First part of the course was held January 6th-17th, 2003, second part June 2nd-6th, 2003. NKS took no part in organising the course, and this project is therefore not included in the evaluation of NKS projects.

2.3.2 Rein

Reindeer is the part of Nordic food production being most vulnerable to radioactive contamination. Despite numerous radioecological studies of reindeer and reindeer meat consumers in the Nordic countries over the last 40 years, there are still important areas of lacking knowledge.

Objectives

• Continue the work initiated under the NKS-B ECODOSES project which showed 2-3 fold differences in 137Cs ecological half-lives in reindeer between different regions. This will be done by synthesising available information on habitat use, reindeer diet and contamination of reindeer in Finland, Sweden and Norway, thereby obtaining a more thorough understanding of the situation.

• Assess regional differences in transfer of radiocaesium to reindeer, by analysing available information that can help quantify the importance of lichen and other vegetation in the reindeer's diet in different areas. In modern reindeer husbandry, especially in Sweden and Norway, slaughtering also occurs in early autumn. An up-to-date emergency preparedness requires information pertinent to this situation.

• Contribute to developing a dynamic model for radiocaesium in reindeer that can help identify knowledge gaps, and be a useful tool in Nordic emergency preparedness.

Summary of evaluation

Title:	**Rein - Regional differences in reindeer radio-caesium contamination**
NKS funding:	85 000 DKK
Co-ordinator:	Lavrans Skuterud, NRPA (NO)
Participants:	NRPA (NO), NINA (NO), SLU (S), FOI (S), STUK (FI)
Evaluation material	Contract for 2004, 3 semi-annual progress reports, status report March 2006
Published deliverables	Doctoral thesis NTNU 2005:151: "Investigation of selected natural and anthropogenic radionuclides in reindeer and lynx" is in part based on results from this project. The doctoral thesis contains 6 papers in international refereed journals (Rad and Environm Biophysics, and J Environm Radioact)
Missing deliverables	Unclear whether a final NKS-report will be published

Work within the project has led to a deeper understanding of factors influencing the radioecology of reindeer. The activity has been delayed, partly because the co-ordinator had to concentrate on his PhD thesis, "Investigation of selected natural and anthropogenic radionuclides in reindeer (Rangifer tarandus tarandus) and lynx (Lynx lynx)", which was successfully defended on August 29th, 2005. Part of the result has been to point out areas that need further investigation, such as:

- The proportion of lichen in the reindeer's diet, during all seasons, together with fallout pattern, are the important factors determining the contamination of reindeer during the first years after a fallout situation. In many areas the proportion of lichen in the diet is not well known. Additionally, grazing intensity needs to be included as a factor in studies of effective ecological halftimes.
- Observed difference in effective ecological half-times are more than a factor of 2 between Chernobyl affected areas in Sweden and Norway and areas less affected by the Chernobyl fallout further north. Further studies are needed to elucidate if the difference could be satisfactorily explained by differences in fallout origin alone or if other factors are also involved.
- Additional information regarding the long-term changes of radiocaesium in lichens and other vegetation important to reindeer would significantly help in understanding the dynamics of the radiocaesium transfer to reindeer.

Modelling is recognised as a helpful tool in this work, and would probably help extract more information from the already available data sets in Nordic countries. The model would also fill an important gap in the other software applied in the emergency preparedness. The model will be applied to study the effects of e.g. various diets, ingested fungi, lengths of winter periods and animal age on ^{137}Cs concentrations in reindeer. The development of a model for radiocaesium in reindeer has started, based on the initial developments by Åhman and Nylén.

This project should be co-ordinated or integrated into larger programmes such as ERICA.

Fulfilment of NKS criteria

NKS evaluation criteria	**Fulfilment of NKS-criteria, Rein**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	High scientific merit through systematic studies of important species for Norwegian radioecology. High pedagogical merit through supporting education of a PhD candidate.	A
The application and scientific perspectives of the project	Important questions in reindeer radioecology have been addressed. Reindeer is an important species in Nordic radioecology, as an important representative of Nordic fauna, but also because of its contribution to dose in humans through reindeer meat consumption.	A
At least three Nordic countries involved	Three Nordic countries have been involved in the project.	B
Potential use of results and information	Important areas for further studies have been identified	B
Project results of adequate quality	Difficult to assess, since final report has not been submitted.	C
Project in accordance with plans and budget	Project has been delayed.	C
Cost-effectiveness of total budget	Difficult to assess, since final report has not been submitted.	C
Relevance for authorities and others	Valuable results for science and authorities were obtained.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.3.3 CsKinetic

A study of the human biokinetics of caesium in two forms, i.) incorporated in foodstuff (137Cs in perch and mushrooms) and ii.) in ionic state (134Cs in aqueous solution) has been carried out at the Department of Radiation Physics in Malmö, starting in 2001. The results of the pilot study were published in 2004, and the CsKinetics project represents a continuation of the aforementioned study.

Objectives

i.) investigate whether Scandinavian populations exhibit shorter biological half-time of radiocaesium than other populations;
ii.) extend the biokinetic study to additional human subjects from the other Nordic countries.

Summary of evaluation

Title:	**CsKinetic - Human metabolism of caesium**
NKS funding:	130 000 DKK
Co-ordinator:	Christopher L. Rääf, Dept. of radiation physics, LU (S)
Participants:	LU (S), SSI (S), Risø (DK), NRPA (NO), STUK (FI)
Evaluation material	Contract for 2004, 3 semi-annual progress reports, draft of final report Sept 2005 (8 p), NKS-120.
Published deliverables	NKS-120: "Human metabolism of caesium", April 2006, 8p.
Missing deliverables	None

Results from the project indicate a near complete absorption of radiocaesium in the gastro-intestinal tract, be it in ion state or contained in food matrix. So far, the literature survey of Nordic studies on biokinetics of Cs suggests that the biological half time is somewhat shorter among Scandinavian males (84 days vs. ICRP-value of 110 days), although females do not exhibit any significant difference (64 days vs ICRP value of 65 days). The participants of the project have compiled a literature study containing more than 50 references on biokinetic studies of radiocaesium, with special focus on studies including some form of excretion sampling. The additional data provided by the project is based on controlled ingestion studies of ^{137}Cs-contaminated food and ^{134}CsCl in three adult volunteers, with subsequent excretion analysis. The project hopes to recruit more Nordic volunteers within a one-year period.

This project is important and relevant for Nordic radioecology. However, it is questionable whether the present project, even on the basis of prior work in Sweden, has the necessary statistical power to significantly demonstrate that biological half-time of radiocaesium in Nordic subjects may be different from standard values published by ICRP. This project should be co-ordinated or integrated into larger investigations.

Fulfilment of NKS-criteria

NKS evaluation criteria	**Fulfilment of NKS-criteria, CsKinetic**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition and analysis.	B
The scientific and pedagogical merits of the project	Heroic, but too limited project. Limited pedagogical merit.	C
The application and scientific perspectives of the project	Insufficient focus on statistical power of planned investigations.	C
At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	Results are interesting and relevant, but not of sufficient statistical power to be significant.	C
Project results of adequate quality	Unclear whether project data were acquired under well-documented conditions and with adequate standardisation and quality assurance to be comparable to ICRP data.	C
Project in accordance with plans and budget	Plans and budgets reviewed and revised annually, with a tendency to prolong ongoing projects.	C
Cost-effectiveness of total budget	The NKS financial support has been 130,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 260,000 DKK. The cost-effectiveness is difficult to assess, but it could be improved by integrating results into larger analyses.	B

Relevance for authorities and others	Indications of valuable results for science and authorities were obtained.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B-**	

2.3.4 RadSem

Objectives

The objective was to organise a mini-seminar in September 2003, in co-operation with NSFS, on radioecology and measurement techniques. Compilation of proceedings from the seminar was to be published, at least as an electronic document.

Summary of evaluation

Title:	**RadSem - Seminar: Radioecology and measurement techniques**
NKS funding:	100 000 DKK
Co-ordinator:	PrgMan
Participants:	22 participants at first seminar, 18 at the second seminar.
Evaluation material	Contract for 2003, 2 semi-annual progress reports 2003, seminar web page
Published deliverables	Seminar web page, http://130.226.56.167/nordisk/publikationer/1994_2004/radsem/gamalt/index.html http://130.226.56.167/nordisk/publikationer/1994_2004/radsem/index.html
Missing deliverables	None

Mini-seminars were held on September 8-9, 2003 and August 19, 2004, at Risø, Denmark. Three NKS-B projects were presented at the first seminar, and possible future activities within NKS-B were discussed as well as work in neighbouring countries with possible links to NKS work. In the second seminar, eight NKS-B projects were presented seven of these subsequently published extended abstracts on the seminar web page.

Fulfilment of NKS-criteria

NKS evaluation criteria	**Fulfilment of NKS-criteria, RadSem**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition and analysis.	B
The scientific and pedagogical merits of the project	High pedagogical merit through seminar experience. The scientific merit of the project appears to be limited.	B
The application and scientific perspectives of the project	Application-oriented seminar	B
At least three Nordic countries involved	Seminars were open to participants from all Nordic countries.	B
Potential use of results and information	Results useful for seminar participants	B
Project results of adequate quality	The quality of project results seems to be good, as judged from web site abstracts.	B
Project in accordance with plans and budget	Project was carried out in accordance with plan and budget.	B

Cost-effectiveness of total budget	The NKS financial support has been 100,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 200,000 DKK. The cost-effectiveness is difficult to assess, but appears to be at the right level.	B
Relevance for authorities and others	Seminars provide opportunities for networking and competence building of relevance to authorities and organisations.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.3.5 Forest

The FOREST project was established to provide multidisciplinary knowledge on sampling of forest vegetation and soil, and publish this as a sampling guide. General and practical aims of the guide are to ensure the overall quality of data collected for determination of radionuclide content in various compartments of forests. The guide also aims at improving the documentation of sampling carried out in the field. Thereby the reliability of the estimation of radionuclide distribution in forests, model parameters derived from the data, and assessment of radiation exposure through radionuclides in forests will also be improved.

Objectives

The aim of the project is to compile knowledge and publish a guide-book for sampling in forests for radionuclide analysis.

Summary of evaluation

Title:	**Forest - Guidance for sampling in forests for radionuclide analysis and update of the Nordic forest radioecology network**
NKS funding:	225 000 DKK, continuing 2006-2007 (200 000 DKK for 2006)
Co-ordinator:	Elisabeth Strålberg IFE (NO)
Participants:	STUK (FI), METLA (FI), FOI (S), IFE (NO)
Evaluation material	Contract for 2005, status rerport 2005, draft of sampling guide
Published deliverables	None
Missing deliverables	Final version of sampling guide planned for publication in 2007.

A study on sampling methodology for forests has not earlier been carried by NKS or by the post-Chernobyl European Community funded projects in the field of nuclear energy. The draft of the sampling guide seems quite adequate, and also contains useful references to other relevant survey manuals.

Fulfilment of NKS-criteria

NKS evaluation criteria	Fulfilment of NKS-criteria, Forest	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology is an identified project area.	B
Nordic competence and network building and maintenance	The project has the potential to build up competence and networking on sampling strategies in forest areas, an important ecosystem in Nordic countries.	B
The scientific and pedagogical merits of the project	Publication of the sampling guide gives the project very good pedagogical merits.	A

The application and scientific perspectives of the project	The project has a practical aim of ensuring good quality in radioecological field work, and is based on necessary scientific considerations. The scientific perspectives of the project appear to be limited.	C
At least three Nordic countries involved	Three Nordic countries involved in project	B
Potential use of results and information	The sampling guide will be useful to workers in radioecology.	B
Project results of adequate quality	Draft of sampling guide indicates that the final report will be of good quality.	B
Project in accordance with plans and budget	Project is continuing in 2006-2007, but seems to be going according to plan.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 225 000 DKK in 2005, with additional funding for 2006. Consequently, the results of should be judged against a total manpower effort of 450 000 DKK for 2005. Cost-effectiveness for compiling knowledge and writing the preliminary draft of the sampling guide seems to be average.	C
Relevance for authorities and others	The result of the project would (at the end) be relevant for the Nordic authorities engaged in radioecological monitoring as well as emergency preparedness and response.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.3.6 ECODOSES

The NKS B-programme EcoDoses project started in 2003 as collaboration between all the Nordic countries. This project may be seen as a natural continuation of work in the previous period (Bok 2.1 and 2.1.2 of NKS 35, NKS 66). In the period to be evaluated, work consists of several smaller projects planned on a yearly basis, with the possibility to base proposals for further work on the outcome of prior projects. The ECODOSES project will also be continued into the following period (2006-).

Objectives

The aim of the project is to improve the radiological assessments of doses to man from terrestrial ecosystems.

Summary of evaluation

Title:	**ECODOSES: Improving radiological assessment of doses to man from terrestrial ecosystems**
NKS funding:	1 010 000 DKK, continued in 2006 (280 000 DKK)
Co-ordinator:	Tone Bergan, NRPA (NO)
Participants:	NRPA (NO), GR (IS), STUK (FI), RISØ (DK), GU (S), FF (FI)
Evaluation material	Contracts for 2003, 2004, 2005, 7 semi-annual progress reports, NKS-98, NKS-110, Status report for 2005 (36s), NKS-123
Published deliverables	NKS-98: “EcoDoses: Improving radiological assessment of doses to man from terrestrial ecosystems”, May 2004, 62p. NKS-110: “EcoDoses: Improving radiological assessment of doses to man from terrestrial ecosystems“, July 2005, 88p. NKS-123: “EcoDoses: Improving radiological assessment of doses to man from terrestrial ecosystems. A status report for the NKS-B project 2005“, April 2006, 39p.
Missing deliverables	Activity ongoing, final report to be submitted.

A 57-page report (NKS-98) describing results from the first part of the project was published in May 2004, with main emphasis on:

- Prediction of spatial variation in global fallout of 137Cs from atmospheric nuclear tests based on precipitation data and ^{137}Cs concentrations in air (based on original concept developed by Hvinden, T., Lillegraven, A., & Lillesæter, O. (1965). Precipitation as a cause of seasonal and latitudinal variations in radioactive fall-out. Nature, Vol. 206, No. 4983, 461-463.) Global fallout from nuclear weapons testing has been thoroughly assessed and modelled by appropriate international agencies (UNSCEAR 1982, 2000). In addition to presenting a valuable review of such data from a Nordic perspective, important findings of the ECODOSES project show that the global model does not take into account the relatively rapid deposition of radionuclides in the Northern Hemisphere originating from the Soviet tests in 1958. The deposited 137Cs in 1958 was also accompanied by high levels of ^{131}I. The UNSCEAR model was also found to significantly underestimate the annual deposition in Norway. The use of precipitation data to predict spatial variation in global fallout ^{137}Cs deposition was found to give reliable predictions for Nordic areas. Five out of six stations showed good agreement (-1 to +8 % deviation) between the precipitation-based estimates and the measured deposition.
- Contamination of radionuclides in milk.

A large amount of data on contamination of radionuclides in milk was collated from the Nordic countries and registered in an excel database. Traditionally, calculation of effective ecological half-life has been done using a single exponential decay regression, but the present work showed that better modelling can be achieved by using dual component regression. For 137Cs the effective ecological half- live seemed to be fairly equal for the different investigated regions - about 1 year for the fast component and 6 years for the long component. The effective ecological half- life for 90Sr is about 1 year for the fast component in all investigated regions while the long component varies between 4 and 12 years. This is a valuable approach that could be further refined. No interpretation of the two different half-life components is presented, nor are their relative contributions presented or discussed.

- Regional differences in 137Cs effective ecological half- lives in reindeer.

A new aspect introduced in the study of regional differences in 137Cs effective ecological half-lives in reindeer is the influence of grazing intensity on radiocaesium levels in the diet. The review emphasises that there are still important gaps of missing information in the understanding of reindeer radioecology, information that will help improving emergency preparedness relevant for a vulnerable indigenous population group at a regional level.

- Workshop on Radioecological Modelling in ECOSYS.

Thirteen persons from Nordic countries and Baltic stated participated in the workshop on radioecological modelling in ECOSYS, held at Risø National Laboratory, 10-11 September 2003. The workshop was based on use of the food and dose module (FDM) in the Danish ARGOS decision-support system which is intended for predicting consequences of short-term accidental releases of radioactivity. Valuable experience was gained. In order to assure reliability of the model applications it seemed important to specify proper assumptions of regional or local characteristics rather than using the standard model assumptions in order to further improve agreement between predicted and observed data.

Results from a continuation of the ECODOSES project was presented in a 85-page report published in July 2005 (NKS-110) focused on:

- A continuation of previous work with a better approach for estimating global fallout on a regional or national scale, based on a correlation between precipitation and deposition rates.

Valuable results are presented for other nuclides than ^{137}Cs, and a method for geographical mapping of predicted deposition was developed based on interpolation of precipitation data.

- Further extension of the EcoDoses milk database

focused on the post-Chernobyl period (1986-). Effective ecological half-lives of Cs-137 in milk from 12 regions were estimated. The fast component (T1) was about 1 year for all series (except Sandnessjøen in Norway), while the slow component (T2) was more variable (7-13 years) - and in some cases not applicable. Interesting studies were performed to use the UNSCEAR model to estimate the integrated transfer coefficients of 137Cs from wet deposition to cows milk from selected sites in three Nordic countries. The model relates the concentration of a radionuclide in a sample from a given year to the deposition rate of the radionuclide from precipitation in the given year and in the year before, and to the accumulated deposition from previous years.

- Determination of effective ecological half lives for fresh water fish from Nordic lakes.

An impressive amount of data on ^{137}Cs has been acquired for a number of fresh water fish species in selected lakes in Nordic countries. Concentration factors (Bq/kg in fish species / Bq/kg in lake water) provide useful summaries of data. The work seems somewhat fragmented, and will probably benefit from further systematic analysis.

- Investigate radioecological sensitivity for Nordic populations.

Important conclusions are drawn: The time-integrated aggregate transfer of 137Cs for the global fallout was 2-3 times higher than from Chernobyl debris for Swedish urban populations. For reindeer herders this difference is even more marked, with a factor of three to four higher time-integrated transfer factor of nuclear weapons fallout. For the the transfer of Chernobyl 137Cs debris the time-integrated transfer factor appears to be more than 25 times higher for reindeer herders in Sweden than for the urban reference groups. These findings are supported by values of committed effective dose coefficients (mSv/kBq m^{-2} ^{137}Cs deposition), but it is not specifically stated to what extent this represents revision of earlier established values.

- Food-chain modelling using the Ecosys- model, which is the underlying food- and dose

module in several computerised decision-making systems. Valuable work has been done subsequent to the preliminary findings in 2004 that the FDM needed a change of a number of model assumptions and parameters from default values based on Central European conditions to those characteristic for Nordic countries, e.g. growing seasons, harvest times, crop yields, animal feeding regimes, human habits. Further generic inadequacies of the modelling system relate to dry deposition processes.

Main results from work in 2005 (Status report for 2005, NKS-123) are:

- Considerable variations in activity concentrations of 137Cs and 90Sr were observed between countries or regions due to factors such as different precipitation patterns, soil types and the inhomogeneity over Europe of Chernobyl fallout. The observed time trends indicate that the factors influencing the ecological half-life for 90Sr are not entirely the same as for 137Cs in the pasture – milk system.
- Deposition of 137Cs estimated based on precipitation data was found to show good agreement with measured values. The sum of the calculated deposition density from NWF and Chernobyl in western Sweden was compared to accumulated activities in soil samples at 27 locations.

Further work in EcoDoses will focus on the doses to man, by improving the fallout models and implementing the collected data into food and dose models. Focus will thus be on internal doses. Also work on the human data on ^{137}Cs body content will be further systemised and compared with the modelled data.

Fulfilment of NKS-criteria

The measurable results of the ECODOSES project for the period 2002-2005 are:

- NKS-98 report (57 pages)
- NKS-110 report (85 pages)
- NKS-123 (39 pages)

The total cost within the period 2002-2005 has been 1010,000 DKK, with additional funding of 280,000 DKK for continuation in 2006. Considering that involved participants contribute assumed equal funding, the cost seems considerable. Cost-effectiveness will, however, depend on the scientific value of the results obtained. For increased value, a further systematic analysis of the data, and their integration into larger high-quality databases and assessment projects such as ERICA would seem desirable.

NKS evaluation criteria	**Fulfilment of NKS-criteria, ECODOSES**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	Pedagogical merits would be high if young candidates participate in project, but this is not known. Data of scientific merit were collected	B
The application and scientific perspectives of the project	Insufficient focus on integration of project with larger projects on the European or international level.	C
At least three Nordic countries involved	All five Nordic countries have been involved in the project.	A
Potential use of results and information	Insufficient emphasis on how to integrate results into larger surveys.	C
Project results of adequate quality	Project data presumably acquired under well-documented conditions and with adequate standardisation and quality assurance.	B
Project in accordance with plans and budget	Plans and budgets reviewed and revised annually, with a tendency to prolong ongoing projects.	C
Cost-effectiveness of total budget	The NKS financial support has been 1,010,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 2,020,000 DKK. The cost-effectiveness of the project appears to be somewhat low, i.e. high costs compared to the outcome of the project.	B
Relevance for authorities and others	Very valuable results for science and authorities were obtained.	A
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.3.7 INDOFERN

Objectives

The objective of the project was to search for new useful organisms accumulating effectively and specifically certain radionuclides in various Nordic ecosystems (terrestrial, fresh water, marine), and to compare their indicator value with those of the earlier known indicators. The aim of the project was to get more information about other long-lived nuclides than Cs-137 (90Sr, Pu and Am) and about the most abundant discharge nuclides from the nuclear power plants (e.g. 60Co). In addition, the usability of different organs and tissues of the organisms as indicators should be studied.

Summary of evaluation

Title:	**Indofern - New indicator organisms for environmental radioactivity**
NKS funding:	3 030 000 DKK
Co-ordinator:	Erkki Ilus, STUK (FI)
Participants:	STUK (FI), NRPA (NO), IFE (NO), UMB (NO), GR (IS), RISØ (DK), LU (S), UF (FI)
Evaluation material	Contracts for 2002, 2003, 2004, 2005, 7 semi-annual progress reports, Summary report and 13 reports from partners to co-ordinator (chapters in NKS-140).
Published deliverables	Web-sites at participating institutions: http://www.stuk.fi/tutkimus/activities_and_projects/preparedness/en_GB/indofern/ http://www.ife.no/avdelinger/miljo_og_stralevern/prosjekter/indofern/view NKS-140: Proceedings of the Summary Seminar within the NKS-B Programme 2002-2005, 24-25 October 2005, Tartu, Estonia. April 2006, 184p (Electronic report). NKS-143: Proceedings of the Summary Seminar within the NKS-B Programme 2002-2005, 24-25 October 2005, Tartu, Estonia. August 2006, 184p (Printed report).
Missing deliverables	None

The study was expected to yield new data on the occurrence, transport and concentrations of many important radionuclides in potential candidates of indicator organisms concerning a wide scale of Nordic ecosystems. The choice of candidates should be based on references to literature concerning accumulation of radionuclides and stable elements to certain species or groups of organisms.

Work within the project has been co-ordinated and discussed in a series of project seminars (May 2002, May 2003, May 2004, April 2005) as well as being presented in the NKS-B summary seminar in Tartu, 24-25 October 2005. The proceedings report (NKS-140, NKS-143) from the latter seminar containing 13 presentations from the INDOFERN project is taken as the final report of the INDOFERN project.

At the beginning of the INDOFERN project, it was discussed in the project group, which term (bioindicator or indicator organism) should be used when studying the ability of organisms to exhibit presence and quantity of radionuclides in the environment. Bioindicators are commonly grouped into accumulation indicators and response indicators. Accumulation indicators store pollutants without any evident change in their metabolism. Response indicators react with cell changes or visible symptoms of damage when taking up even small amounts of harmful substances. Within radioecology, the term bioindicator is normally synonymous with accumulation bioindicator, i.e. organisms or organism communities that accumulate pollutants without any visible effects. The group decided to use the term *indicator organism*, without further definition of what was meant by this term, relative to the others. The search is for new useful organisms accumulating effectively and specifically certain radionuclides in various Nordic ecosystems (terrestrial, fresh water, marine), and to compare their indicator value with those of the earlier known indicators.

The idea in sampling was to take the samples from relatively small areas where the environmental factors (type of soil etc.) and the amount of radioactive deposition are likely homogenous, which makes it possible to compare the indicator value of different organisms. Data were collected from about 170 organisms (species, family or group). The list of organisms consists of 49 mushrooms, 7 lichens, 5 mosses, 13 spore-bearing plants (*Pteridophytes*), 38 seed plants, 10 algae (including plankton and periphyton), 11 benthic animals, 15 fish species, 9 birds, 4 seals, 1 whale, the lynx and the polar bear. A majority of the organisms (98 species) represent terrestrial environment, 56 of them are from marine or brackish-water environment and 20 from the fresh water environment. The most extensively studied individual organisms were from the marine/brackish water environment, such as *Fucus vesiculosus* and *Mytilus edulis.* Large amounts of highly valuable data have been collected. However, it may seem that the measurement programs have to some extent been based more on what is feasible, rather than what is most needed. Thus, one of the progress reports points out that within the EU-project Framework for Assessment of Environmental Impact of Ionising Radiation (FASSET) it was recently concluded that particularly radiological data on marine mammals are lacking. Nevertheless, only 5 such animals were sampled in the INDOFERN project. Results are reported on radionuclide concentrations in indicator organisms (Bq/kg dry or wet weight), as well as on aggregated transfer factors (Bq/kg per Bq/m^2 deposition) or concentration factors (Bq/kg per Bq/kg water). The measurements vary somewhat with respect to protocol. Thus, in some cases marine samples have been collected without at the same time collecting representative water samples, whereas in other cases both types of data were collected, thus allowing reliable calculations of concentration factors. Collection of systematic time series of radionuclide concentrations in sea water at chosen locations would establish an important source function for studying accumulation of radionuclides in various marine species at the same sites. This project should be co-ordinated or integrated into larger programmes such as ERICA.

Fulfilment of NKS-criteria

The INDOFERN project is the largest project under the NKS-B programme for the 2002-2005 period, requiring 30% (3 million DKK) of total NKS-B programme funding. Considering that assumed equal funding is contributed by involved participants, the cost seems considerable. Much cost-intensive fieldwork has, however, been carried out within the project. Since the final report of the project is in form of a seminar proceedings, it is difficult to assess the final value of the project.

NKS evaluation criteria	**Fulfilment of NKS-criteria, Indofern**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which radioecology is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to maintain and extend the competence on radio-ecological data acquisition, analysis and modelling.	B
The scientific and pedagogical merits of the project	Pedagogical merits would be high if young candidates participate in project, but this is not known. Data of scientific merit were collected	B
The application and scientific perspectives of the project	Insufficient focus on integration of project with larger projects on the European or international level.	C
At least three Nordic countries involved	All five Nordic countries have been involved in the project.	A
Potential use of results and information	Vast amounts of data have been collected, with corresponding potential usefulness, but end-use of the results seems uncertain.	C
Project results of adequate quality	Project data seem to be collected without a strict protocol.	D
Project in accordance with plans and budget	Plans and budgets reviewed and revised annually. There seems to be a lack of stringency in the planning of fieldwork.	D
Cost-effectiveness of total budget	The NKS financial support has been 3,030,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 6,060,000 DKK. Fieldwork entails extra cost. The cost-	D

	effectiveness of the project is difficult to assess since end-use of the results is uncertain.	
Relevance for authorities and others	Valuable results for science and authorities were obtained.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B-**	

2.3.8 General evaluation of radioecology projects

The main relevance of NKS radioecological projects is to establish reliable data for use in decision support systems for handling of emergency situations. For this purposes it is important that the work performed is well planned and integrated into larger frameworks. Nordic countries possess significant competence in the above-mentioned area, as exemplified by the ARGOS decision support system versus the RODOS system developed by EU, and well-established time-series of a number of radioecological analyses.

From the published reports of NKS-projects in this field, it is not always clear how the results will be utilised in a systematic manner to further strengthen the expertise in the area of radioecology. For improvement of decision support systems, an initial critical analysis should first be performed on what type of data is most needed to strengthen system performance. Subsequently, such data should be acquired through focused project work. INDOFERN is by far the largest NKS project in radioecology, requiring 30 % of total NKS-B project funding. Amongst the plethora of species and ecosystems that could be analysed, it would seem important to concentrate on a limited number of species chosen as representatives of various ecosystems of special interest and relevance for Nordic

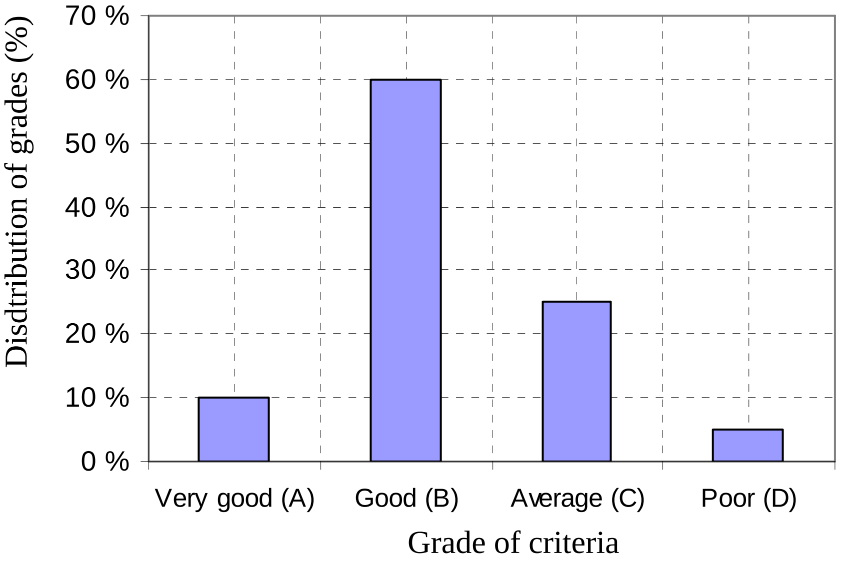


Figure 18. Distribution of grades for ten evaluation criteria over the six evaluated radioecology projects (7 radioecology projects in total)

countries. The effort should then be focused on systematic, long-term monitoring of the chosen species. Such systematic measurement programmes should be implemented in collaboration with university personnel to encourage student recruitment to the area. Yearly field work and subsequent sample analyses could be run in parallel between student projects and professional work, where the latter would provide student advice and guidance but also be responsible for the official measurement results. Such collaborative projects with university groups could in addition to the fixed measurement programme also pursue more explorative studies, e.g. on the added value of analysing several organs from the selected species as part of biodistribution studies.

A crude averaging of the overall quality of radioecology projects has been performed by adding (over all the projects and evaluation criteria) scores of the same grade (from very good to very poor) as shown in figure 18. The results indicate that the "average overall quality" of the six evaluated radioecology projects in general is quite satisfactory as 70% of all scores fall within the categories "very good" and "good". Despite the satisfactory average score, individual differences in 'quality' exist.

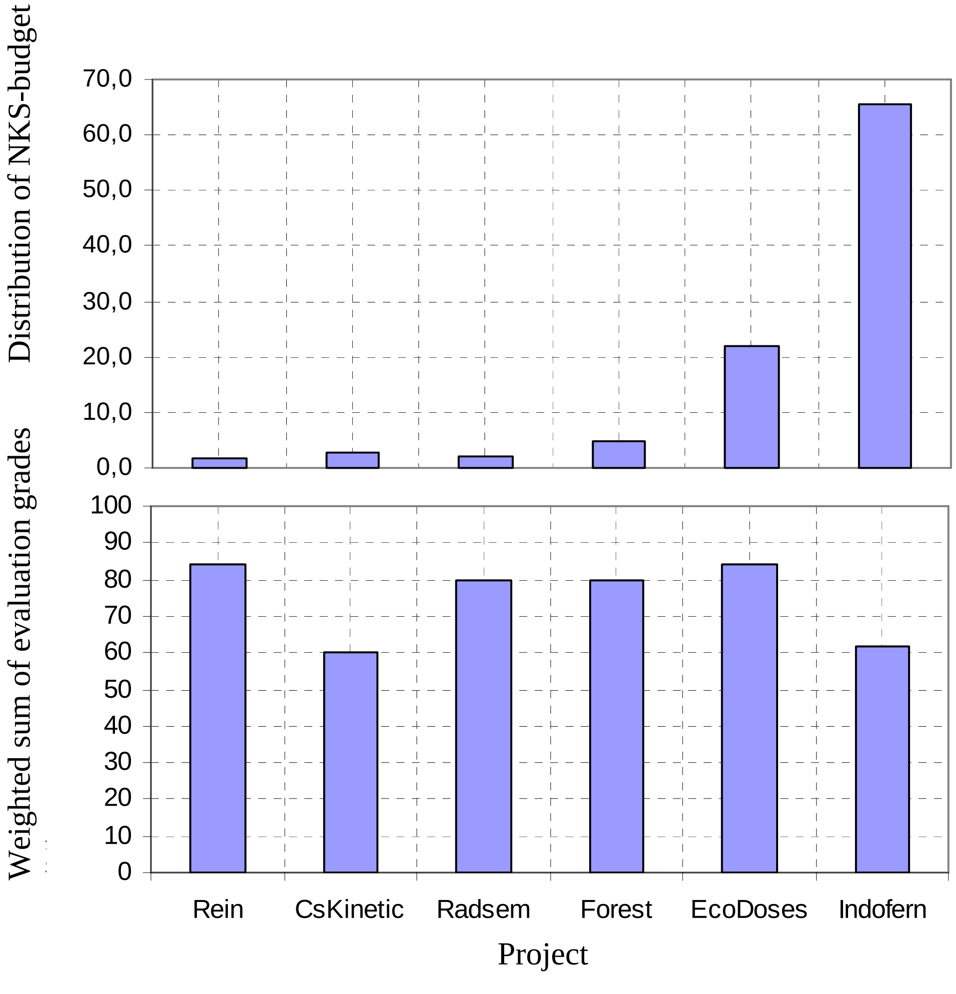


Figure 19. Relative distribution of the NKS-budget and weigthed sum of grades for each of the six evaluated radioecology projects (7 radioecology projects in total).

Radioecology projects represent a total cost of 4,620 kDKK, with ECODOSES and INDOFERN being the two largest, representing 21% and 65 % of the radioecology project costs, respectively, as shown in the upper panel of figure 19.

To have an indication for the alleged differences in ‘quality’ between individual radioecology projects the sum of grades of the same category (A, B, C etc.) over the ten evaluation criteria has been weighted using the same weighting algorithm as for measurement technology projects (see chapter 2.2.10):

$$\overline{G} = 2^4 \cdot N_A + 2^3 \cdot N_B + 2^2 \cdot N_C + 2^1 N_D + 2^0 \cdot N_E$$

The weighted sum of evaluation grades, $\overline{G}$, for each of the radioecology projects is shown in the lower panel of figure 19.

Challenges for the future will be to:

- Integrate results efficiently into knowledge data bases and decision support systems
- Stronger focus towards
  - the needs of radiological input to decision support systems
  - systematic measurement programmes for a few selected organisms of combined Nordic and EU interest and relevance.
- Include to a larger extent university personnel and graduate students in projects of academic interest and relevance.

2.4 Emergency preparedness

The aim of the NKS-B programme is to strengthen radiological emergency preparedness in the Nordic countries. Apart from activities directly targeted at emergency preparedness also activities in related areas such as radioecology and effective communication and information management should be included and be focused on emergency preparedness related questions. Two main aspects have been given the highest priority:

(1) Maintaining and building up *competence*, and
(2) Maintaining and building *close informal Nordic networks* between scientists in emergency preparedness related disciplines.

In the guidelines for the NKS-B programme for the period 2002 - 2005 overall considerations on future efforts have been proposed. They include issues like decision support systems, consequence analyses, exercises, measurement strategies and methods as well as information strategies. Some specific project areas have been identified:

- evaluating existing decision support systems with respect to further development, validation and harmonisation of such systems
- performing exercises with a longer time perspective including, *e.g.* contaminated foodstuffs
- performing studies on the consequences of accidents at nuclear power plants in Western Europe
- developing manuals for application in accident situations
- developing optimum sampling and measurement strategies on environmental samples
- developing portable field measurement systems

- developing measurement protocols for characterisation of fallout in urban areas as basis for decisions on countermeasures
- development of models for estimation of doses to urban populations
- further development of Nordic collaboration on information in emergency situations

In the following evaluation the projects have been judged firstly against how well they fulfil the aims of the fields, and secondly against the ten criteria that emerged from the interpretation of the guidelines set out by the NKS Board (see Appendix 1).

2.4.1 URBHAND

Phase 1 of the project URBHAND has been performed in the period 2004 - 2005. The project will continue during 2006 - 2007 in a phase 2 where national end-user fora will be set up in the Nordic countries to discuss and review the handbook. In addition, an exercise will be formulated in which regulators and decision-makers can test the handbook with the aim of producing a final handbook at the end of 2007.

Objectives

The objectives of the URBHAND project have been formulated in ‘Call for Proposals’ and they are summarised below:

- The overall objective of the project was to create a handbook designed to assist Nordic decision-makers in the remediation of contaminated inhabited areas in the event of a severe nuclear accident. The handbook should address the special Nordic perspective and utilise state-of the-art knowledge as basis for the decision on different remediation strategies.
- The handbook should describe an easily applicable methodology for calculation of long-term doses in an inhabited environment, including the newest radionuclide transfer data in dose calculations.
- The importance of measurement strategies, systems and equipment for the purpose of countermeasure optimisation should be described. Flow charts or other chart representations should be suggested to help decision-makers through crucial steps of the planning.
- The handbook should focus on the radionuclide ^{137}Cs released in major nuclear accidents. Also the specific problems with the detonation of a so-called ‘dirty bomb’ dispersion device in an inhabited area should be dealt with.
- A number of countermeasures that would be considered to be particularly appropriate for Nordic kitchen garden areas should be described, considering the optimisation principles introduced by ICRP 82.

Summary of evaluation

The deliverables and funding of phase 1 of the project are summarised in the table below. Phase 2 is planned for in the period 2006 - 2007.

Title:	**URBHAND - Decision support handbook for remediation of contaminated inhabited areas**
NKS-funding:	205,000 DKK (2004), 205,000 DKK (2005), 410,000 DKK (2006 - 2007)
Co-ordinator:	Kasper G. Andersson, Risø National Laboratory (DK)
Participants:	STUK (FI), IFE (N), SLU (S)
Evaluation materials:	Project proposals for 2004 and 2005, progress reports for 2004 and 2005, Handbook

Published deliverables:	Version 1 of Handbook for end-user discussion Paper presented at the NSFS ordinary meeting in 2005 in Rättvik, Sweden
Missing deliverables:	Final Handbook (to be finalised in 2007)

Central parts of the handbook contain data for remediation techniques that can be used in urban environments and simple calculation schemes for assessing external doses from deposited radionuclides on different types in an urban environment, *e.g.* walls, roofs and grass/soil/trees. Together with the remediation data described in Chapter 4, the dose calculation schemes can be used to assess the avertable doses for selected remediation strategies.

The handbook addresses both nuclear and radiological accidents including malicious radionuclide dispersion devices (‘dirty bombs’). Such a device might be ‘loaded’ with α- or pure β-emitters such as ^{239}Pu or ^{90}Sr, and, consequently, in phase 2 of the project, Chapter 5 might be extended with tables containing dose conversion factors for such radionuclides to assess inhalation dose rate from resuspended material for given values of the resuspension factor.

Chapter 9 of the handbook is quite important focusing on the process on how to select an optimised remediation strategy. However, this important chapter needs to be tightened and several illustrative examples might be included. Flow charts and other graphical illustrations would be important together with these examples to illustrate the process of justification and optimisation of remediation strategies. Of special importance is an illustration of how the social factors dealt with in Chapter 8 should be included in the justification/optimisation process.

In the introduction of Chapter 9 a somewhat more detailed elaboration of the ICRP/IAEA recommendations on remediation of contaminated areas would have been appropriate also because the use of the ICRP 82 in the optimisation process was one of the objectives of the project. Reference levels of 10 mSv/a and 100 mSv/a are recommended both in ICRP No. 82, IAEA-TECDOC-987 and the IAEA Safety Requirements No. WS-R-3. In the application example in chapter 9 the three relevant remediation options seem to be unjustified on pure cost-benefit considerations using the cost data presented and not including social factors.

In the phase 2 of the URBHAND project it should be considered if some of the results of the EMARAD project, *e.g.* material on measurement strategies and monitoring systems as well as material on urban dispersion calculations, could be transferred and integrated into the Handbook as a supplement to the already existing material.

Fulfilment of NKS-criteria

The measurable results of the URBHAND-project during the project period 2004 - 2005 are:

- Project contract and project proposals
- A draft handbook for end-user discussion with nine chapters in 124 pages
- Two progress reports (2004 and 2005)
- A paper at the NSFS ordinary meeting in 2005 in Rättvik, Sweden

The project results information seems to have been rather scarce during the project period. It could be advantageous to continue the project in the new NKS-programme; if so, the handbook should be extended to include methodologies on justification/optimisation of remedial measures in urban environments.

The results of the URBHAND-project have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	**Fulfilment of NKS-criteria, URBHAND**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework within which “developing manuals for application in accident situations” is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to extend the competence on the use of clean-up data from full-scale experiments in the former USSR.	C
The scientific and pedagogical merits of the project	The scientific merit of the project appears to be limited. The pedagogical merit of the project is the collection of a large amount of data in a single handbook.	C
The application and scientific perspectives of the project	The handbook has the potential of being useful for the Nordic emergency preparedness community. The handbook includes the latest scientific data, based on both theory and experiments. The scientific perspective would be the incorporation of an overall justification/optimisation procedure that would allow the inclusion of social attributes.	B
At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	The results and the information in the handbook are relevant in nuclear and radiological accident situations where urban environments have been contaminated. The handbook could be made more user-friendly, e.g. by moving much of the background text to appendices. Many technical details are “submerged” in the text, e.g. shorter calculations using figures extracted from the tables. Such calculations and results could with advantage be presented as examples instead of being integrated in the text and a more ‘handbook-like’ text would appear. Also the use of flow charts in the examples would be beneficial.	C
Project results of adequate quality	The quality of the results is adequate but the handbook could be made somewhat more user-friendly in phase 2 of the project.	C
Project in accordance with plans and budget	The project is in accordance with plans and budget although minor parts of the objectives are not met.	B
Cost-effectiveness of total budget	The NKS financial support of phase 1 of the project has been 410,000 DKK. Consequently, the results of phase 1 of the project should be judged against a total manpower effort of 820,000 DKK. The cost-effectiveness appears to be somewhat low, i.e. high costs compared to the outcome of the project.	C
Relevance for authorities and others	The result of the study and the handbook are relevant for authorities being important participants in the decision-making process.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**–	

2.4.2 UrbContSem

An international conference entitled “Radioactive Contamination in Urban Areas” was held at Risø National Laboratory in the period 7 - 9 May 2003 with financial support from NKS.

Objectives

The conference was arranged in the light of the experience gathered after the Chernobyl accident that the urban environment has not received the same attention in radioecology as has the agricultural environment, and that data are needed to ensure justified and optimised remediation strategies for urban areas. The objectives of the conference were:

- To create a forum for presentation of new knowledge on contamination and decontamination of inhabited areas.
- To provide a basis for a much needed improvement of preparedness strategies for inhabited areas in Europe.
- To pinpoint areas where further investigations are needed.

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**UrbContSem - Conference on urban contamination**
NKS-funding:	200,000 DKK
Co-ordinator:	Jørn Roed, Risø National Laboratory (DK)
Participants:	STUK (FI), IFE (N), SLU (S), SSI (S)
Evaluation materials:	Conference program, abstracts and NKS web site
Published deliverables:	All abstracts, slides and posters presented are displayed on the NKS web site: www.nks.org/nordisk/B-delen/resultater.htm Journal of Environmental Radioactivity, Volume 85, Issues 2-3, Pages 151-388 (2006), Radioactive Contamination in Urban Areas, Edited by Kasper G. Andersson
Missing deliverables:	None

In the period 7 - 9 May 2003, a Conference on Radioactive Contamination in Urban Areas was held at Risø National Laboratory to provide a forum for presenting new knowledge of relevance to urban contamination. A total of 53 presentations were given at the conference including five invited presentations. The presentations provided many interesting and valuable conclusions, but also left many important questions open, clearly demonstrating the needs for further research. A separate session at the conference was devoted to the problems of contamination of natural recreational areas and forests frequently used by urban populations. A special issue of Journal of Environmental Radioactivity contains 17 selected papers elaborating on presentations given at the conference and dealing with different aspects of urban contamination.

In recent years, the possibility of a very different type of radiation incidents has attracted attention, *e.g.* detonation of malicious radionuclide devices in urban areas. However, available data to perform detailed analyses of such consequences of contamination in urban areas are relatively sparse. A major conclusion from the conference was that extrapolation from the Chernobyl accident would not apply to such different types of contaminating scenarios.

Fulfilment of NKS-criteria

The measurable results of the UrbContSem-project are:

- Project contract and project proposal
- The conference on Radioactive Contamination in Urban Areas held at Risø National Laboratory 7 - 9 May 2003

- The publication of papers from the conference in the Journal of Environmental Radioactivity, Volume 85, Issues 2-3 (2006)
- The publication of all abstracts, slides and posters on the NKS web site

The results of the UrbContSem-project have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	**Fulfilment of NKS-criteria, UrbContSem**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework within which “development of models for estimation of doses to urban populations” is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to Nordic network building and identified areas for further competence building.	B
The scientific and pedagogical merits of the project	The pedagogical merit of the project is the high quality papers presented. The scientific merit is the identification of the further research needs to make urban dispersion modelling more reliable.	B
The application and scientific perspectives of the project	The conference revealed the need for more model data, especially on dry deposition, deposition under foggy conditions, weathering and resuspension as well as a large discrepancy between results from different urban dispersion models. The perspectives for further research might be oriented towards the application of models on the malicious radionuclide dispersion devices in urban environments.	B
At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	The conference gave many useful results and the application potential of many of the presented papers is high.	B
Project results of adequate quality	The quality of the presentations at the conference was high and 17 papers from the conference have been published in Journal of Environmental Radioactivity.	B
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 200,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 400,000 DKK. The cost-effectiveness appears to be at the right level.	B
Relevance for authorities and others	The results of the presentations are relevant for both authorities and other professionals, especially regarding the importance of reliable consequence assessment models for contaminated urban areas.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.4.3 NucVess

The project NucVess has been performed in the period 2004 - 2005. The aim of the project was to reduce the gap between the desirable and the actual knowledge on Russian marine reactors and their fuel through a study of all available open sources on this subject. The focus has been on source term data, based on information on actual design and earlier accidents with Russian naval vessels.

Objectives

The objectives of the NucVess-project were:

- To evaluate all available design information for marine reactors, complete studies of release fractions for specific accidents (LOCA, criticality accidents during re-fuelling/de-fuelling) with releases to air and/or sea
- To examine the possibility for re-criticality in spent fuel configurations on shore (*i.e*. in storage at former naval bases) for PWR marine reactors and in spent removal blocks from liquid metal reactors
- To improve the overall ability of the relevant Nordic authorities to perform impact assessments for accidents involving Russian naval vessels and spent fuel
- To prepare two reports: (1) Russian Nuclear Power Plants for Marine Applications and (2) Source Term Evaluation for Severe Accidents with Russian Nuclear Power Plants for Marine Applications

Summary of evaluation

The deliverables and funding of the NucVess-project are given in the table below.

Title:	**NucVess - Impact assessment of accidents with nuclear powered vessels - analysis of release mechanisms and source term composition**
NKS-funding:	100,000 DKK (2004), 240,000 (2005)
Co-ordinator:	Ole Reistad, Norwegian Radiation Protection Agency, Poul Ølgaard, Risø National Laboratory
Participants:	NRPA (N), Risø (DK)
Evaluation materials:	NKS-138 and NKS-139
Published deliverables:	NKS-138: Russian Nuclear Power Plants for Marine Applications, April 2006, 92 pp. NKS-139: Inventory and Source Term Evaluation of Russian Nuclear Power Plants for Marine Applications, April 2006, 70 pp.
Missing deliverables:	None

NKS-138 describes the development of and the present state of the nuclear vessel classes and generations of the Russian nuclear navy, of the Russian nuclear icebreaker classes and of the Russian nuclear submarine designs. The different types of Russian marine reactors are described and data for Russian nuclear naval vessels - both submarines and surface vessels for military and civilian purposes - are listed in detail in an Annex. Also Russian nuclear marine bases and shipyards are listed in an Annex. Finally, criticality and loss of cooling accidents that have involved Russian nuclear vessels are reviewed and rather detailed accidents descriptions are presented in an Annex.

NKS-139 deals with source terms for accidents at nuclear submarines. The report focuses on the different factors contributing to the source term for accidents at Russian naval reactors and their spent fuel and presents information on the activity inventory in Russian naval reactors and source terms for criticality accidents, loss-of-cooling-accidents and sunken submarines. The report also includes estimations of the radiological consequences in the marine environment after potential releases of radionuclides from the submarine Kursk.

The reports conclude that loss-of-cooling accident may have serious consequences to the submarine crew since the whole submarine may be contaminated, but it will result in little activity release to the environment. The sinking accidents will leave a significant amount of activity at the bottom of the sea, but its release to the environment will be very slow and therefore result in very small activity concentrations in the surrounding water. Spent fuel accidents may well give rise to important contamination of areas of the naval bases, but its effect will be local. The only exception is a criticality accident with spent fuel, but this type of accident is not very probably, since safe geometries are used in connection with spent fuel handling

Both reports contain valuable material that can be used in the impact assessment of accidents involving Russian naval vessels and spent fuel. There is some overlap between the content in the two reports and it might be considered to combine the two reports into one report. It should also be considered to include the major findings of the present project into the NKS-B project "Knowledgebase" the scope of which has been to prepare a base of knowledge regarding possible nuclear threats in the vicinity of the Nordic countries.

Fulfilment of NKS-criteria

The measurable results of the NucVess-project during the project period 2004 - 2005 are:

- Project contract and project proposal
- NKS-138: Russian Nuclear Power Plants for Marine Applications
- NKS-139: Inventory and Source Term Evaluation of Russian Nuclear Power Plants for Marine Applications

A periodic update of the project results might be considered if new designs of nuclear powered vessels are launched.

The results of the NucVess-project have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	Fulfilment of NKS-criteria, NucVess	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework within which "performing studies on the consequences of accidents at nuclear power plants in Western Europe" is an identified area.	B
Nordic competence and network building and maintenance	The competence network building and maintenance is limited due to the relatively narrow topic and to the limited number of participants.	C
The scientific and pedagogical merits of the project	The scientific merit of the project appears to be rather low. The pedagogical merit is the collection of a large collection of detailed technical data on Russian nuclear powered vessels. Furthermore, the project has contributed as part of a PhD-education of a young scientist.	B
The application and scientific perspectives of the project	The scientific perspectives of the project are judged to be rather limited. The results can be applied in different information databases.	C
At least three Nordic countries involved	Only two Nordic countries (N + DK) have been involved in the project, which can be justified considering that particularly Norway is exposed to the threat from Russian nuclear powered vessels.	C
Potential use of results and information	The results of the project are relevant in accident situations involving Russian nuclear powered vessels. The potential use of the project results and information can be increased by integrating the results in the website database "Nuclear threats in the vicinity of the Nordic Countries" that has been built in another NKS-B project "Knowledgebase".	C
Project results of adequate quality	The quality of the project results is judged to be on the average.	C
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support of the NucVess project has been	D

	340,000 DKK (100,000 DKK + 240,000 DKK). Consequently, the results of the project should be judged against a total manpower effort of 680,000 DKK. The cost-effectiveness appears to be rather low, i.e. high costs compared to the outcome of the project.	
Relevance for authorities and others	The results of the project are relevant for the Nordic authorities, especially the Norwegian authorities, as the possible nuclear threats from Russian nuclear powered vessels are primarily directed against Norway.	C
Evaluation grade	**B–**	
A (very good), B (good), C (average), D (poor), E (very poor)		

2.4.4 NordRisk

The NordRisk project was started in 2005 and will be finalised in 2006. The main focus of the project is on atmospheric dispersion and meteorology and a general aim of the project is to build up competence on probabilistic risk assessment. The activity will strengthen and expand a multidisciplinary network among Nordic modellers, radiologists, nuclear-safety experts, and decision-makers. The project has been performed in connection with the NKS-B MetNet project.

Objectives

The objectives of the NordRisk-project were/are:

- to provide a simple and practical method for assessing and comparing nuclear risks due to atmospheric transport deposition from accidental releases;
- to build an atlas of long-range atmospheric dispersion and deposition following a number of release scenarios following hypothetical nuclear accidents in Northern Europe;
- to supplement this atlas with practical tools for rapid risk assessment for other (user defined) radionuclide release scenarios.

The project aims at supplying users and decision makers with practical means for risk and vulnerability mapping, considering, *e.g.*, what geographical areas are at risk from nuclear accidents.

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**NordRisk**
NKS-funding:	180,000 DKK (2005), 260,000 DKK (2006)
Co-ordinator:	Bent Lauritzen, Risø National Laboratory (DK)
Participants:	Risø(DK), DMI (DK), NRPA (N), SSI (S)
Evaluation materials:	Project proposals for 2005 and 2006, progress report 2005, Status report of October 2005, NordRisk web site: http://www.risoe.dk/nuk/emergency/NordRisk.htm
Published deliverables:	Project presentations on NordRisk web site Probabilistic risk assessment for long-range atmospheric transport of radionuclides, Paper submitted to Journal of Environmental Radioactivity, Special Issue, The 2nd International Conference on Radioactivity in the Environment & the 6th International Conference on Environmental Radioactivity in the Arctic and the Antarctic, 2-6 October 2005 in Nice, France
Missing deliverables:	Atlas of long-range atmospheric dispersion and deposition following release scenarios following hypothetical nuclear accidents in Northern Europe PC-based software tool for rapid assessment of average transport patterns with graphical interface and the allowance for user-defined parameter values

The project has at the time of evaluation not been fully completed. The results presented at international conferences and papers submitted to peer-reviewed international journals indicate, however, that both the atlas and the software tool will be valuable tools for the end-users being the Nordic emergency management authorities. In addition, there seems to be a potential for futher development of the prepared methodology in the NordRisk project.

Fulfilment of NKS-criteria

The measurable results of the NordRisk project during the project period 2005 - March 2006 are:

- The NordRisk web site
- Project contract and project proposals of 2005 and 2006
- Project status reports of October 2005 and December 2005
- Presentations at two international conferences
- Paper submitted to Journal of Environmental Radioactivity

The NordRisk project continues in 2006 and the project results can therefore not be evaluated fully at this time. The project results so far have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	Fulfilment of NKS-criteria, NordRisk	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework within which consequence analyses of nuclear accidents is an identified area.	B
Nordic competence and network building and maintenance	The project has contributed to build up competence on probabilistic risk assessment. The project has strengthened the multidisciplinary network among Nordic modellers.	A
The scientific and pedagogical merits of the project	The scientific merit of the project is the disclosure of the need for further development of simplified methods for probabilistic risk assessments. The pedagogical merit of the project is the atlas of long-range atmospheric dispersion and deposition together with PC-based software tool for rapid assessment of average transport patterns.	A
The application and scientific perspectives of the project	The results of the project are applicable for emergency preparedness planning with regards to accidental releases from nuclear power plants and other atmospheric releases of radioactive materials. The methodology for simplified probabilistic risk assessments may be further developed to include regional and climatological variations in the atmospheric dispersion and deposition potential.	A
At least three Nordic countries involved	Three Nordic countries and a Russian institute have been involved in the project.	B
Potential use of results and information	The potential end-users of the project results are the Nordic emergency management authorities. The project will give users and decision-makers practical tools for mapping which areas are vulnerable and at risk from nuclear accidents with atmospheric releases of radioactive materials.	B
Project results of adequate quality	The quality of the project results can at present not be judged adequately as the final product will be delivered during 2006. If the results are of similar quality as of the previous deliverables they are expected to be of high quality.	B
Project in accordance with plans and budget	The project is in accordance with plans and budget. The final versions of the atlas and the practical PC tool will be delivered during 2006 and has therefore not been evaluated.	B
Cost-effectiveness of total budget	The NKS financial support has been 180,000 DKK in 2005.	B

	Consequently, the results of the project should be judged against a total manpower effort of 360,000 DKK. The cost-effectiveness appears to be at the right level.	
Relevance for authorities and others	The result of the project is relevant for both authorities and others engaged in the assessment of the consequences of a nuclear accident with long-range atmospheric dispersion and deposition of radioactive materials.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B+**	

2.4.5 MetNet

The MetNet project started in 2003 and will be finalised in 2006. The project aims at creating a network of Nordic meteorological services engaged in nuclear preparedness and response through operational real-time calculations of long-range atmospheric dispersion and deposition of radioactive materials released to the atmosphere in nuclear accidents.

Objectives

The objectives of the MetNet project were/are:

- to harmonise a general layout of the MetNet password protected homepages at each Nordic Meteorological Institute and to include graphical software that might be different for the different institutes;
- to harmonise the output of the different dispersion models, including graphical plots and data files to be made available to the Nordic emergency management authorities from the MetNet homepages;
- to perform at least two nuclear emergency modelling exercises in connection to suitable exercises performed by the Nordic emergency management authorities or other international exercises;
- to prepare for an operational continuation of the MetNet after 2006;
- to perform an evaluation of the performed real-time exercises with regard to both scientific aspects and presentations on the Web.

The MetNet network aims at being a forum for exchange of scientific information concerning atmospheric dispersion modelling as well as being a Nordic Web-based backup facility for long-range atmospheric dispersion calculations and for exchange of real-time and forecast model results.

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**MetNet**
NKS-funding:	190,000 DKK (2003), 200,000 DKK (2004), 200,000 DKK (2005), 200,000 DKK (2006)
Co-ordinator:	Jens Havskov Sørensen, DMI (DK)
Participants:	DMI (DK), NMI (N), SMHI (S), FMI (FI), IMO (IS)
Evaluation materials:	Project proposals, Project contract, Progress report 2004, Revised status report 2004, Minutes of project meeting in Reykjavik 2004, Reports on exercises
Published deliverables:	MetNet web sites at the Nordic Meteorological Institutes Report of MetNet real-time exercise 2.1, 2003 Report of MetNet exercise 3, Havsörn, 2004

	Report of MetNet exercise 4, Vulcanic eruption in Mt. Grimsvötn in Iceland, 2004
Missing deliverables:	Final Project Report, project continues during 2006

The project has at the time of evaluation not been fully completed. The results of the project so far are primarily the outcome of three exercises of which two dealt with nuclear accidents at a Swedish and a Finnish nuclear power plant whereas the third exercise dealt with a vulcano eruption in Iceland.

The experience from the exercises showed a great value of having an Nordic network for real-time atmospheric transport calculations and that the NKS-MetNet partners can act as an operational unit in case of an emergency situation. Within only a few hours qualitative good results can be produced from the institutes.

Fulfilment of NKS-criteria

The measurable results of the MetNet project during the project period 2003 - March 2006 are:

- Project contract, project proposals and progress/status reports
- Minutes of a project meeting
- The MetNet web sites at the Nordic Meteorological Institutes
- Reports on three MetNet exercises

The MetNet project continues in 2006 and the project results have therefore not been fully evaluated at the deadline for the evaluation report. The project results information seems to have been rather scarce during the project period. However, the project fits well with the NKS-priority of building close informal Nordic networks between scientists in emergency preparedness related disciplines. The project results have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	**Fulfilment of NKS-criteria, MetNet**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework within which consequence analyses of nuclear accidents is an identified area.	B
Nordic competence and network building and maintenance	The project has resulted in a Nordic network that can be very useful in a nuclear emergency situation in delivering results to the end-users/decision-makers. The network will continue after 2006 within the Nordic meteorological institute's co-operation NORDMET.	B
The scientific and pedagogical merits of the project	The scientific merit of the project appears to be limited. The pedagogical merit of the project is that the MetNet partners can act as an operational unit for real-time atmospheric transport calculations in case of an emergency situation.	C
The application and scientific perspectives of the project	The created network is applicable at the operational level in emergency situations and the intention is that it should act also as a forum for exchange of scientific information concerning atmospheric modelling to be used in emergency situations.	B
At least three Nordic countries involved	Five Nordic countries have been involved in the project.	A
Potential use of results and information	The potential end-users of the network are the Nordic emergency management authorities. The network can supply end-users and decision-makers valuable input for assessing the consequences of nuclear accidents.	C
Project results of adequate quality	The quality of the project results can at present not be judged adequately as the final product will be delivered in 2006. If the	C

	quality of the final product will be similar to that of previous deliverables it is expected to be average.	
Project in accordance with plans and budget	The project seems to be in accordance with plans and budget.	C
Cost-effectiveness of total budget	The NKS financial support has been 590,000 DKK in the three year period 2003 - 2005. Consequently, the results of the project should be judged against a total manpower effort of 1,180,000 DKK. The cost-effectiveness of the project appears to be rather low, i.e. high costs compared to the outcome of the project.	C
Relevance for authorities and others	The result of the project is relevant for both authorities and others engaged in the assessment of the consequences of a nuclear accident with long-range atmospheric dispersion and deposition of radioactive materials.	C
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**–	

2.4.6 Knowledgebase

The Knowledgebase project started in 2002 and was finalised in 2003. The purpose of the Knowledgebase project was to continue the cross-disciplinary study SBA-1 “Base of knowledge” in the NKS research program 1998 - 2001 regarding possible nuclear threats in the vicinity of the Nordic countries. The main task of the project was to expand and envelope this database. The project has focused on potential events at nuclear installations and the consequences for the Nordic countries, especially with regards to vulnerable food chains, doses to man, environmental contamination and emergency preparedness systems. The geographical area dealt with includes North-west Russia and the Baltic states and the nuclear installations investigated are nuclear power plants, ship reactors and storage and handling of used fuel and radioactive waste.

Objectives

The objectives of the Knowledgebase project were:

- to continue the fact finding for the ‘Base of knowledge’ on nuclear threats in the vicinity of the Nordic countries;
- to work with other NKS-projects to establish a Nordic network for information exchange on scientific questions concerning nuclear threats;
- to produce an information system that takes care of the information in the ‘Base of knowledge’;
- to present a new version of the ‘Base of knowledge’ for the emergency authorities.

The main goal of the project was better information preparedness in the Nordic countries through use of modern technology, and with that better emergency preparedness and response and better public information.

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**Knowledgebase**
NKS-funding:	150,000 DKK (2002 + 2003)
Co-ordinator:	Inger Margrethe H. Eikelmann, NRPA (N)
Participants:	NRPA (N), SSI (S), SKI (S), STUK (FI), Beredskabsstyrelsen (DK), Geislavarnir rikisins (IS)

Evaluation materials:	Project contract, Project proposal, Final Project Report
Published deliverables:	Knowledgebase web site: http://nrk.svanhovd.no/ NKS-121: Nuclear Threats in the Vicinity of the Nordic Countries, April 2006, 9 pp.
Missing deliverables:	None

Compared to the previous NKS project SBA-1 in the period 1998 - 2001 the present project has expanded the geographical area of the nuclear threats and new information has been included in the 'Base of knowledge'. Also the literature database has been expanded.

The main task for the project has been the expansion of the database. This will be a continuous process which extends beyond the end of this project in order to have an operating and updated database also in the future. In the present project arrangements have been made that can take care of the database in the future.

Fulfilment of NKS-criteria

The measurable results of the Knowledgebase project during the project period 2002 - 2003 are:

- Project contract and project proposal of 2002
- Knowledgebase web site
- NKS-121: Nuclear Threats in the Vicinity of the Nordic Countries, April 2006

The project results have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	Fulfilment of NKS-criteria, Knowledgebase	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework within which "developing manuals for application in accident situations" is an identified project area.	B
Nordic competence and network building and maintenance	The project has contributed to extend the knowledge of the nuclear threats to the Nordic countries and has established a network for Nordic information exchange.	C
The scientific and pedagogical merits of the project	The scientific merit of the project appears to be rather low. The pedagogical merit is the collection of a large collection of different technical data, e.g. on Russian nuclear power installations.	C
The application and scientific perspectives of the project	The results of the project are applicable to assess the threats to the Nordic countries from surrounding nuclear installations. The scientific perspectives of the project are judged to be rather limited.	C
At least three Nordic countries involved	Four Nordic countries have been involved in the project.	B
Potential use of results and information	The potential end-users of the project results are the Nordic emergency management authorities, especially those in Norway having the highest risk of being affected by accidents at Russian nuclear powered vessels.	C
Project results of adequate quality	The quality of the project results is judged to be fairly good.	C
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support has been 150,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 300,000 DKK. The cost-effectiveness is judged to be at the right level.	B
Relevance for authorities and others	The result of the project is relevant for both authorities and others engaged in the assessment of the threats of nuclear facilities to the Nordic countries.	B

Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B–**

2.4.7 EMARAD

The EMARAD project was started in 2002 and will be finalised in the beginning of 2006. The project consists of two major parts, namely pre-calculated consequences of accidents at nuclear power plants located in or close the Nordic countries *and* monitoring strategies that are needed in the management of different nuclear and radiological radiological emergencies.

Objectives

The objectives of the EMARAD project were:

- to establish a web site containing various radiation-threat and radiation monitoring related data and documents and documents that can be used by all the Nordic countries;
- to analyse various factors that can affect direct measurement and sampling strategies in nuclear and radiological emergencies;
- to contribute to harmonisation of radiation monitoring and emergency management strategies;
- to disseminate relevant information on urban dispersion following illicit and malicious use of radioactive materials;
- to extend the network between Nordic experts on consequence analyses, radiation monitoring and emergency preparedness.

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**EMARAD**
NKS-funding:	400,000 DKK (2002), 360,000 DKK (2003), 280,000 DKK (2004), 100,000 DK (2005)
Co-ordinator:	Juhani Lahtinen, STUK (FI)
Participants:	STUK (FI), VTT (FI), NRPA (N), SSI (S), Lund University (S), Geislavarnir Ríkisins (IS), Risø (DK)
Evaluation materials:	Project proposals, Project contract, Project and work descriptions, Working documents and presentations, Draft final report, Summary Report
Published deliverables:	A STUK-hosted web site http://valhalla.stuk.fi containing the following project data and reports: - downloadable nuclear power plant accident consequence for ten power plants located in or close to the Nordic countries - special application programs for processing the accident consequence data - downloadable demos, working documents/reports, presentations on an urban dispersion model and aspects related to malicious use of radioactive materials - draft final project report - NKS-137: Emergency Management and Radiation Monitoring in Nuclear and Radiological Accidents. Summary Report on the NKS Project EMARAD, April 2006, 20 pp. - NKS-142: Emergency Monitoring Strategy and Radiation Measurements. Working Document of the NKS Project Emergency Management and Radiation Monitoring in Nuclear and Radiological Accidents (EMARAD), April 2006, 35 pp.
Missing deliverables:	Proceedings of the NKS-mini-seminar on malicious use of radioactive material

The management of nuclear or radiological emergencies requires pre-planning and that the authorities and their advisers have relevant background material at their disposal. The web based library with the results produced by the EMARAD project are very useful and highly relevant as background material in emergency situations. Of special importance are the application programs for processing the pre-calculated nuclear accident-scenario consequence data.

Possible malicious use of radioactive materials and its consequences has been discussed at a EMARAD mini-seminar. Within this context special concern has been given to urban areas and the use of radiological dispersion devices or so-called ‘dirty bombs’. The work on this topic within the EMARAD project has concentrated on the testing of an Urban Dispersion Model (UDM) developed in the UK. Data for calculating the consequences of dispersion of radioactive materials and other pollutants in urban environments are included in the material on the web site.

The problem of defining an emergency monitoring strategy is complicated and requires a systematic approach. The EMARAD project gives a thorough documentation of different monitoring systems and their characteristics and also how environmental factors will affect the measurements. Attention is given to representativeness and interpretation of monitoring data also in relation to the source terms for different types of accident scenarios.

The web site contains a lot of useful material for assessing the consequences of nuclear or radiological accidents in which radioactive materials are released to the atmosphere. It should be considered if some of the material could be copied and transferred to the NKS-B projects URBHAND and Knowledgebase.

Fulfilment of NKS-criteria

The measurable results of the EMARAD project during the period 2002 - 2005 are:

- Project contract and project proposals of 2002, 2004 and 2005
- Project description of 2002, work description of 2004, status reports of 2004 and 2005
- Mini-seminar on Malicious Use of Radioactive material, Stockholm, Sweden, 24 - 25 May, 2005
- Working documents and reports:
  - Emergency monitoring strategy and radiation measurements (2006)
  - Simulation of dispersion in combination of flat, complex and urban terrain (2004)
  - Realistic Urban Scenarios for Copenhagen (2004)
  - Simulation of dispersion in urban areas: Experience gained during the EMARAD work 2002 - 2005 (2005)
  - The implication of airborne contamination created an action of terror in an urban environment (2004)
  - On factors influencing doses from deposition on humans of contaminants dispersed by ‘dirty bombs’ (2005)
- Published papers in scientific journals:
  - Radiation monitoring strategy: Factors to be considered. Radiation Protection Dosimetry 109 (2004) 1 - 2, pp. 79 - 82

  - Effective use of radiation monitoring data and dispersion calculations in an emergency. Accepted for publication in a special issue of the International Journal Risk Assessment and Management 2006
- Draft Final Report Emergency Management and Radiation Monitoring in Nuclear in Nuclear and Radiological Accidents, February 2006
- NKS-137: Emergency Management and Radiation Monitoring in Nuclear and Radiological Accidents, April 2006
- NKS-142: Emergency Monitoring Strategy and Radiation Measurements. Working Document of the NKS Project Emergency Management and Radiation Monitoring in Nuclear and Radiological Accidents (EMARAD), April 2006
- The EMARAD web site at STUK

The project results have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	**Fulfilment of NKS-criteria, EMARAD**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework within which consequence analyses of nuclear accidents and development of optimum sampling and measurement strategies are identified areas.	B
Nordic competence and network building and maintenance	The project has contributed to extend the network between Nordic experts on consequence analyses, radiation monitoring and emergency preparedness.	A
The scientific and pedagogical merits of the project	There are several scientific merits of the project, e.g. the development of programs for the processing of nuclear accident consequence data and aspects related to malicious use of radioactive materials. The pedagogical merit of the project is the established web site with various data that can be used in all the Nordic countries.	A
The application and scientific perspectives of the project	The results of the project are applicable at the operational level in case of accidental releases from nuclear power plants and other atmospheric releases of radioactive materials. There are various scientific perspectives of the project, i.e. a further development of the urban dispersion model and the methodology of special application programs to process the accident consequence data.	B
At least three Nordic countries involved	Five Nordic countries have been involved in the project.	A
Potential use of results and information	The potential end-users of the network are the Nordic emergency management authorities. The project results will give users and decision-makers practical tools for assessing the consequences of a wide spectrum of nuclear and radiological accidents.	A
Project results of adequate quality	The quality of the project results is judged to be good.	B
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support in the period 2002 - 2005 has been 1,140,000 DKK. Consequently, the results of the project should be judged against a total manpower effort of 2,280,000 DKK. The cost-effectiveness appears to be at the right level.	B
Relevance for authorities and others	The result of the project is relevant for both authorities and others engaged in the assessment of the threats of nuclear facilities to the Nordic countries and the consequences of nuclear or radiological accidents. Of special importance is the emphasis on the systematic approach of defining a proper monitoring strategy.	A

Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**A–**

2.4.8 IRADES

The project IRADES has been performed in the period 2004 - 2005. The aim of the project was to improve the Nordic emergency preparedness, especially on thyroid measurements following a nuclear or radiological accident. Although an efficient network of Nordic specialists on assessing internal doses has been created in recent years, there is still a need for improving the information on the availability of instruments and the number of trained persons to perform emergency thyroid measurements.

Objectives

The objectives of the IRADES-project were:

- to improve the preparedness for thyroid measurements on people in the early phase of a nuclear or radiological accident
- to assess the inventory of available instruments for thyroid monitoring and to continue the work on inter-calibration and -comparisons on direct measurements of ^{131}I in the thyroid
- to arrange a workshop on inter-comparison and internal dose assessments

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**IRADES - Assessment of Internal Doses in Emergency Situations**
NKS-funding:	50,000 DKK (2004), 50,000 DKK (2005)
Co-ordinator:	Tua Rahola (STUK)
Participants:	STUK (FI), SSI (S), NRPA (N)
Evaluation materials:	IRADES report 2004 for the NKS Board meeting 9 November 2004
Published deliverables:	Project presentation at a NKS-B mini-seminar at Risø 18 - 20 August 2004 NKS-128: Assessment of Internal Doses in Emergency Situations, April 2006, 47 pp. IRADES internal dosimetry course, Tartu, Estonia, Wednesday 26 October 2005 Portable thyroid monitors for detection of ^{131}I in emergency situations, IRADES Paper presented at NSFS meeting in Rättvik 28 - 31 August 2005 Intercomparison exercise for whole-body measurements in the Nordic countries, Draft Report of 13 February 2006
Missing deliverables:	None

In a nuclear emergency situation thyroid measurements are important, both for control of the contamination situation and for later dose assessments. There are different types of measurement systems that can be used for such measurements, *e.g.* thyroid monitors, instruments for uptake measurements of ^{131}I at hospitals, handheld instruments, whole-body counting systems and gamma cameras.

In the report of the former NKS project BOK-2.1.2 an overview of tested instruments for thyroid monitoring was given, but no information on the availability of the instruments was collected. In the project IRADES an inventory of available instruments for thyroid monitoring has been worked out and measurement strategies have been developed. In addition, an inter-comparison exercise for whole-body measurements has also been performed. The phantom IRINA has been circulated between 13 laboratories in Norway, Sweden and Finland during 2004 and 2005. The results of the inter-comparison show that the participating laboratories in general have well functioning and well-calibrated equipment for whole body measurements.

The results achieved in IRADES-project show that there is a very good network of Nordic ‘internal-dosimetry experts’ and that this network can be used in an emergency situation should one or all Nordic countries be affected by a nuclear accident. However, there are still important issues in the handling of an emergency situation in practice that need to be addressed, *e.g.* Nordic emergency preparedness exercises on training in simple direct thyroid measurements of people in the early phase of an emergency. The manual produced in the BOK-2.1.2 project could be extended by including data on how many instruments there are available in the Nordic countries in an emergency situation as well as instructions on the use of handheld instruments for thyroid measurements.

Fulfilment of NKS-criteria

The measurable results of the IRADES-project during the project period 2004 - 2005 are:

- NKS-B mini-seminar at Risø in August 2004
- NKS-128: Assessment of Internal Doses in Emergency Situations
- IRADES-Paper 2005: Portable thyroid monitors for detection of ^{131}I in emergency situations, Presentation at the NSFS meeting in Rättvik
- Draft Report 2006: *Intercomparison exercise for whole-body measurements in the Nordic countries*

The results of the IRADES-project have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	Fulfilment of NKS-criteria, IRADES	Grade
Project falls within NKS-B framework	The project falls within the NKS-B framework in which exercises, measurement strategies and methods are identified project areas.	B
Nordic competence and network building and maintenance	The project has contributed to build new competences on the assessment of internal doses, especially thyroid doses from intake of ^{131}I. A good network of Nordic specialists has been created.	A
The scientific and pedagogical merits of the project	The scientific merit of the project is limited to a status of the capability of the Nordic laboratories to assess internal doses. The pedagogical merit of the project is the identified need for Nordic emergency preparedness exercises on the training in simple direct thyroid measurements in the early phase of an accident.	B
The application and scientific perspectives of the project	The project results are oriented towards the practical application in nuclear emergency situations. The scientific perspectives of the project appear to be limited.	C
At least three Nordic countries involved	Three Nordic countries have been involved in the project.	B
Potential use of results and information	The project results and information have a high potential to be used by professionals performing internal dose assessments in emergency situations.	A
Project results of adequate quality	The quality of the project results is judged to be good.	B
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 100,000 DKK. Consequently, the results of should be judged against a	A

	total manpower effort of 200,000 DKK. The cost-effectiveness appears to be high, i.e. the project costs are low compared to the results of the project.	
Relevance for authorities and others	The result of the project is relevant for both authorities and others engaged in assessment of internal doses following a radiological or nuclear accident.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B+**	

2.4.9 CommTech

The project CommTech has been performed in the period 2003 - 2005. The aim of the project was to bring together at NKS-B mini-seminars key users from the Nordic nuclear and radiological emergency response authorities and experts in different fields of communication technology to exchange views and to encourage a dialogue that would make it easier for the authorities to co-operate and to use modern communication- and IT-technology more effectively in an emergency situation.

Objectives

The objectives of the CommTech-project were:

- to arrange NKS-B mini-seminars on the use of modern IT- and communication technology in emergency situations with participants from Nordic authorities and from relevant international organisations
- to strengthen the dialogue on use of communication technology for emergency preparedness between the Nordic authorities
- to build up and sustain Nordic competence on the use of communication technology in emergency situations

Summary of evaluation

The deliverables and funding of the project are summarised in the table below.

Title:	**CommTech - Communication technology and emergency preparedness**
NKS-funding:	180,000 DKK (2002)
Co-ordinator:	Sigurður Emil Pálsson (Geislavarnir Ríkisins)
Participants:	Geislavarnir ríkisins (IS), STUK (FI), NRPA (N), SSI (S), SKI (S), SIS (DK), DEMA (DK)
Evaluation materials:	Project proposal, seminar presentations
Published deliverables:	NKS-B CommTech mini-seminar at STUK 27 - 28 February 2003 NKS-B CommTech mini-seminar at SSI, Stockholm, 31 May - 1 June 2005 PowerPoint presentations from the mini-seminars
Missing deliverables:	None

Results from the previous NKS work in BOK-1.6/MINEP have been taken into consideration in the CommTech-project. The project has resulted in an active exchange of ideas and experiences between the Nordic authorities and the authorities have also taken an active role in international work on the utilization of communication technology, *e.g.* within the IAEA.

Fulfilment of NKS-criteria

The measurable results of the CommTech-project during the project period 2003 - 2005 are:

- NKS-B mini-seminar at STUK, Helsinki, 27 - 28 February 2003
- NKS-B mini-seminar at SSI, Stockholm, 31 May - 1 June 2005
- PowerPoint presentations from the two mini-seminars
- Poster presentation at the international symposium *Off-site Nuclear Emergency Management - Capabilities and Challenges* held in Salzburg, Austria, 29 September - 3 October 2003

The results of the CommTech-project have been evaluated against NKS-criteria and the results are presented in the table below.

NKS evaluation criteria	**Fulfilment of NKS-criteria, CommTech**	**Grade**
Project falls within NKS-B framework	The project falls within the NKS-B framework in which further development of Nordic collaboration on information in emergency situations is an identified project areas.	B
Nordic competence and network building and maintenance	The project has contributed to build up the competences and strengthened the dialogue on the use of modern communication- and IT-technology in emergency situations	B
The scientific and pedagogical merits of the project	The scientific merit of the project appears to be low. The pedagogical merit of the project has been the mini-seminars for experts in the field and participants from Nordic authorities and international organisations.	B
The application and scientific perspectives of the project	The project results are oriented towards the practical application in nuclear emergency situations. The scientific perspectives of the project appear to be limited.	C
At least three Nordic countries involved	Five Nordic countries have been involved in the project.	A
Potential use of results and information	The end-users of the project results are the Nordic emergency management authorities. The project results have the potential to be used in emergency situations. It is judged that more work would be needed with the aim of harmonisation and standardisation.	B
Project results of adequate quality	The quality of the project results is judged to be good.	B
Project in accordance with plans and budget	The project is in accordance with plans and budget.	B
Cost-effectiveness of total budget	The NKS financial support of the project has been 180,000 DKK. Consequently, the results of should be judged against a total manpower effort of 360,000 DKK. The cost-effectiveness appears to be at the right level for the arrangement of two mini-seminars.	B
Relevance for authorities and others	The result of the project is highly relevant for the Nordic authorities engaged in emergency preparedness and response.	B
Evaluation grade A (very good), B (good), C (average), D (poor), E (very poor)	**B**	

2.4.10 General evaluation of emergency preparedness projects

The emergency preparedness projects have been evaluated against how well they fulfil the aims stated in the project proposals and also against their scientific merits. The following emergency preparedness issues have been included in the different emergency preparedness projects:

- assessment of nuclear or radiological accident consequences in urban areas (Urbhand, UrbContSem)
- assessment of consequences of nuclear accidents at nuclear powered vessels (NucVess)
- emergency measurements of internal doses to thyroid (Irades)
- database on nuclear threats in the Nordic countries (Knowledgebase)
- Nordic network on meteorological services (MetNet)
- communication technology in emergency situations (ComTech)
- probabilistic risk assessment of long-range dispersion and deposition of radionulides from nuclear accidents (NordRisk)
- assessment of the consequences of nuclear or radiological accidents and harmonisation of monitoring and sampling strategies (EmaRad)

The quality of the deliverables varies considerably. Also, the cost-effectiveness, *i.e*. the "return of the investment" in the different projects varies as do the scientific perspectives of the projects. However, many of the projects have the potential of being further developed within Nordic research programmes.

The projects have been evaluated against ten criteria each of which have been given a grade (score) ranging from "very good" to "very poor" (A to E). No individual weighting has been given to these criteria and the final grade of each project is therefore a 'best judgement'. A crude averaging of the "overall quality" of the projects has been performed by adding the number of the same grade over all the projects. The result of this averaging is shown in figure 20.

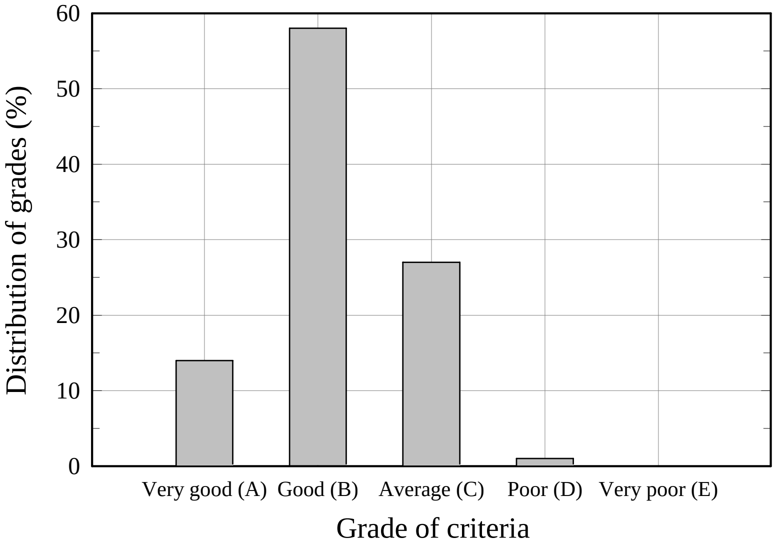


Figure 20. Distribution of grades for ten evaluation criteria over the nine emergency preparedness projects.

The results indicate that the "average overall quality" of the nine emergency preparedness projects in general is quite good as more than 70% of all scores fall within the categories "very good" and "good". Despite the fairly good average score, larger individual differences in 'quality' exist.

To have an indication for the alleged differences in ‘quality’ between the emergency preparedness projects, the sum of grades of the same category (*A*, *B*, *C* etc.) over the ten evaluation criteria has for each project been weighted using an exponential weighting algorithm:

$$\overline{G} = 2^4 \Sigma A + 2^3 \Sigma B + 2^2 \Sigma C + 2^1 \Sigma D + 2^0 \Sigma E$$

where, *e.g.* ΣA is the total number of grade *A* scored for that project.

The relative distribution of NKS-budget on the nine emergency preparedness projects as well as the weighted sum of evaluation grades, $\overline{G}$, for each of the emergency preparedness projects is shown in figure 21.

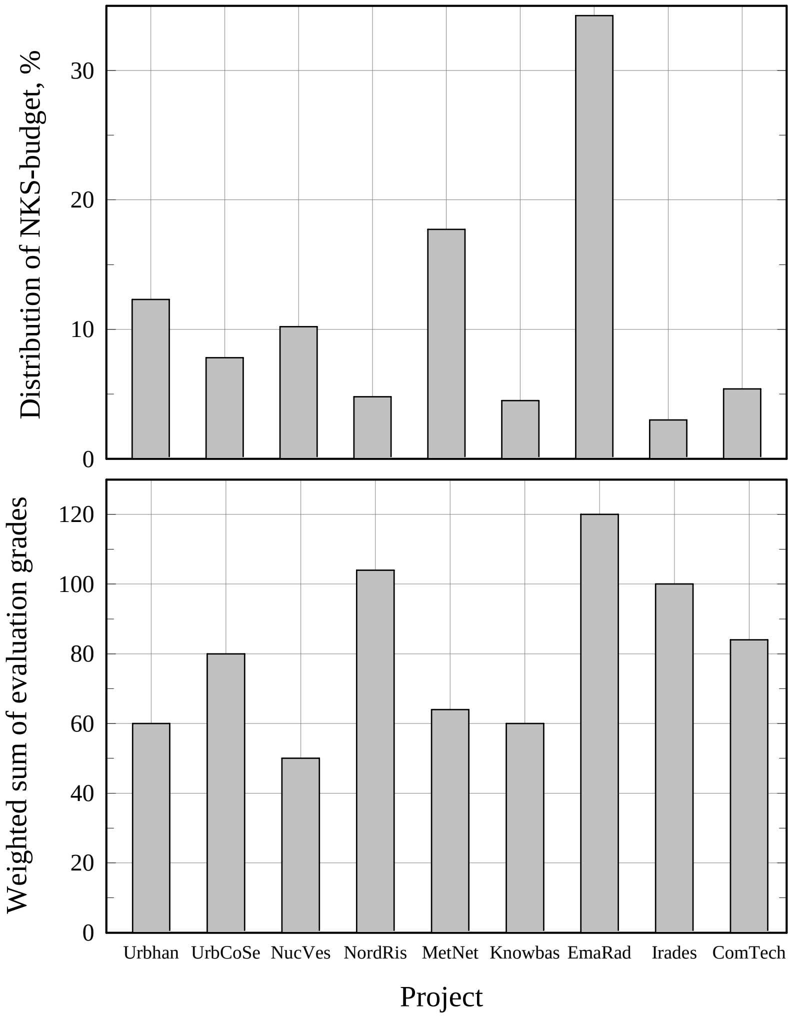


Figure 21. Relative distribution of the NKS-budget and weighted sum of grades for each of the nine emergency preparedness projects.

The total NKS-budget for the emergency preparedness projects is 3,330 kDKK. The largest project is EMARAD, requiring more than a third of the funding for the emergency preparedness projects. It appears to be the “battleship” among the projects, and also the one with the highest weighted grade as shown in figure 21. Another observation is that the project with the second and the third highest weighted grade (NordRisk and IRADES) each has required less than 5% of the total budget.

In the 2002 - 2005 the NKS-B programme the emergency preparedness projects are well-anchored and well-known. In general, all projects are relevant for emergency preparedness and they fulfil the criteria set up in the NKS-B programme. The projects have contributed to (1) maintain and building up competence and to (2) maintain and building Nordic networks between scientists in emergency preparedness disciplines, and these two issues are given the highest priority in the NKS-B programme. The ambition that there should be at least three Nordic countries involved in each accepted activity has also been fulfilled for most of the projects.

Some final reflections from the evaluation of the emergency preparedness projects have been given below:

- It seems from the published deliverables that transverse collaboration between closely related projects have been rather low. In the process of integrating the results of the projects into databases, operational handbooks and decision support systems this kinship between, *e.g.* the projects UrbHand, NucVess, Knowledgebase and EmaRad should be borne in mind.
- The emergency databases and handbooks prepared within the NKS-B programme need updating to be continuously valuable. It seems unclear if such updating has been taken into consideration when the database/handbook-type of projects was launched.
- Relevant parts of the results in the prepared databases/handbooks could with benefit be integrated into existing decision support systems.
- Research-oriented emergency preparedness projects appear to be in the minority on the expense of projects on databases, handbooks, web-sites and seminars. It might be a correct balance, also in the light of the high priority given by NKS to network building, but maintaining and building up competences also needs research projects.

In the preparation of future NKS activities careful consideration - still assuming a high priority on network building - should be given to the balance between research-oriented and more practical-/routine-oriented projects.

2.5 Recommendations and conclusions

The projects in the NKS-B programme for the period 2002 - 2005 have been evaluated against some of the general criteria for evaluating proposals as described in the document NKS(02)6 *Programme handbook 2002 - 2004* as well as the supplementary criteria described in the document *Emergency Preparedness (B) part of the NKS programme 2002 - 2005, NKS-B Framework, Version 2.1.* The present evaluation is based on guidelines dated December 7th, 2005, set out by the NKS Board (see Appendix). For the evaluation, the above-mentioned guidelines were interpreted into ten different criteria, firstly some that judge how well the projects fulfil the aims of the programme, secondly criteria that judge the scientific and pedagogical merits of the project as well as their usefulness and relevance for authorities and end-users. The evaluation included 25 NKS-B projects within three basic fields, *Measurement Strategy, Technology and Quality Assurance* (nine projects), *Radioecological Studies* (seven projects) and *Emergency Preparedness* (nine projects). The total funding, including national in kind funding from the participating institutions, was 20 million DKK, fairly equally distributed between the Nordic countries.

Each of the ten evaluation criteria has been given a grade (score) ranging from “very good” to “very poor” (A to E). In general, the average ‘overall quality’ of the projects has been judged to be quite good in terms of the distribution of grades across all projects as about 70% of all grades were ‘good’ or ‘very good’. However, both ‘quality’ and cost-effectiveness, *i.e*. the ‘return of the investment’, of the different projects vary quite substantially. Also the scientific perspectives of the projects vary. Many of the projects have the potential of being further developed within future Nordic research programmes. The evaluation process has resulted in a number of recommendations and conclusions, which are reported below.

2.5.1 Conclusions

In general, the NKS-B programme has been rather successful, especially seen in the light of the limited resources for the programme. A little less than half of the projects dealt with radioecology, about a third with emergency preparedness and the remaining with measurement technology. The net NKS-funding of the NKS-B programme was 10 million DKK for 25 projects (nine measurement technology, seven radioecology and nine emergency preparedness projects) over four years, corresponding to an average annual NKS-support of 100,000 DKK per project, which is equivalent to approximately 1 man·month/year per project. Despite this modest contribution the outcome of the NKS-B programme has been quite good in terms of 11 mini-seminars and 23 reports in the NKS-series. Many of these NKS-reports have a high standard and the seminars have all been very successful.

The nine projects on *Measurement Strategy, Technology and Quality Assurance* were a valuable part of the NKS-B programme, and all fulfil the criteria set up in the NKS-B programme. The projects on field-measurements and laboratory-based analysis were highly relevant, and very valuable results have been obtained from both field exercises and laboratory intercomparisons. Nevertheless, radiological measurements constitute an expertise only mastered by a few institutions in each of the Nordic countries. Future NKS-projects therefore have the opportunity to further develop and maintain this competence as well as to work out common protocols and procedures that will ensure coordinated actions within the Nordic countries in case of an emergency.

The seven *Radioecological* projects all fulfil the criteria set up in the NKS-B programme. Reliable data for prediction of possible doses to humans from different ecosystems, to be used in decision-support systems, has been established. It is, however, not always clear how the results achieved will be utilised in a systematic manner to further strengthen the expertise within the field of radioecology. To improve decision-support systems, critical analyses to identify which data are most needed to strengthen system performance should be made and the data should be acquired through focused project work.

The nine *Emergency Preparedness* projects have been well anchored. In general, all the projects have been relevant for emergency preparedness and they fulfil the criteria set up in the NKS-B programme. The projects have contributed to maintain and building up competence and to maintain and create Nordic networks between scientists in emergency preparedness disciplines. However, transverse collaboration between closely related projects seems to have been rather low but might be improved in future project work on integrating the achieved results into broader decision-support systems. Another reservation is if preparation of databases and handbooks is a natural part of NKS research programmes. If so, updating is necessary for the databases/handbooks not to be useless after some years and it is unclear if this aspect has been considered at the onset of such projects.

In summary, each of the NKS-B projects have been evaluated by ten criteria that emerged from the interpretation of the NKS-guidelines and each of these criteria have been graded by a score ranging from very good to very poor (A to E). These scores have been weighted to obtain an overall weighted grade for each project. Figure 22 presents the cumulative weighted grades for the NKS-B projects.

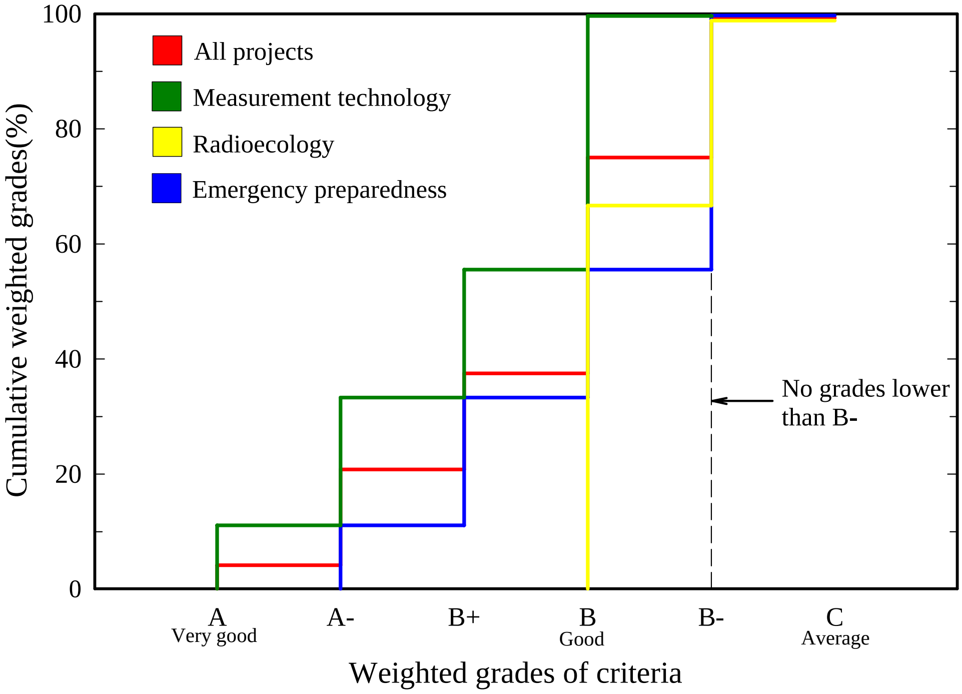


Figure 22. Cumulative weighted grades for each of the three main project groups and for all NKS-B projects as a whole.

Comparing the cumulative weighted grades between the three NKS-B project groups in figure 22, the “Measurement Technology” projects are ranked highest and the “Radioecology” projects lowest. The weighted grades for the “Emergency Preparedness” projects are closer to the average weighted grade for all the NKS-B projects as a whole. In addition, figure 22 shows that the weighted grades for all NKS-B projects are better or equal to B**–.**

In figure 23 the average weighted grade is presented for each of the ten criteria for the three project groups as well as for all the projects as a whole. It appears from figure 23 that for eight of the ten criteria the “Measurement Technology” projects are ranked highest and that for six of the ten criteria the “Radioecology” projects are ranked lowest.

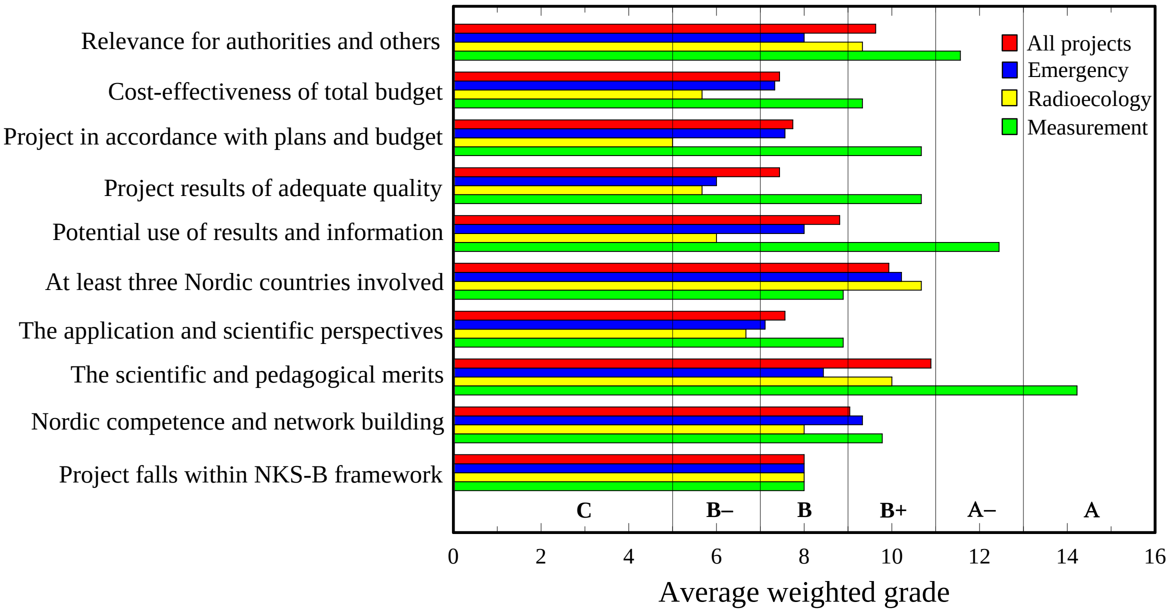


Figure 23. Average weighted grades for each of the ten criteria that emerged from the interpretation of the NKS-guidelines for each of the three main project groups and for all NKS-B projects. The intervals for each of the average weighted grades from C to A are indicated.

2.5.2 Recommendations

In general, the NKS B programme with its three sub-programmes on (1) Measurement strategy, Technology and Quality Assurance, (2) Radio-ecological Studies and (3) Emergency preparedness was judged to be fairly good. However, it is recommended that the future composition of the NKS-B programme should be reconsidered. New sub-programmes like decommissioning of nuclear facilities and radioactive waste treatment – still within the context of radiological protection - might be added or substitute some of the existing sub-programmes.

In future NKS-B projects a balance between research-oriented and more practical-/routine-oriented projects should be considered carefully. Also more clear communication of the project results, integration of project results into decision-support systems, better integration of NKS-activities with relevant EU-activities, and inclusion of university departments in research projects should be further examined.

The scientific seminars and workshops organised within the NKS-B programme were very useful instruments to communicate the results of the projects more widely, to build network between Nordic scientists and attract young scientists, and also to perform courses in different disciplines like internal dosimetry, spectral data processing and sampling strategies. It is highly recommended that this activity should be continued and strengthened in the next framework programme. The seminars might be even more efficient if they were organised transversely between related projects within the programmes but also between the R and B programmes NKS has in the past in the NKS-B programme supported PhD-education of young scientists (e.g. through the projects Rein and NucVess). Considering the limited NKS-funding, such an activity is prohibitively expensive and very little cost-effective. The attraction of young scientists to the nuclear and radiological profession is indeed extremely important and the support to their education is one of the criteria for the NKS activities. It is therefore recommended that NKS for the next framework programme should consider various possibilities to support university students in the nuclear or radiological field, *e.g.* by financial incentives to offer MSc thesis projects, preferably with a Nordic collaboration element. Projects for graduate students are easier established than PhD projects, require much less financing, and probably represent a good strategy for helping to recruit young research candidates into the field.

The process of evaluating NKS-projects needs a careful re-evaluation. When the four-year programme structure was left and more continuous programmes were introduced, the former evaluation procedure more or less lost its validity. Without a fixed deadline for the final project reports to be evaluated, the evaluation process becomes rather difficult, especially when tying the outcome of the evaluation process to a fixed-date status seminar. It is therefore recommended that the NKS-project reports (final or intermediate) to be evaluated are sent to the evaluators in due time before the status seminar, and that no later-stage project reports should enter the evaluation process. Alternatively, the evaluation process could be a “rolling” process, *i.e.* each project would be evaluated in line with its completion. Such a prolonged evaluation could, however, be considered more inconvenient for the evaluators.

Appendix 1: Direktiv för utvärderingen

Byrån

Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

NKS(05)6 Rev 1
2005-12-07

Direktiv för utvärdering av NKS-verksamheten 2002 - 2005

Inledning

Dessa direktiv är antagna av styrelsen vid dess möte i Reykjavík den 17 november 2005

Utvärderingen ska omfatta de två fackliga delarna: R och B. Namnen på utvärderarna framgår av referatet från styrelsemötet. En process för revidering och effektivisering av NKS' struktur, organisation och administration pågår parallellt och berörs inte av denna utvärdering.

Metod

Utvärderarna ska sträva efter största möjliga flexibilitet i sitt arbete och själva fördela arbetsuppgifterna mellan sig. De kan vid behov kalla in andra personer med särskild kompetens som bedöms som värdefull. Exekutivsekreteraren ska kontaktas i startfasen av utvärderingen och hållas löpande informerad om arbetet vad avser status i förhållande till tidsplaner och budget.

Utvärderarna har rätt att från styrelsen (inklusive ägarna och byrån), programcheferna och sekretariatet begära sådan information (elektronisk, skriftlig, muntlig) som krävs för att genomföra utvärderingsarbetet på ett effektivt och nöjaktigt sätt. Vidare har utvärderarna rätt att via intervjuer, deltagande i möten, seminarier etc skaffa sig kompletterande information. För sitt arbete disponerar varje utvärderare DKK 40 000. De tillrättalägger själv sina resor, möten, intervjuer etc. Slutrapporter för R- och B-utvärderingarna på vardera maximalt cirka 30 A4-sidor (inklusive inledning, rekommendationer, sammanfattande värdering och kort redovisning av kostnaderna för utvärderingsarbetet) sänds i elektronisk form till NKS-sekretariatet. Rapporterna kommer att sammanställas till en gemensam NKS-rapport och publiceras i såväl tryckt som elektronisk form. Ett utkast till NKS-rapporten ska presenteras och diskuteras på styrelsemötet i maj 2006 enligt den översiktliga tidsplanen nedan.

Översiktlig tidsplan

17 nov 2005	Styrelsemöte i Reykjavík; start för utvärderingen av verksamheten 2002 – 2005
dec’05 – april’06	Utvärderingsarbete
13 april 2006	Utkast till slutrapporter sänds elektroniskt till NKS-sekretariatet
13 – 26 april 2006	Sekretariatet sammanställer en samlad NKS-rapport som sänds ut till styrelsen
13 april – 10 maj	Kompletterande utvärderingsarbete
10 – 11 maj 2006	Statusseminarium i Otnäs
11 maj 2006	Styrelsemöte i Otnäs med diskussion om NKS-rapporten
maj 2006	Justeringar av NKS-rapporten, som vid behov sänds elektroniskt till styrelsen för godkännande via en snabb ”silent procedure”
juni – juli 2006	NKS-rapporten trycks, distribueras och publiceras på hemsidan

Kriterier för NKS-aktiviteter

- Det ska finnas ett påtagligt nordiskt mervärde, inklusive
    - skapande och vidmakthållande av nordiska nätverk
    - spridning och utvidgning av nordisk kompetens inom sakområdet
    - satsning på unga nordiska forskare
- Det teknisk/vetenskapliga innehållet ska hålla hög internationell standard och ha ett nyhetsvärde
- Arbetet ska präglas av en helhetssyn samt vara transparent och öppet för bredast möjliga deltagande
- Det ska gå att ställa upp tydliga och mätbara mål för såväl det teknisk/vetenskapliga arbetet som informations- och kommunikationsinsatser
- Resultaten av verksamheten ska vara av påtaglig nytta för finansiärer och slutanvändare
- Där så är möjligt och lämpligt kan stöd ges till PhD- och MSc-studerande
- De praktiska resultaten ska presenteras i form av
    - seminarier, temamöten etc
    - tekniska rapporter och vetenskapliga artiklar i internationellt erkända publikationer
    - rekommendationer, manualer, handböcker, checklistor
    - CD-ROM, hemsidor och andra elektroniska media
    - undervisnings- och informationsmaterial
- Arbetet ska bedrivas så kostnadseffektivt som möjligt
- När så är lämpligt och möjligt ska NKS-arbetet koordineras internationellt
    - med det arbete som bedrivs av EU, IAEA och OECD/NEA
    - inom ramarna för pågående nordisk samverkan med länder i östra Europa

Utvärderingen av R- och B-delarna

R-delen: Reaktorsäkerhet inklusive avveckling och radioaktivt avfall

B-delen: Beredskap inklusive radioekologi och beredskapsrelaterad information/ kommunikation

Syfte med utvärderingen:

A Fastställa om arbetet varit välplanerat, användbart och kostnadseffektivt

B Undersöka i vad mån NKS-kriterierna (se ovan)
  - var relevanta
  - uppfyllts

C Dra lärdomar av erfarenheterna och ge rekommendationer inför framtiden

Några frågor som utvärderingen av R- och B-delarna bör försöka besvara:

1. Är NKS-aktiviteterna förankrade och välkända?
2. Har nordisk kunskap och samsyn ökat genom aktiviteterna? Har NKS-arbetet hjälpt till att bevara och utveckla det nordiska kontaktnätet?
3. Har NKS-arbetet hjälpt till att upprätthålla och utveckla expertis? Har möjligheterna till utbildning och engagemang av unga forskare tagits till vara?
4. Saknas några viktiga fackområden i NKS-arbetet? Kan några områden nerprioriteras eller utgå?
5. Är resultaten av aktiviteterna av tillräckligt god kvalitet? Om inte, vad är orsaken?
6. Följdes arbetsplan, tidsplan, budget?
7. Positiva och negativa erfarenheter av NKS-arbetet? Särskilda problem?
8. Lärdomar och rekommendationer inför det fortsatta NKSarbetet?

Utvärderarna av R- respektive B-delen avgör själva vilka bedömningsregler och betygsskalor eller liknande som ska användas.

Övrigt

Referensmaterial för utvärderingen av R- och B-delarna:

* Ramverket för R resp B (Framework Program) med bl a programstruktur, forskningsområden, kriterier, aktiviteter och Call for Proposals

* Dokumentation av processen med Call for Proposals under perioden

* Statusrapporter till styrelsen

* Tekniska rapporter, vetenskapliga artiklar och liknande publikationer

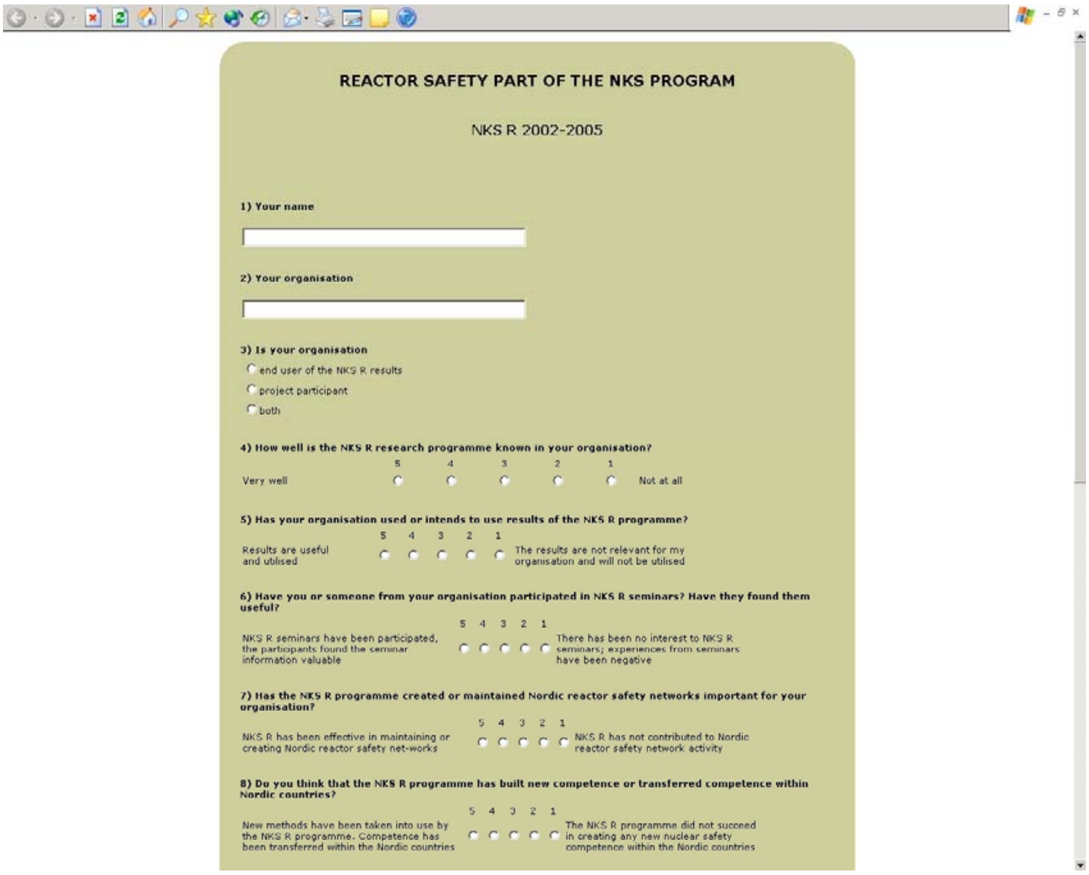
* Programhandboken, NKS(04)6 daterad 2004-12-08

* Tidigare utvärderingsrapporter, särskilt NKS-66 från november 2002

* Referat från styrelsemöten

* Kompletterande material på NKS' hemsidor

Appendix 2: NKS-R Questionnaire



REACTOR SAFETY PART OF THE NKS PROGRAM

NKS R 2002-2005

1) Your name

2) Your organisation

3) Is your organisation

○ end user of the NKS R results
○ project participant
○ both

4) How well is the NKS R research programme known in your organisation?

	5	4	3	2	1	
Very well	○	○	○	○	○	Not at all

5) Has your organisation used or intends to use results of the NKS R programme?

	5	4	3	2	1	
Results are useful and utilised	○	○	○	○	○	The results are not relevant for my organisation and will not be utilised

6) Have you or someone from your organisation participated in NKS R seminars? Have they found them useful?

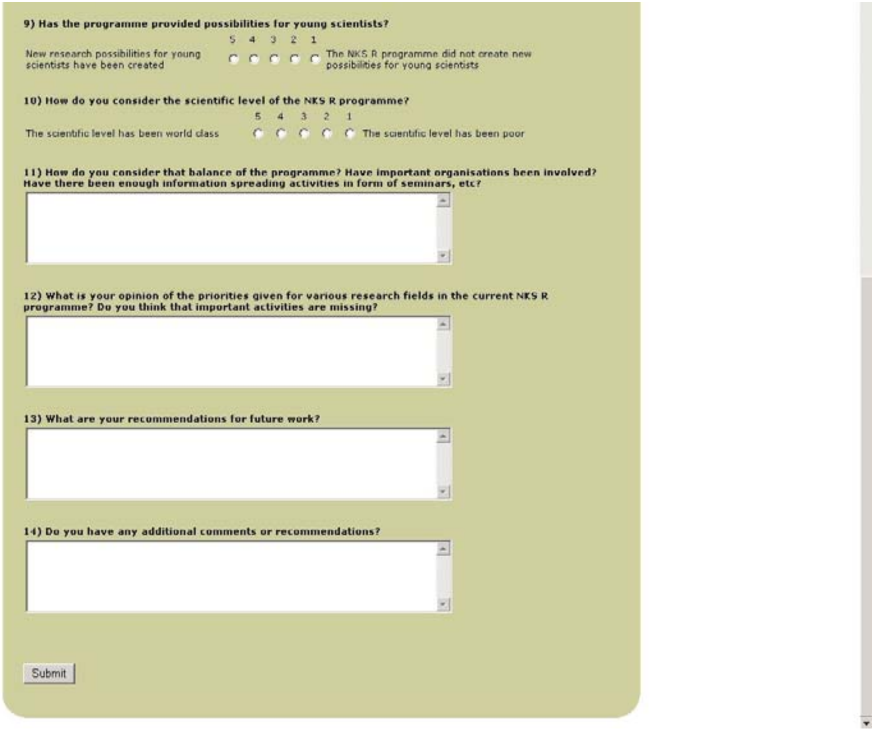
	5	4	3	2	1	
NKS R seminars have been participated, the participants found the seminar information valuable	○	○	○	○	○	There has been no interest to NKS R seminars; experiences from seminars have been negative

7) Has the NKS R programme created or maintained Nordic reactor safety networks important for your organisation?

	5	4	3	2	1	
NKS R has been effective in maintaining or creating Nordic reactor safety net-works	○	○	○	○	○	NKS R has not contributed to Nordic reactor safety network activity

8) Do you think that the NKS R programme has built new competence or transferred competence within Nordic countries?

	5	4	3	2	1	
New methods have been taken into use by the NKS R programme. Competence has been transferred within the Nordic countries	○	○	○	○	○	The NKS R programme did not succeed in creating any new nuclear safety competence within the Nordic countries



9) Has the programme provided possibilities for young scientists?

	5	4	3	2	1	
New research possibilities for young scientists have been created	○	○	○	○	○	The NKS R programme did not create new possibilities for young scientists

10) How do you consider the scientific level of the NKS R programme?

	5	4	3	2	1	
The scientific level has been world class	○	○	○	○	○	The scientific level has been poor

11) How do you consider that balance of the programme? Have important organisations been involved? Have there been enough information spreading activities in form of seminars, etc?

12) What is your opinion of the priorities given for various research fields in the current NKS R programme? Do you think that important activities are missing?

13) What are your recommendations for future work?

14) Do you have any additional comments or recommendations?

Appendix 3: Acronyms and Abbreviations

AGS	Air-borne Gamma Spectrometry
APRI	Accident Phenomena of Risk Importance (Swedish research program)
ARGOS	Accident Reporting and Guiding Operational System (Denmark)
BWR	Boiling Water Reactor
CCF	Common Cause Failure
CFD	Computational Fluid Dynamics
CGS	Car-borne Gamma Spectrometry
DD	Danish Decommissioning
DELI	Development and Validation of Assessment Methods and New Technology (NKS-R reserarch theme, comprising a number of activities)
DeliPool	Condensation pool experiments (NKS-R activity)
DEMA	Danish Emergency Management Agency
DKK	Danish currency unit (crowns, kroner; also kDDK and MDKK)
DTU	Technical University of Denmark
ECODOSES	Improving radiological assessment of doses to man from terrestrial ecosystems (NKS-B activity)
ECOMAGS	Nordic – EU collaboration on design and evaluation of the RESUME 2002 exercise (NKS-B activity)
EMARAD	Emergency management & radiation monitoring in nuclear and radiological accidents (NKS-B activity)
EU	European Union
FOI	Swedish Defense Research Agency
FRIT	Danish Science Research Councils' Instrument Service
GR	Icelandic Radiation Protection Institute
IAEA	International Atomic Energy Agency
I&C	Instrumentation and Control
ICRP	International Commission on Radiological Protection
ICRU	International Commission on Radiation Units and Measurements
IFE	Institute for Energy Technology (Norway)
INDOFERN	New indicator organisms for environmental radioactivity (NKS-B activity)
KTH	Royal Institute of Technology (Sweden)
LOCA	Loss of Coolant Accident
LUT	Lappeenranta University of Technology (Finland)
MainCulture	Maintenance culture and management of change (NKS-R activity)
MANGAN	Management and Organization of Safety and Quality Assurance (NKS-R research theme, comprising a number of activities)
MFM	Multilevel Flow Modelling
MGS	Mobile Gamma Spectrometry
MS	Mass Spectrometry
MU	Mälardalen University
NGU	Geological Survey of Norway
NKS	Nordic Nuclear Safety Research
NKS-B	Emergency Preparedness Program of NKS

NKS-R	Reactor Safety Program of NKS
NLH	Agricultural University of Norway
NORTHNET	Nordic Thermal Hydraulic Network
NPSAG	Nordic PSA Group
NRPA	Norwegian Radiation Protection Authority
NSFS	Nordic Society for Radiation Protection
NTNU	Norwegian University of Science and Technology, Department of Physics
OECD/NEA	Organization for Economic Cooperation and Development/ Nuclear Energy Agency
OKG	Oskarshamns Kraftgrupp (Sweden)
POOLEX	Condensation Pool Experiments (Finnish research activity)
PSA	Probalistic Safety Analysis
PWR	Pressurized Water Reactor
RESUME	Rapid Environmental Surveying Using Mobile Equipment (NKS-B exercises)
SGU	Geological Survey of Sweden
SIS	Danish Radiation Protection Authority
SKI	Swedish Nuclear Power Inspectorate
SLU	Swedish University of Agricultural Sciences
SSI	Swedish Radiation Protection Authority
STUK	Radiation and Nuclear Safety Authority (Finland)
SU	Stockholm University (Sweden)
TACO	Traceability and communication of requirements in digital I&C systems development (NKS-R activity)
TVO	Industrial Power, Ltd. (Finland)
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VALDOR	Values in Decisions on Risk (A series of NKS-supported international conferences)
VTT	Technical Research Center of Finland

Title	Evaluation of NKS Research Activities during 2002 - 2005
Author(s)	Risto Sairanen[1], Per Persson[2], Per Hedemann Jensen[3] and Tore Lindmo[4]
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No. of pages	116
No. of tables	8
No. of illustrations	23
No. of references	3
Abstract	NKS research work during the years 2002 – 2005 and its results have been evaluated against a set of criteria defined by the NKS Board. The evaluation encompassed the NKS-R (reactor safety) and NKS-B (emergency preparedness) programs and was conducted by two persons per program. The mode of work of the two evaluation teams was adapted to the special conditions of the program at hand, one being aimed more at the nuclear industry and the other at a more academic surrounding; in both cases, however, with great involvement of relevant national authorities. The findings of the evaluators are presented in this report. Financing and participating organizations, end users, deliverables, quality aspects, cost-benefit issues, time schedules, budgets and related issues are discussed. Finally, the sections on NKS-R and NKS-B, respectively, include conclusions and recommendations for future NKS work.
Key words	accidents; ageing; application; automation; call for proposals; competition; contamination; control room; cost calculation; criteria; decision support system; decommissioning; deliverable; dose assessment; emergency preparedness; end user; environment; evaluation; funding; indicator organisms; in-kind contribution; intercomparison; interview; measurement; monitoring; network; Nordic dimension; nuclear safety; objectives; organizational issues; plant lifetime management; probabilistic safety analysis; program manager; protection; quality assurance; questionnaire; radiation; radioactive; radioecology; release; remediation; risk analysis; safety culture; sampling; spectrometry; thermal hydraulics; waste

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Comparison of overall ranking from evaluation marks versus ranking form for NKS-R CfP 2011

Evaluation marks					Ranking form				
Rank	Proposal Name	Mean of Overall marks	Mean of Criteria marks		Average Ranking	Proposal Name	Funding Recommended	Funding If Possible	Funding Not Recommended
1	ENPOOL	6.4	6.2		4.0	ENPOOL	4	1	0
2	DIGREL	6.4	6.0		4.0	DIGREL	4	1	0
3	SADE	6.2	6.0		4.2	SADE	4	0	1
4	POOLFIRE	6.0	6.1		5.4	POOLFIRE	4	1	0
5	MoReMO	6.0	5.8		6.4	MoReMO	4	1	0
6	NOMAGE4	5.5	5.4		7.0	NOMAGE4	4	1	0
7	AIAS	5.4	5.6		7.5	RASTEP	1	1	2
8	RASTEP	5.3	5.2		8.8	AIAS	1	4	0
9	DPSA	5.0	5.2		8.8	DPSA	2	1	2
10	NAFTI	5.2	5.2		9.4	NAFTI	3	2	0
11	GRID	5.2	4.9		9.6	GRID	1	3	1
12	NAFCS2	5.0	5.0		9.8	NAFCS2	2	0	3
13	VNEMVALID	4.8	4.6		11.0	VNEMVALID	1	1	3
14	EXAM-HRA	4.4	4.6		11.6	EXAM-HRA	1	1	3
15	FMNPP	3.8	3.9		14.8	FMNPP	0	0	5
16	PANDAROSA	3.3	3.9		14.8	PANDAROSA	0	0	5

Comparison of overall ranking from evaluation marks versus ranking form for NKS-B CfP 2011

Evaluation marks					Ranking form				
		Mean of					Funding		
Rank	Proposal Name	Overall marks	Criteria marks		Average Ranking	Proposal Name	Recommended	If Possible	Not Recommended
1	GammaWorkshops	5.6	5.4		3.6	GammaWorkshops	7	1	0
2	NordEx12	5.6	4.8		4.3	RadWaste	6	2	0
3	RadWaste	5.5	5.4		4.4	NordEx12	5	2	1
4	PIANOLIB	5.4	5.2		4.9	PIANOLIB	7	0	1
5	RADPAST	5.1	4.7		5.3	RADPAST	5	2	1
6	ORPEX	4.9	4.8		6.5	ORPEX	5	2	1
7	RASTEP	4.6	4.7		6.6	RASTEP	4	2	2
8	NUFOR	4.4	4.7		7.1	GammaRate	4	1	3
9	GammaRate	4.4	4.0		8.1	NUFOR	2	3	3
10	noremex	3.9	3.7		8.3	Noremex	3	0	5
11	NORDPOL	3.8	4.5		9.1	NORDPOL	1	3	4
12	PONPP	3.5	3.8		9.9	PONPP	0	5	3

<u>***DRAFT REPORT #6 OF 6***</u>

Nordic Nuclear Safety Research 1994 – 2008:

From Standardized 4-Year Classics To Customized R&B

Torkel Bennerstedt, TeknoTelje HB

Text in red indicates major changes compared to draft #4.

Abstract

This is a presentation of NKS (Nordic Nuclear Safety Research), its work and achievements in the years 1994 – 2008, during which the author served as Nordic secretary and (later) as coordinator. NKS and the Nordic perspective are briefly introduced. Then follows a description of the NKS support structure, organization and administration: owners, board, Nordic secretary, Bureau and Secretariat.

The author then embarks on a journey through the modern history of NKS work. The last two of the six fixed 4-year programs are described as regards planning, contents, project work, administration, dissemination of results, evaluations and conclusions. The trip continues to the land of R&B and the present (2011) structure of two general frameworks, namely, NKS-R: reactor safety, and NKS-B: emergency preparedness; each consisting of a set of flexible activities; hence, R&B. The reasoning behind this makeover is touched upon together with the new organization and simpler administration that developed. Major activities and the produced results are introduced and the evaluations summarized. The author's own conclusions and recommendations are followed by a short and subjective list of references.

In a number of appendices some important background material has been compiled: bullet point versions of minutes of owners group and board meetings; economic contributions and budgets; an overview of all NKS programs and evaluations; lists of R&B activities and funding; the author's personal remarks; a list of some NKS documents (other than technical reports and minutes); and a list of acronyms used in this report.

The author's personal views are essentially confined to two sections of the report: Concluding Personal Reflections; and Appendix 9: Author's Remarks. Other than that, they will be given in the form "(*Author's comment: …*) throughout the report (where applicable).

Key Words

Aging; biological transfer; BWR; CAMS; call for proposals; Chernobyl; clean-up; clearance; computerized accident management support system; contamination; core coolability; countermeasures; database; decommission; dispersion; dissemination of information; dose assessment; EIA; emergency preparedness; environmental impact assessment; evaluation; exercises; food chains; framework program; human factor; integrated sequence analysis; intermediate storage; internal dose; international cooperation; LOCA; maintenance strategies; man-machine interaction; mass spectrometry; measurements; mobile reactors; monitoring; network; NKS; Nordic nuclear safety research; nuclear power; nuclear safety; nuclear threat; operability; organic iodine; plant modernization; probabilistic safety analysis; PSA; PWR; QA; quality assurance; radiation protection; radioactive; radioecology; radionuclide; reactor; recriticality; reflooding; risk assessment; safety culture; sampling; severe accident; spectrometry; source term; validation; vulnerability; waste

Acknowledgment

NKS conveys its gratitude to all organizations and hundreds of persons who by means of financial support, countless hours of hard work and contributions in kind for many years have made the results presented in this report possible.

This report has evolved in close cooperation with Sigurður M Magnússon, NKS chairman and head of IRSA (the Icelandic Radiation Safety Authority). He has offered invaluable advice and comments throughout the writing process. The contributions of former chairmen Magnus von Bonsdorff and Helge Smidt Olsen, Finn Physant of the NKS Secretariat at FRIT, Risø, and my wife Lena Bennerstedt are also gratefully acknowledged.

Disclaimer

The views expressed in this report remain the responsibility of the author and do not necessarily reflect those of NKS. In particular, neither NKS nor any organization or body supporting its activities can be held responsible for the material presented herein, or how the material is interpreted or put to use.

Color Code

Portions of the text in this report are written against a colored background. The colors signify:

Lilac	Matters related to the Owners Group
Yellow	Matters related to the Board
Blue	Information on the research program
Green	Organizational / administrative matters

Don’t ask me nothing ‘bout nothing
I just might tell you the truth

Bob Dylan: Outlaw Blues

Extended Summary

NKS: Nordic Nuclear Safety Research

Nordic Nuclear Safety Research (NKS) is a platform for Nordic cooperation and competence in nuclear safety and related radiation safety issues including emergency preparedness and radioecology. The work is financed by Nordic authorities, research institutions and power companies; and supported by a number of other organizations. The objective is to produce seminars, exercises, scientific articles, technical reports and other deliverables. The participating countries are Denmark, Finland, Iceland, Norway and Sweden. Each major activity should involve at least three of the Nordic countries.

The owners and main financiers of NKS are:

- The Danish Emergency Management Agency (DEMA)
- The Finnish Ministry of Employment and the Economy (TEM)
- The Icelandic Radiation Safety Authority (IRSA)
- The Norwegian Radiation Protection Authority (NRPA)
- The Swedish Radiation Safety Authority (SSM)

Representatives of the owners form the Owners Group, and together with experts appointed by the owners they constitute the NKS Board. The owners decide in matters regarding funding, policy, structure and overall matters, whereas the Board handles questions regarding priorities, budgets, program plans and activity related issues. The quality and cost-effectiveness of NKS work is closely followed by the Board. Some noteworthy Owners Group and Board discussions and decisions are briefly summarized in the main text of this report and presented at greater length in two appendices.

The owners appointed a Nordic secretary to coordinate and oversee the scientific work and the secretarial services. Up to 1994 Franz Marcus had served as Nordic secretary; he was then followed by Torkel Bennerstedt who served for the 15 years coverd by the present report; the last years as coordinator. The position was cancelled in 2008 and the tasks of the Nordic secretary / coordinator were taken over by others.

In 1994 – 2006 the Bureau served as the Board’s working group. It consisted of the NKS chairman, the secretary of the Board and the Nordic secretary.

For the entire period covered by this report, the secretarial function rested with two FRIT members, first as a division of Risø, later as a private company within the premises of Risø.

NKS 1994 – 2008: 15 years of work and development

This report covers the 15 years when the author served as Nordic secretary. It is impossible not to be impressed with the vast amount of research, exercises, dissemination of information, sharing of resources and experience, networking, recruitment and participation of many hundreds of persons in nuclear safety, radiation protection and emergency preparedness from all five Nordic countries. Most participants will remain anonymous to the reader of this report; but you can rest assured that all their contributions have made a difference in the development of NKS work and its high international standard. Without the support of the owners, the Board, other contributing organizations and last but not least the NKS Secretariat, all of this would not have happened. And it is an ongoing process, still as viable as ever after decades of Nordic collaboration and international cooperation.

During the first 8 of the 15 years, work progressed in accordance with the traditional pattern of 4-year programs, where the first part of the period was used to plan the work, the following years were spent on actual project work and the last part of the period was spent summing up, reporting and evaluating the old program and discussing the next.

In order to further improve the cost-effectiveness of the work and increase the flexibility, the NKS structure was changed in 2002. A new program structure, consisting of two research areas – NKS-R (reactor safety) and NKS-B (emergency preparedness) – was developed, together forming the new R&B program. In annual Calls for Proposals participating organizations can suggest activities, specify work plans and apply for NKS funding. Activities are no longer automatically prolonged for several years, as in the old 4-year programs. All applications for NKS funding shall answer some basic questions: Who is supposed to do what why when where how at what cost, who picks up the tab and who benefits from it all?

The yearly *contributions* to NKS work ranged from DKK 7391k to 9875k, totalling about DKK 124 million for 1994 – 2008. The in-kind contributions of participating organizations were of the same order of magnitude.

The yearly *budgets* ranged from DKK 6670k to 11978k, totalling about DKK 129 million for 1994 – 2008. There are numerous explanations as to these annual variations: fluctuations in national funding; transfer of unused funds from one year to the next; the number of activities that were supported; etc.

In the background, the NKS Secretariat did a tremenduous work, keeping track of all administarative matters like finances, bookkeping, audits, publication of reports, assisting project leaders, program managers and many others in their daily chores.

Initially, dissemination of information usually consisted of writing and distributing reports and articles, arranging or participating in seminars, conferences and workshops etc. But as new media emerged, the focus was on the Internet with email, websites, electronic reporting, CD and DVD formats in an ongoing evolution. Networking has taken on a whole new meaning.

NKS policy and administrative routines were developed in an evolutionary process over the years, maturing and adapting to the decisions of the owners and the Board and the needs of the participants.

The most important criteria for program plans and activity proposals have been

- Relevance to financiers and end users
- Conformity with policy and adopted program structures
- The Nordic perspective: of common Nordic interest
- High international standard of the work and its results

Simply put, NKS should engage in select and timely activities, for the right reasons, while striving for optimal quality, at a reasonable cost with maximum positive impact, benefitting as many of the stake-holders as possible.

The quality of the work is monitored by the owners and the Board through assessment of proposed activities and work plans, presentations and discussions at Board meetings, scrutiny of deliverables and independent evaluations of a well-defined program period according to directives stipulated by the Board.

The programs and results of NKS work in 1994 – 2008 are summarized in the sections below.

Scientific program of the fifth 4-year period 1994 – 1997

The program adopted by the Board was divided into three project categories: RAK, AFA and EKO, plus a joint services function called SAM.

RAK	*Reactor safety:*
RAK-1	Strategy for reactor safety Objective: To explore strategies for reactor safety as applied in Finland and Sweden; specifically to investigate and evaluate the safety work; increase realism and reliability of the safety analysis; and suggest how safety can be improved in selected areas.

	Subdivided into: Mapping and evaluation of of the safety work; Initiating events; Integrated sequence analysis – especially human errors; Maintenance strategies and aging; and Modernization.
RAK-2	Prevention of severe accidents Subdivided into: Studies of the consequences of selected severe accident scenarios and phenomena in Nordic reactors; Development and testing of a computerized accident management support system (CAMS); and Data collection on different mobile and British reactors in Nordic surroundings.
AFA	*Waste management:*
AFA-1	Safety in waste disposal Objective: To give authorities and waste producers background material for decisions on management and disposal of long-lived low and intermediate level radioactive waste. Subdivided into: Waste characterization; Performance assessment for repositories; and Environmental Impact Assessment (EIA).
EKO	*Environmental effects:*
EKO-1	Marine radioecology Objective: To enable better and faster assessments of the effects of releases of radionuclides to the marine environment, taking health and economy into account. Subdivided into: Model work; Reasearch: field and laboratory studies; and Dissemination of information.
EKO-2	Long ecological half-lives in semi-natural systems Objective: To identify the contributions from semi-natural systems by determining ecological half-lives for specific foodstuffs from these areas, and determine dose to man. Subdivided into: The sheep project; The forest project; and The fresh-water fish project.
EKO-3	Preparedness strategy and procedures Objective: To assist Nordic authorities in improving their emergency response and international cooperation in selected issues. Subdivided into: Mobile measurements; Quality assurance; and Operational Intervention Levels (OIL).
EKO-4	Emergency preparedness exercises and information Objectives: To develop competence and contingency plans; to contribute to Nordic evaluation and coordination; and to improve understanding of actions taken in Nordic neighbor countries. Subdivided into: Various exercises and seminars on source term analysis; Atmospheric dispersion; Dose calculation; Clean-up operations; and Mobile measurements.
EKO-5	Pre-planning of early clean-up Objective: To work out guidelines to be used in the planning of early clean-up actions after a nuclear accident, in order to reduce doses from external radiation in inhabited areas. Subdivided into: Identifying relevant actions; Calculations for various building types; and Guidelines and tables for planners regarding the studied cases.
SAM	*NKS coordination:*
SAM-1	Secretarial services, administration Objective: Cost-effective services to the NKS organization. No subdivision.

SAM-2	Coordination of NKS-Baltic activities Objective: To facilitate Nordic-Baltic cooperation when needed and in line with NKS policy. No subdivision.
SAM-3	Coordination of NKS-EU activities Objective: Meetings and seminar to investigate the possibilities for contacts and cooperation with EU. No subdivision.
SAM-4	Overriding information issues Objective: To create a forum for discussions and education in issues regarding information to media and members of the public. Subdivided into: How to inform about a difficult subject in a modern society; How to provide advance information; How to inform when an accident has occurred; and How to inform about NKS and its projects.

Evaluation of the scientific program 1993 – 1997

- The general aim of the program was well in line with NKS objectives. The planning and execution of the program has been systematically documented. With a few exceptions, deadlines have been met, and budgetary constraints were respected.
- The activities in the *nuclear safety* area concentrated on comparative analyses of nuclear safety work in Finland and Sweden. All subprojects were relevant and the objectives sufficiently ambitious.
- Among the problems on *radioactive wastes*, long-lived low and medium level waste management practices in the Nordic countries as well as approaches to analyze the environmental effects due to waste storing were under study and deliberation. Finnish and Swedish participation from authorities and the industry was scarce, which might reflect the choice of program contents.
- Main efforts in the area of *radioecology* were allocated to the modeling and analyses of long term radioactive contamination in a Nordic environment. Joint training and exercises were organized to test and develop emergency preparedness emphasizing the possibility of a nuclear accident.
- The selection of RAK, AFA and EKO projects was done after careful pre-studies. Some of the projects represent the top level of scientific technical knowledge, others are state-of-the-art. Important results have been presented and useful information collected for future use. Technical reporting should however be done only if real advancements can be presented or if there is a need to bring some special aspects to a broader forum for discussion.
- The *information* project consisted of a number of interesting and important subareas but was probably too ambitious. The NKS Board should seriously consider the pros and cons before adopting new information projects (other than communication techniques).
- The *administrative functions* and the corresponding documentation has improved vastly the last couple of years. The level of competence is high and the functions have served the program well.

Final seminar of the scientific program 1993 – 1997: Eight years with NKS

The two-day seminar was arranged in Saltsjöbaden, Sweden in March 2008. It covered the results of the recently finnished 4-year program and plans for the next. Most of the first day was spent on reporting of the project leaders and the evaluator, and discussions on the results, findings and recommendations. The Secretariat also presented its achievements. The second day was spent discussing NKS and the future. After a presentation of a proposed new research program, the participants formed a number of groups to discuss different aspects of the proposal and reported in plenum, after which followed a joint final discussion.

Scientific program of the sixth 4-year period 1998 – 2001

The program adopted by the Board was divided into three project categories: SOS, BOK and SBA, plus a joint services function called SEK.

SOS *Nuclear safety and radiation protection:*

SOS-1 Risk assessment and strategies for safety
Subdivided into: Risk assessment; Safety analysis; and Strategies for safety management.
Highlighted current development within the nuclear energy area on a broad base. Safety is understood as awareness in regard of the control of risk. It cannot be said to be provided for until it has been communicated, implemented and well understood. The safety culture must continuously be encouraged and stimulated. Safety indicators reflect the safety of a nuclear facility and provide warnings that future performance might be in danger. Quality systems have an important task of ensuring a systematic knowledge sharing and learning. Safety analysis is at the core of risk assessment for decision making both in reactor safety and for waste disposal.

SOS-2 Reactor safety
Subdivided into: Safety development; Management of plant maintenance and renewal; and Severe accidents.
Focused on certain safety-related topics of common interest to the Nordic nuclear community. Problems related to risk-informed decision making were addressed, especially uncertainties and incompleteness due to use of PSA. Analyses of human and organizational factors in maintenance were promoted, as was the need to enhance understanding related to maintenance management. Phenomenological studies of hydrogen combustion, formation of organic iodine, and core recriticality due to molten core – concrete interactions in the lower head of the reactor vessel were performed. The current status of research and management of severe accidents in the Nordic countries was reviewed.

SOS-3 Radioactive waste
Subdivided into: Environmental Impact Assessments (EIA); Intermediate storage of low and medium level waste; and Contamination levels in metals.
Priority was given to a Nordic perspective with participation from all five countries. Therefore, work focused less on waste from nuclear power plants than on waste from research institutions, hospitals and industries. The target group for the results was primarily authorities and organizations managing waste in the Nordic countries. However, the results are presumably useful in other countries as well. This applies particularly to the work on contamination levels in metals. The EIA part of the project included four strictly Nordic seminars on procedures for the disposal of radwaste.

BOK *Nuclear preparedness and consequences:*

BOK-1 Nuclear emergency preparedness
Subdivided into: Laboratory measurements and quality assurance; Mobile measurements and measurement strategies; Field measurements and data assimilation; Countermeasures in agriculture and forestry; Emergency monitoring in the Nordic and Baltic Sea countries; and Nuclear exercises.
The project comprised a number of activities aimed at developing and improving nuclear emergency preparedness. The activities included surveys of techniques and equipment, workshops and exercises. The project included research activities concerning monitoring and modeling the radiological impact of nuclear accidents, aiming at developing emergency response plans. Radiation protection authorities, governmental agencies, universities, research organizations and laboratories have been

partners in the project, which have had participants from all of the Nordic and Baltic Sea countries.

BOK-2 Radiological and environmental consequences
Subdivided into: Important Nordic food chains: Radiological vulnerability; Internal doses; Radioactive tracers in Nordic sea areas: Sea water transport; Biological and biogeochemical processes; Applications of ICP-MS for measuring radionuclides; and Methodology for defining exemption levels of radionuclides in timber.
The project focused on radioecology in the Nordic countries and areas of interest to them. An important aim was to provide a stimulating environment and to encourage contacts and cooperation between young and experienced researchers, between scientists in different fields (within and outside traditional radioecology) and between scientists within the Nordic countries and neighboring regions. This was done through meetings, seminars and dissemination of information, including use of the Internet. The Nordic network within radioecology is important for national authorities and for new people in the field and for making it possible to start close cooperation quickly between countries, e.g., if needed because of a nuclear accident.

SBA *Safety and preparedness related activities:*

SBA-1 Nuclear threats in Nordic surroundings
No subdivision.
The main task was to aggregate already compiled knowledge of nuclear threats in the vicinity of the Nordic countries into a base of knowledge, presented by means of modern information technology and made available to Nordic authorities as a supplement to national emergency preparedness systems. The project focused on potential events in nuclear installations and the possible consequences for the Nordic countries and especially on vulnerable food chains, dose to man, environmental contamination and emergency preparedness. The main installations in question were nuclear power plants, nuclear powered ships and nuclear fuel and waste storage facilities. A literature database is presented on a website and as a report with some 500 references, including the most relevant publications, papers and reports on the topic at hand.

SBA-2 Information issues
Clear goals were never formulated, but the project intended to answer very much the same questions as the information project of the previous 4-year program. A workshop on information for NKS project leaders and participants was carried out and a combined course and field trip to Sellafield for journalists was arranged. Due to circumstances beyond the control of the project leadership, the Board decided in 2000 to cancel the project.

Evaluation of the scientific program 1998 – 2001

- The program proved that this kind of cooperation is needed to develop the joint Nordic view on radiation and nuclear safety issues and to maintain and develop direct personal contacts between the authorities and researchers.
- It is recommended that a new criterion – the Nordic added value – should be applied when assessing project proposals.
- It is not always clear what the aims of a project or subproject are, or why a subproject was added.
- Parts of SOS-1 were carried out in cooperation with an EU project, focusing on Oskarshamn NPP and communication with the public. A continuation of the work on safety analysis is not necessary. The utilities participated in the part that dealt with safety management, and this work should be continued.
- To a large extent, SOS-2 was a continuation of RAK. The results are interesting and valuable both to authorities and end users. Good that the depencence of PSA results on the studied object is brought up. Risk informed methods are of great value. Maintenance and renewal issues are

important in view of the deregulation of the power market. It is essential to maintain competence as regards organic iodine, and work on severe accidents should continue.

- SOS-3 was partially a continuation of AFA-1.3. Nordic differences in EIA policy and work were highlighted in a series of successful seminars, where non-nuclear cases were also studied.The analysis of Nordic experience of waste storage and deposition excluded nuclear power, and Iceland was not mentioned. It was demonstrated that doses to man from contaminated scrap metal will be insignificant, which is an interesting result in itself. The compilation of Nordic regulations on clearance is valuable.
- BOK-1 had a background in earlier BER and EKO programs. The coordination and administration of the project was excellent, and the Nordic perspective well taken care of. It was demonstrated that the Nordic countries are well prepared to make good quality field and laboratory measurements in case of an emergency. The database on countermeasures in agriculture and forestry should be integrated with RODOS and ARGOS. The valuable handbook on Nordic and Baltic Sea states was updated and now covers 11 countries. The exercises strengthened the ability to cooperate under emergency conditions.
- BOK-2 had its background in earlier RAD and EKO programs. The many environmental surveys are more costly than other types of NKS work, so NKS funding was only a small fraction of the total budget. It was a good forum for networking and training, with some Baltic cooperation. The results of the studies of radionuclides in important Nordic food chains are of great use.The competence regarding radioactive tracers has increased. It was demonstrated that ICP-MS is applicable both for heavy and lighter isotopes. The results of the studies on timber clearance levels should be of interest to the forest industry.
- SBA-1 was divided into two parts. One created an Internet literature database of some 500 publications on nuclear installations in the Nordic countries and surrounding areas. The other part was the creation of an Internet base of knowledge on risks and nuclear threats to the public and the environment. It is important that these excellent databases are kept operational.
- SBA-2 failed to achieve most of its goals. No reports were published. As for NKS information activities in general, any actions should be end-user driven and future plans (if any) more concrete.
- The proposed division of the new NKS program into two main areas is supported.

Evaluation of the NKS structure 1998 – 2001

- The overall impression is excellent.
- The total NKS organization generally prepares the ground well for the work carried out under the program.
- The internal dissemination of results is good; the external could be improved.
- Steps should be taken, for each project, to consider selective information measures vis-à-vis relevant users.
- The administrative support is excellent and comes at a cost of 20% of the budget.
- Budgeting is unrealistic. Achieving improved financial management requires realistic budgeting to ensure that costs accrue in the period to which the allocation applies and that actual costs are formally debitable. Realistic budgeting also enables financiers to run their own financial management according to the cash principle.
- Ensure that written documents from the secretariat are available for all business to be dealt with where they may be of use.
- Downsizing of the Board is recommended.

The transition seminar in Roskilde 2002

The seminar “NKS Today and Tomorrow” marked the transition from the traditional model of cyclical 4-year programs to a more flexible structure of annual calls for activity proposals. The seminar agenda consisted of three main parts:

- Results of the 1998 – 2001 program (project leaders, secretariat, evaluators)
- Presentations by invited international speakers on
    - Nuclear power: Past accomplishments, future challenges
    - Radiological protection at the start of the 21st century: A progress report

- Plans for the new R&B structure (Reactor safety & Emergency preparedness) with presentations of the old and new chairman, owners, end users and the newly appointed NKS-R and NKS-B program managers

Scientific program of R&B in 2002 – 2005

In 2001 the NKS Board adopted a dynamic scientific framework program, divided into two main areas, each led by a program manager:

- NKS-R: Reactor safety
- NKS-B: Emergency preparedness

Practical work began in 2002. Financial support is to be given fairly evenly to the R and B parts.

The contents, time frames and budgets of the program and its many activities are decided by the Board, in accordance with the NKS-R and NKS-B frameworks. All activity proposals are assessed against a set of criteria established by the Board. Changes in work plans are made when called for. Activities may be expanded, reduced, or cancelled; new activities are added. The program is constantly renewed through a regularly occurring procedure of Call for Proposals, which is open to all relevant Nordic organizations. When an activity has been finished and the final report accepted by the Board, the results will be disseminated and can be implemented by the end users.

The NKS-R framework and results of some R activities:

The program was divided into two main areas:

DELI	Development & Validation of assessment methods and new technology. This theme covers the challenges related to plant safety assessment and the introduction of new technology into the plants.
MANGAN	Management & Organization of safety and quality assurance. This theme covers the challenges related to the implementation and assessment of effective safety and quality management, and to human performance in different situations.

Under these two themes, five main topics have been identified: Prediction methods; New technology; Integrity and operability; Safety principles; and Human factors.

The eight activities that received the most funding were the following.

1. BWR condensation pool experiments: DeliPool studied the effects of a rapid bubble collapse and a fluid-structure interaction. A method for calculation of pressure loads was tested.
2. Assessment of maintenance culture safety and efficiency in Finland and Sweden: MainCulture strives to combine technical and human resources approaches, raising questions that are not usually explicitly taken into account in change management.
3. Safety management: A theoretical framework was created to analyze non-nuclear industries, and the relevance of the results for the nuclear industry and its regulators was investigated.
4. Barriers, control and management: It was investigated how formalized concepts can be used to define concepts to be used in design and assessment of NPP safety systems and procedures.
5. Experiments on ruthenium behavior in severe accident conditions: RutheniumReleases studied how volatile Ru species are formed and deposited on piping or released into the containment.
6. Traceability and communication of requirements in digital I&C systems development: TACO created a framework for requirements handling, and represents a generic approach to lifecycle-oriented, traceability-based requirements management.
7. Nordic thermal hydraulic and nuclear safety network: NOTNet (now established as Northnet) combines the resources of different research teams in order to carry out more ambitious and extensive research programs than would be possible for the individual teams.
8. Ex-vessel coolability and energetics of steam explosions in Nordic boiling water reactors: ExCoolSE was an experimental activity to evaluate the consequences of severe reactor accidents involving melting of the core and release of radioactivity.

The NKS-B framework and results of some B activities:

Potential activities should fall into any of the following three main areas and their sub-areas:

- Emergency preparedness – in general; and specific tools
    - Improving exchange of information and communication techniques
    - Decision support (handbooks on countermeasures, application of current radioecological knowledge in emergency preparedness)
- Measurement strategy, technology and quality assurance (this can include laboratory, mobile and whole-body measurements)
    - Quality assurance and improvements in the application of current technique
    - Testing the usefulness of new techniques, helping to create Nordic cooperation in their use
    - Radioecological studies of relevance for emergency preparedness
    - Nordic land use: effects of fresh fallout, long-term effects, effects of countermeasures
    - Studies for improvements of marine dose assessment models (i.e., transport with ocean currents, sedimentation processes, uptake in biota and pathways to man)
    - Syntheses of earlier radiological studies of Nordic interest (e.g., workshop / seminar)

The eight activities that received the most funding were the following.

1. Intercomparison of laboratory analyses of radionuclides in environmental samples: Labinco engaged 38 laboratories in an intercomparison exercise including alpha and beta emitters. The results were quite good, although there is room for improvements at most laboratories.
2. Radiochemical analysis in emergency and routine situations: RadChem compared and evaluated radiochemical procedures used in Nordic laboratories, and an intercomparison exercise was performed.
3. Nordic collaboration on the use of mass spectrometers for the analysis of radioisotopes: NorCMass dealt with problems in isotope ratio and ultra trace measurements of plutonium and uranium isotopes and Np-237 using ICP-MS, including an educational part.
4. Improving radiological assessment of doses to man from terrestrial ecosystems: EcoDoses improved the radiological assessment of doses to man from terrestrial ecosystems and developed a model for estimating radioactive fallout. Comparisons with ARGOS were made.
5. New indicator organisms for environmental radioactivity: Indofern identified organisms that effectively accumulate certain radionuclides in various Nordic ecosystems and yielded new data on occurrence and transport of radionuclides.
6. Decision support handbook for remediation of contaminated inhabited areas: UrbHand suggests methods for measurement of contamination and doses prognoses, and data for evaluation of countermeasures and associated waste management options.
7. Nordic network of meteorological services engaged in nuclear emergency preparedness: MetNet led to a certain harminization of presentation of the modelling results.
8. Emergency management and radiation monitoring in nuclear and radiological accidents: EMARAD produced and gathered data and information to be used in preparing emergency procedures and radiation monitoring strategies.

Evaluation of the R&B program 2002 – 2005

The NKS-R program:

- The results are very good, mostly applicable and cost-effective, with only a few delays.
- The Nordic perspective is lacking in many activities and utility participation was often scarce.
- The evaluation criteria were translated to 15 questions, and the answers were obtained through interviews, a survey and review of the deliverables.
- Conclusions regarding the eight NKS-R activities presented above:
    1. DeliPool: The scientific content is judged to be moderate.
    2. MainCulture: There is a substantial use for the study both by plants and authorities.
    3. SafetyManagement: The findings are new and the published book useful for end users.
    4. BarriersControlManagement: Gives interesting theoretical insights to the concepts routinely used in nuclear safety work.

5. RutheniumReleases: Of interest for all LWRs. The reports are of high international standard.
6. TACO: The developed structure is new but should be tested practically to assess its usefulness.
7. NOTNet: Several Nordic contracts have been signed for cooperation under the name Northnet.
8. ExCoolSE: The report is of high international quality, the questions raised are central to Nordic BWRs, and the activity has contributed to the maintenance of Nordic competence.

The NKS-B program:

- The seminars were very useful, but the quality of the deliverables varies considerably.
- Many of the activities definitely have the potential of being further developed.
- The activities were evaluated by applying ten criteria and graded on a scale A – E, with an overall average of B-.
- Conclusions regarding the eight NKS-B activities presented above:
    1. Labinco: Maintains and extends competence in radiological data acquisition. Pedagogical.
    2. RadChem: Valuable information on practices for specified analyses and separation procedures.
    3. NorCMass: Created a Nordic network. High pedagogical merits. Relevant and practical results.
    4. EcoDoses: Continuation of BOK-2. Very valuable results obtained for science and authorities.
    5. Indofern: Valuable data and results on new Nordic indicator organisms accumulating certain radionuclides, e.g., after a discharge into the Nordic ecosystem.
    6. UrbHand: Results and information in the handbook relevant in accident situations.
    7. MetNet: Results relevant for authorities assessing the consequences of a nuclear accident.
    8. EMARAD: Relevant when assessing nuclear threats and accidents, including malicious uses.

Continued R&B work after 2005

Following the thorough evaluation of the first four years of R&B work and applying the practical experiences of the program managers, secretariat and others directly involved in the daily work, the program and routines were adjusted as needed and the smooth and valuable endeavors continued. Some of the post 2005 activities are listed below. A joint R&B seminar was held in 2009, and the proceedings were published as report NKS-201.

Notes on some NKS-R activities 2006 – 2008

- The activity RutheniumReleases was continued.
- The activity ExCollSE was continued.
- The aim of MORE was to improve management of all new Nordic NPP modernization projects. It was linked to TACO.
- Auto New Tech dealt with a turbine automation interface.
- WERISK studied the effects of extreme weather conditions on plant operation and shutdown.
- WASCO developed wire testing methods and performed experiments to check for safe operation.
- POOL studied thermohydraulics and thermal loads in the drywell and wetwell after a LOCA.
- SafetyGoal included NKS, NPSAG and OECD/NEA work on probabilistic NPP safety criteria.
- StratRev studied stratification issues in LWR primary systems: validation and modeling.
- NROI experimented on formation of iodine oxide aerosols and analyzed the reaction products.
- PODRIS studied effects of flaw detection probability assumptions on risk reduction at inspections.
- MOSACA gave insight into safety culture and factors considered important for safety.
- RiskEval published a guidance for evaluation of technical specification conditions with PSA.

Notes on some NKS-B activities 2006 – 2008

- BIODOS established improved biodosimetric applications in emergency preparedness.
- UrbHand further developed the first draft of the handbook and published the final version.
- SPECIATION focused on development of speciation analysis of radionuclides in the environment.
- NordRisk produced an atlas of risks from long-range radionuclide dispersion and deposition.

- HOT II gave an overview of sources of potential radioactive particles of Nordic relevance.
- BIOPEX was a continuation of BIODOS.
- GAPRAD filled knowledge gaps in radiation protection methodologies for non-human biota.
- In REMSPEC synthetic early-phase gamma ray spectra were used for analysis and comparison.
- LUCIA assessed the impact of releases of radionuclides into urban sewage systems.
- REIN studied the long-term decline of radiocesium in Fennoscandian reindeer.
- PardNor addressed shortcomings in modeling of ingestion doses for Nordic decision support.

Revised R&B frameworks

New R&B frameworks were adopted by the Board in November 2008.

The nuclear power industry and regulatory bodies have a number of challanges of particular interest where research activities are essential, and will be prioritized. The following NKS-R main research areas were judged to be of current interest:

- Reactor physics and thermo-hydraulics
- Modernization, introduction of new techniques and new demands
- Aging of nuclear facilities
- Severe accidents
- Probabilistic methods
- Organization, man and safety culture
- Phase-out and decommissioning of nuclear facilities
- Common seminars for reactor safety and emergency preparedness

The aim of the NKS-B program is to strengthen Nordic work concerning

  - radiological emergency preparedness
  - management of radioactive waste and discharges
  - radioecology and environmental assessments

Activities will be judged against how well they comply with the framework as well as against their scientific and pedagogical merits. The following main research areas were judged to be of current interest:

E	Emergency preparedness (in general as well as specific tools)
W	Waste and discharges
R	Radioecological assessments
M	Measurement strategy, technology and quality assurance

Joint R&B activities are foreseen regarding decommissioning and radwaste issues, joint R&B seminars and information and communication targeting media and the general public.

Wrapping it up

Under the heading “Concluding personal reflections” the author summarizes his experinces from 15 years as Nordic secretary and coordinator, and gives his personal comments and recommendations as to research work and administrative routines. Additional personal views are collected in one of the appendices that conclude the report. The other appendices give details on Owners Group and Board meetings, economic contributions, budgets, evaluations, policy matters, R&B activities and funding, and NKS documents. The last item is a list of acronyms used in this report.

Table of Contents

Introduction

About This Report

This report gives the author's version of important NKS decisions, events and achievements during his 15 years as Nordic secretary and coordinator. Others could and probably would have written a different story. It has been the author's intention to put everything forth as it happened, to the best of his recollection, after digging through the archives and interviewing old colleagues and friends. Others might remember things differently or recall different things. Some would perhaps have made different choices in focus or perspective.

When the author of this report took over after Franz Marcus in 1994, he also took over a structure and administrative support function that had been in place for many years. The position held by Franz Marcus and Torkel Bennerstedt has been referred to as Nordic secretary, executive secretary, secretary general, and – for the final period – NKS coordinator. The job title used in this report is Nordic secretary.

As time passed, a series of changes and developments took place. Therefore, in 2009 the Board felt that a new historic NKS review was of interest. It was intended as a follow-up or sequel of "Half a Century of Nordic Nuclear Co-operation – An Insider's Recollections" by Franz R. Marcus from November 1997.

By agreement with NKS the objective of the present report is to give the author's personal impression of NKS, its work, results and development during his 15 years as Nordic secretary. Thus, the scope is quite wide:

- Research activities as well as structure, organization and administration of the work
- Major programs, projects and activities
- From pre-projects via technical / scientific work, results, major seminars and other forms of dissemination of information and networking to evaluation and follow-up
- Cooperation with other organizations (national, regional, European, international)
- Listing of owners, additional financiers, board members, project leaders, program managers and budgets through the years
- Author's comments where appropriate

"From Standardized 4-Year Classics To Customized R&B" – what kind of a title is that? How could it possibly describe anything but a change from classical music with its confined structure and regular patterns to the much freer and often improvized forms of present-day Rhythm & Blues? And since when does NKS deal with musical issues?

The title of this report refers to the structural and administrative evolution that took place during the author's 15 years of active NKS work. Up to and including 2001 NKS work was organized in standardized 4-year program periods, as it had been since the start of the first program in 1977. The first part of each program period was spent on pre-projects, the following years were devoted to the actual research work, and the last part of the period consisted of reporting, summing up and evaluation. This was, if you will, the classical model since it lasted for six 4-year periods. With time, the classical model was considered somewhat rigid. But the NKS work was followed closely by the Board, and on several occasions project plans were revised. The best example of this is perhaps the Chernobyl accident in 1986, which proved that plans could be significantly and swiftly revised when urgently needed.

After the sixth standardized classical 4-year program followed a more flexible structure of activities tailored to suit both financiers, participants and end users better, starting in 2002. All activities have to fit into the broad framework of reactor safety (R for *reaktorsäkerhet*) and emergency preparedness (B for *beredskap*) in a broad sense. They are called R&B activities in Scandinavian languages, and that acronym is also used here. An activity (formerly called project) no longer automatically continues for a given number of years. On the contrary, its merits are weighed and measured in competition with other activities, new or ongoing, for NKS funding. Hence, NKS work has changed to customized R&B and the organization and administration has been trimmed to form a more efficient structure in 2008, that marks the end of this report.

This report will only be available electronically. The typical reader is expected to be interested in an overview of NKS and its work for about a decade and a half of dynamic development and dedicated efforts. This could be a junior or senior participant, someone who would like to join the work, or anyone who wants to know what is going on – all are equally important and just as welcome. Most likely, the primary target group consists of subscribers to the NKS electronic newsletters (which includes the board and all program participants; and many more); and secondarily all webpage visitors including both various types of stakeholders, media and the general public.

Some administrative documents (i.e., not scientific or technical reports) from the period 1994 – 2008 are listed in Appendix 10. These administrative documents are not available on the NKS website, only in the NKS archives. Appendix 11 explains the acronyms used in this report.

NKS: Nordic Nuclear Safety Research

NKS was created in 1975 as an *ad hoc* committee under NKA (Nordic Liaison Committee for Atomic Energy) to assure the safety of the growing Nordic nuclear power program and secure funds to that end. NKA in turn was an organization under the Nordic Council, with joint Nordic funding. NKS was instructed to prepare a research program which would take up current safety issues. Practical NKS work did not start until 1977 with its first 4-year program (1977 – 1980), with Nordic funding. However, it soon became obvious that the involved politicians took an increasingly negative stand on NKA and NKS since their work involved nuclear power issues. After the Chernobyl accident in 1986 this grew to downright mistrust, especially on the part of the environmental ministers. NKA and NKS were regarded more as promoters of nuclear power than safety-driven work groups. So when NKA was dissolved in 1989, NKS had to find other ways and means of financing its research activities. After a period of negotiations a consortium of relevant central authorities and ministries in the five Nordic countries took over.

Since the start in 1977 NKS has served as a platform for Nordic cooperation and competence in nuclear safety and related radiation safety issues including emergency preparedness and radioecology. The work is now financed by Nordic authorities and a ministry, research institutions and power companies; and supported by a number of other organizations. The results must be of relevance to the involved parties, e.g., by being practical and directly applicable; or by increasing the knowledge base. Information on NKS activities is disseminated through seminars, reports, electronic newsletters and the NKS website. The results are used by financiers and other participating organizations in their decision making processes and information efforts, and are available free of charge to anyone interested in NKS activities.

The Nordic Perspective

NKS is an informal forum, serving as an umbrella for Nordic nuclear safety and related radiation safety initiatives and interests. Its purpose is to support joint Nordic research activities, producing seminars, exercises, scientific articles, technical reports and other types of reference material and tools. Special efforts are made to engage young Nordic scientists. To ensure that the Nordic perspective prevails, each major activity should include representatives from at least three Nordic countries.

The region in question is the five Nordic countries, i.e., Denmark (including the Faroe Islands and Greenland), Finland, Iceland, Norway and Sweden. With a total population of some 25 million people, and a common cultural and historic heritage, the Nordic countries have cooperated in the field of nuclear safety for well over half a century. Informal networks for exchange of information have developed over the years, strengthening the region's potential for fast, coordinated and adequate response to nuclear threats, incidents and accidents. NKS has served well as a platform for such activities.

Nordic Heritage Photo: Torkel Bennerstedt

The Nordic interest in cooperation and pooling of resources via NKS is due to a number of nuclear installations and activities in the region. There are four nuclear power reactors in operation in Finland, a fifth (Olkiluoto 3) is under construction and two more authorized (Olkiluoto 4 and Fennovoima's first unit). Sweden has 12 nuclear power reactors. Of these, 10 will continue operation and two (Barsebäck 1 and 2) have been permanently shut down and are being decommissioned. There are research reactors in Denmark, Finland, Norway and Sweden. The three Danish reactors have been closed and decommissioning work has started. The research reactors in Finland and Norway are still in operation. The two Swedish research reactors have been shut down and face decommissioning. Sweden has a nuclear fuel production plant in operation. There are no nuclear reactors in Iceland, but just like in its Nordic neighbors there are a number of hospitals, research institutions and industries that produce radioactive waste. All five Nordic countries have interim radwaste storages. Finland, Norway and Sweden have final repositories in operation for low and medium level waste. In Finland and Sweden work is in progress to allow construction of final repositories for spent fuel. Apart from nuclear installations in the Nordic countries, there are commercial, research and naval nuclear reactors and other nuclear installations and devices in surrounding eastern and western countries.

Torhamn, Blekinge in the southeast corner of Sweden.
Photo: Torkel Bennerstedt.

Organization and Support Structure of NKS

The owners and main financiers of NKS are four central authorities and one ministry in the Nordic countries, all with interests and competence in the nuclear field. Together with a number of experts appointed by the owners they constitute the NKS Board. Decisions on financing, program activities, NKS policy etc. are made by the owners and the Board. A secretariat handles administrative duties such as economy, electronic media, publishing of reports etc.

Apart from NKS, five more Nordic bodies are referred to in this report:

- The Nordic Directors Group (*chefsgruppen*): the heads of the Nordic radiation protection and nuclear safety authorities. The group follows – but does not supervise – NKS work.
- The NEP group (Nuclear Emergency Preparedness) with members from relevant central authorities. There has been some coordination of NKS and NEP activities.
- The Nordic Society for Radiation Protection (*Nordiska sällskapet för strålskydd*, NSFS). NKS has cooperated with NSFS in arranging a few seminars.
- The Nordic Liaison Committee for Atomic Energy (*Nordiska kontaktorganet för atomenergi-frågor*), NKA; dissolved in 1989
- The Nordic Council of Ministers. There are now no official contacts between NKS and the Council, but in the years 1977 – 1989 NKS was fully financed by the Nordic Council of Ministers, via NKA.

The technical and scientific work carried out by the many hundreds of participants in NKS projects and activities will be covered in later chapters.

The NKS Owners Group

Originally, the main financiers of NKS were referred to as the Consortium. Later this has been replaced by the Owners Group or simply the owners.

NKS Owners

- DEMA (Danish Emergency Management Agency), Denmark
- TEM (Finnish Ministry of Employment and the Economy), earlier KTM (Finnish Ministry for Trade and Industry), Finland
- IRSA (Icelandic Radiation Safety Authority), Iceland
- NRPA (Norwegian Radiation Protection Authority), Norway
- SSM (Swedish Radiation Safety Authority), earlier SKI&SSI (Swedish Nuclear Power Inspectorate and Swedish Radiation Protection Authority), Sweden

The owners appoint on a national basis the experts that together with the owners form the NKS Board. The owners review and evaluate the scientific work and its results as well as the overall NKS structure, organization and administration to improve the efficiency of the research program and make the best use possible of available resources.

Cooperation under the umbrella of NKS rests on a written agreement, which has the form of a letter of intent, listing scope, objectives, organization, financing, immaterial rights and validity dates. Since all owners depend on funding over the national budget, no guarantees can be made for more than one fiscal year at a time. It is agreed that the NKS program shall

- promote competence and preparedness in all Nordic countries in order to jointly be able to assess important questions regarding nuclear safety and radiation protection

- initiate and support research projects in nuclear safety and radiation protection of central, common interest to the Nordic countries, e.g., as regards reactor safety and accident preparedness
- communicate a broad overview in the above matters and disseminate achieved results in a comprehensible form to involved authorities, industries and other affected societal institutions
- strengthen the possibilities of the Nordic countries to participate in international debate and cooperation in this field
- contribute to a common view on nuclear safety and radiation protection in the Nordic countries and encourage contacts between Nordic experts in these matters

Funding of NKS

The owners constitute the main contributors to NKS funds. In addition, a number of organizations support NKS financially or in kind. These contributions have varied over the years, and it would be to go too far to list them all. In 2008 additional financial support was obtained from the following organizations:

- Fennovoima Oy in Finland
- Fortum Power and Heat Oy in Finland
- Teollisuuden Voima Oy (TVO) in Finland
- IFE Halden in Norway
- Forsmarks Kraftgrupp AB in Sweden
- Nuclear Training and Safety Center AB (KSU) in Sweden
- OKG Aktiebolag in Sweden
- Ringhals AB in Sweden

In 2008 the contributions of the owners together with support from the additional financiers above totaled some 8.6 million Danish crowns (1.2 million euros). See Appendix 4 for additional figures.

To this should be added in-kind contributions by participating organizations, e.g., work hours, travel expenses, and laboratory and other resources. These contributions are worth approximately as much as the actual NKS budget, and the program is highly dependent on them. Hence, all activity proposals are expected to offer at least a 50/50 in-kind contribution by the applicants.

Owners Group Members

The following persons have represented the owners at one time or another during the years 1994 – 2008.

	Members of the NKS Owners Group 1994 – 2008
Denmark	Bjørn Thorlaksen → Michael Boesgaard Brøndel
Finland	Sakari Immonen → Jussi Manninen → Timo Haapalehto → Olli Vilkamo → Timo Haapalehto → Jorma Aurela → Anne Väätäinen (→ Jorma Aurela since 2009)
Iceland	Sigurður Magnússon
Norway	Knut Gussgard → Ole Harbitz
Sweden	Lennart Hammar → Christer Viktorsson → Lars Gunsell (SKI; now SSM) Jan Olof Snihs → Ulf Bäverstam → Leif Moberg (SSI; now SSM)

Owners Group Meetings

The dates of the Owners Group meetings and a brief account of what happened at each of these meetings is given in Appendix 1.

Some noteworthy Owners Group discussions and decisions extracted from Appendix 1:

- **Nov. 1993:** This was the first Owners Group meeting chaired by Magnus von Bonsdorff, newly elected chairman of NKS.
- **In Sept. 1994** the owners decided that NKS will not continue its service to the Nordic Council of Ministers of commenting reports on nuclear safety. The Nordic secretary was instructed to inform the Council that in the future such requests should be directed to pertinent national authorities, not NKS.
- **Jan. 1996:** The Swedish funding is handled by SKI but is shared equally between SKI and SSI. It was therefore confirmed that Sweden has two representatives in the Owners Group.
- **Sept. 1997:** The owners are to participate in future Board meetings. This will facilitate dissemination of information between the two groups and be practical from a number of aspects. Future project leaders are to report directly to the Board.
- **Feb. 1998:** It was decided that the owners are also members of the Board. Each country may appoint up to three national experts (Sweden four) as members of the Board. The scientific reference groups linked to the different 4-year programs were abolished, effective from the start of the coming 4-year program. All NKS projects and groups were urged to be more cost effective.
- **March 2001:** The work of the next program will be divided into **two areas**: the **NKS-R** program (**reactor safety** including waste and development issues); and the **NKS-B** program (**emergency preparedness** including radioecology and emergency preparedness related information/communication). Helge Smidt Olsen was appointed new chairman of NKS. He will take over after Magnus von Bonsdorff starting Jan. 1, 2002.
- **March 2002:** It was decided that from now on all contributions to NKS should be specified in euros, not in DKK or the various national currencies. (*Author's comment:* It seems like this decision is not followed any longer.)
- **May 2002:** It was decided that future Owners Group meetings should once again be separated from the Board meetings.
- **Nov. 2002:** It was decided to invite the NKS chairman to participate in future owners' meetings.

The NKS Board

Board Members

The following persons have served as Board members at one time or another during the years 1994 – 2008.

	Members of the NKS Board 1994 – 2008
Owners	The owners as listed above are permanent members of the Board
Others:	
Denmark	Benny Majborn Kaare Ulbak Bjørn Thorlaksen
Finland	Raimo Mustonen → Olli Vilkamo → Marja-Leena Järvinen Lasse Mattila → Björn Wahlström → Ulla Ehrnstén Pekka Salminen → Heikki Raumolin → Nici Bergroth
Norway	Erling Stranden → (no successor since Ole Harbitz joined the Owners Group) Helge Smidt Olsen → Atle Valseth Erik Anders Westerlund → Magne Røed → Anne Liv Rudjord

Sweden	Jan Olof Snihs → (no successor as he joined the Owners Group) Ralf Espefält → Karl-Fredrik Ingemarsson → Synnöve Sundell-Bergman
Chairman	(Svante Nyman →) Magnus von Bonsdorff (1994 – 2001) → Helge Smidt Olsen (2002 – 2006) → Sigurður M Magnússon (2006 – present)
NKS secy.	(Bjarne Regnell →) Helge Smidt Olsen → Sigurður M Magnússon → Nordic secretary → program managers
Also participating:	
Nordic secy.	Franz Marcus → Torkel Bennerstedt → position cancelled

The Board's decisions are consensus-driven. It is appointed by the owners and decides in matters concerning priorities, budgets, programs and research plans and activities. The quality and cost-effectiveness of NKS work is closely studied by the Board.

Board Meetings

The dates and a brief account of what happened at each of the Board meetings is given in Appendix 2.

Some noteworthy Board discussions and decisions extracted from Appendix 2:

- **Feb. 1994:** New chairman of the Board: Magnus von Bonsdorff. New secretary of the Board: Helge Smidt Olsen. New Nordic secretary: Torkel Bennerstedt. A special working group called the Bureau was formed. All final reports from the 1990 – 1993 period are delayed. The pre-project work for the 1994 – 1997 program progresses as planned.

- **June 1994:** Project leaders, chairpersons and members of the reference groups were named for the 1994 – 1997 program.

- **Sept. 1994:** The 1990 – 1993 evaluation report suggests that a midway evaluation of the projects be performed after about two years. 1994 – 1997 project plans: the Board needs additional information on three projects whereas the remaining four were satisfactory.

- **Feb. 1995:** The plans for the last 1994 – 1997 projects were approved. Work has already begun in most projects and subprojects. It was decided to write a policy document for NKS work. Franz Marcus presented a plan for a book on the history of Nordic nuclear cooperation. The idea was accepted in principle, but the economic issue remained unsolved.

- **Sept. 1995:** There are still three final reports missing from the 1990 – 1993 period. All 1994 – 1997 projects follow the adapted time schedule. RAK-1 has produced a paper on possible future cooperation with EU. The Board decided to develop informal contacts with EU (DG-XI and DG-XII). EKO-1 communicates with its participants via a WWW Home Page. The Nordic Directors Group expressed their satisfaction with NKS work at its last meeting. NKS will not finance cooperation projects with countries in eastern Europe. (*Author's comment:* Cf. Aug. 1996 below.)

- **Jan. 1996:** A critical review of the present program revealed some delays, and some sub-projects were questioned. The plans were adjusted as needed. Although an information project was accepted, there was a general attitude that information issues should be closer integrated with the projects in next NKS four-year program.

- **Aug. 1996:** Most projects are progressing as planned. The chairman will contact DG-XII in order to pave the way for a visit by a small NKS delegation. The Board stated that NKS should seriously consider a wider cooperation with eastern Europe. (*Author's comment:* Cf. Sept.

1995 above.) The Bureau was asked to compile project proposals for the next 4-year period and suggest a procedure for the upcoming planning process.

- **Jan. 1997:** NKS work is progressing according to plans. The recriticality work done by RAK-2 will be continued as an EU project. It was pointed out that all NKS activities shall be performed in such a fashion that they cannot be misinterpreted as regulations or recommendations issued by national authorities. (*Author's comment:* Cf. Feb. 1998 below.) When asked to perform an evaluation of the present NKS program, professor Antti Vuorinen declared that he was "not disinterested". The policy document was adopted. It was reported that the Nordic Directors Group at their last meeting expressed a positive attitude toward NKS and its work. The NKS chairman, Nordic secretary and Franz Marcus will meet with EU representatives shortly to discuss modes of exchange of information and coordination.

- **Sept. 1997:** At joint seminar for all NKS projects is planned. The final reports will be distributed primarily as a CD/ROM. The evaluator, Antti Vuorinen, reported on his work. The owners were urged to nominate a program committee to work out the details of the new program in cooperation with the Bureau. There will be no reference groups in the next period. The Nordic history by Franz Marcus will undergo a language check before publication.

- **Feb. 1998:** Most final reports are finished and several of the final project seminars have been held. Antti Vuorinen recommended that NKS supports fewer but larger projects and focuses on training of young scientists and competence building. The Board stressed that the role of NKS is to give recommendations, not to issue rules or standards. (*Author's comment:* Cf. Jan. 1997 above.) A meeting with EU will be arranged in the spring. Sigurður Magnússon presented a draft structure of the 1998 – 2001 program: two major areas, SOS and BOK. A special reference group for the pre-projects will be appointed by the owners. Franz Marcus' Nordic history is ready to be printed. The graphic profile of NKS was approved. There is a growing interest in the NKS website; the number of hits is steadily increasing.

- **Sept. 1998:** Some final reports are still missing. Information was given on the joint NKS-EC seminar. NKS cannot expect EC funding, but a communication channel has been established. New project leaders will be instructed to keep abreast with EC projects and developments. EC does not find the existence of regional cooperation programs controversial. After some minor changes, project plans for the new NKS program were approved and project leaders appointed.

- **Feb. 1999:** The Board expressed concern regarding the slow start of some of the projects, caused by the long preparation phase. The ongoing work was approved. The Bureau shall prepare a document before the next Board meeting, outlining some ideas for the planning procedure and structure of the next 4-year program.

- **Sept.1999:** The Board noted that two final reports for 1994 – 1997 were still missing. A mid-way seminar with tentative evaluation of the 1998 – 2001 program will be arranged next year.

- **Feb. 2000:** One final report from the 1994 – 1997 program is still missing. All annual project reports for the 1998 – 2001 program were approved.

- **May 2000:** Changes in some of the subproject work were made. The Nordic secretary was granted a budget for promoting Nordic – Baltic cooperation. The presented directives for the evaluation of the current program are to be revised by the Bureau. A planning group for the next NKS program is being organized.

- **Nov. 2000:** As suggested by the project leader, the information project will be discontinued. A transition seminar for final reporting of the present program and plans for the next will be arranged. Evaluators of the present scientific program: Raimo Mustonen, STUK, and Gustaf Löwenhielm, SKI. Evaluator of NKS organization and administration: Martin Høiby, NRPA. A memo from the Bureau outlining a new scientific program structure for future NKS work and a slimmer and more flexible *modus operandi* will be discussed further. The Bureau suggested that two major areas of work be identified: Reactor safety including decommissioning and waste (NKS-R); and Emergency preparedness including radioecology (NKS-B) to form the new program frame, R&B. As Helge Smidt Olsen leaves the NKS Board, Sigurður M Magnússon was appointed new secretary of the Board.

- **May 2001:** The apparent overspending of SOS-1 funds has to be investigated and necessary action taken. The Nordic secretary reported on planned seminars and two international exercises (Baltic Nuclear and Barents Rescue) with NKS participation. The chairman summed up the evaluation reports. The Board was informed that the owners had appointed the two program managers: Timo Okkonen, STUK (NKS-R) and Sigurður Emil Pálsson, IRSA (NKS-B). A planning group shall propose the initial activities.

- **Nov. 2001:** The auditor reported on SOS-1 finances. There was enough blame to go all around, but the project leader and the Nordic secretary were especially singled out. The situation could however be corrected, and actions were taken to avoid similar situations in the future. The Bureau reported on the NRPA/IUR/NKS consensus seminar. The Board was reluctant toward future seminars on ethical/philosophical issues and environmental radiation protection, and consensus seminars in general. The R&B frameworks as presented at the previous status seminar were accepted after a few modifications. It was decided that organizations from Baltic Sea countries can participate in NKS activities at their own expense if it benefits NKS and its goals.

- **March 2002:** Helge Smidt Olsen took over as chairman of NKS after Magnus von Bonsdorff. The program managers' outlines of the structural framework and initial activities were well received. The Board stressed the importance of transparent assessments of proposed activities in accordance with NKS criteria and demanded that the program managers have full control of the financial situation.

- **May 2002:** It was reported that the Nordic Directors Group is satisfied with the new program structure and its initial activities, and stressed the importance of efficiency and cost effectiveness. To clarify the roles of the owners and the Board, respectively, a separation of Owners Group meetings and Board meetings is called for. (*Author's comment:* Cf. notes from the Owners Group meetings in Sept. 1997, Feb. 1998 and May 2002 above.) The program managers shall ensure that all activities are embraced by the potential end users and that the expected results are realistic. It was decided that on certain conditions MS and PhD courses and work can be supported by NKS. Two final reports are still missing from the 1998 – 2001 program. The scientific evaluation will be finished shortly.

- **Nov. 2002:** All future R&B contracts must specify a deadline for scientific work and final reporting. The Owners declared that measures should be taken to avoid an accumulation of unused funds. The chairman is invited to participate in future Owners Group meetings. In their status reports to the Board, program managers shall include information on participants, end users and an estimate of the quality of the expected results. The Board expressed its satisfaction with the beta version of the CD-ROM containing the final reports, technical reports and other NKS material. The scientific evaluation report of the 1998 – 2001 period is ready and will be discussed at the next Board meting.

- **May 2003:** The strategy discussion continued, including a debate on whether an activity on nuclear vessels is something for NKS, and if so, where it belongs. It was decided that it should be handled by NKS-B. Work to find new co-financiers is in progress. The scientific evaluation for 1998 – 2001 was discussed in depth. The mostly positive report concludes that the objectives were fulfilled and recommends that NKS work continues for a new period. The evaluators supported the new structure and administrative changes.

- **Nov. 2003:** The Nordic secretary informed on the preparations for a joint NKS-BKAB seminar on Quality in Radiation Protection Work at Nuclear Installations. At its last meeting the Nordic Directors Group concluded that for the foreseeable future the Directors Meetings and

NKS will continue to be two separate arenas with no formal links. The Swedish owners presented a memo on efficiency and organization in the next couple of years. The Board agreed on the goals but differed somewhat in ways to get there. It was decided to let the program managers report whether they are able to take on additional tasks under the present contracts with NKS and let activity leaders answer a questionnaire on the new structure. The function of the Nordic secretary was discussed.

- **May 2004:** The Board wished to stress that if there is a request for relocating unused funds to another activity, this is to be considered as a new application and will be treated as such. The Nordic secretary informed on the participants' enthusiastic evaluation of the second joint NKS-BKAB seminar. The Bureau reported that the activity leaders were satisfied with the new R&B structure and the administrative support; and that the program managers saw no possibility to take on more administrative duties under the present contract. The Secretariat was requested to draft a policy for dissemination of information.

- **Nov. 2004:** The Board expressed some concern regarding the fact that there are R activities with as little as one or two participating organizations. Measures should be taken to avoid this to the extent possible. It was also pointed out that the process of assessing new B proposals should be made more transparent. The Consortial partners should from now on be referred to as the Owners. It is the Board that decides in budgetary matters. The Nordic secretary presented the new routines for dissemination of information. The NKS webpage is updated continuously. Electronic newsletters will be distributed at least twice a year.

- **May 2005:** The owners are very satisfied with the new structure. The Board expressed its satisfaction with R&B work. A replacement for the present program manager for NKS-R will have to be found soon since the present manager has been promoted within her own organization. The contract with the NKS-B manager will be prolonged. Administrative routines and costs will continue to be scrutinized. The need for an evaluation of NKS work since the start of the R&B program will be discussed in November. The Bureau was asked to produce a memo until then. A work group was established for the status seminar in Finland May 2006.

- **Nov. 2005:** Measures will be taken to reduce costs and simplify the administration. The Nordic secretary will be replaced by a time-limited coordinating function. The Bureau will be dissolved and the post as secretary of the Board discontinued. Finland and Sweden will check whether some large R activities could be carried out bilaterally. A review of the R program should consider the interests of the co-financiers. Sigurður Magnússon takes over as chairman of NKS after the next Board meeting. The Board declared its satisfaction with the progress of the R&B program. The Bureau presented its proposed directives for the evaluation of work and results in 2002 – 2005. The R&B evaluators were appointed.

- **May 2006:** Two work groups were appointed to review the R&B frameworks. The Call for Proposals (CfP) procedure and the assessment of proposed activities will be reviewed. The Board was pleased with the NKS status seminar. The coordinator was asked to arrange a meeting to speed up the process of finishing the evaluation report. Sigurður Magnússon now took over as chairman and thanked Helge Smidt Olsen for his many years of dedicated work for NKS.

- **Nov. 2006:** The new chairman, Sigurður Magnússon, noted that the structural and administrative changes seem to work well. The Board thanked the four evaluators for their fine work. NKS results are of high standard, especially considering available resources. The review of the R&B frameworks will continue. The revision of the Call for Proposals procedure concluded that end users shall be identified in all applications. There was again a change of NKS-R program managers. The website will undergo a complete overhaul.

- **May 2007:** The coordinator and the NKS-B program manager will be replaced in 2008. Work on the new R&B frameworks will continue in the summer. An information policy shall be outlined by the chairman, the coordinator and the Secretariat. Together with the program handbook and the framework it will form an NKS policy document. R&B work is proceeding according to plans.

- **Nov. 2007:** After many years of outstanding leadership and constructive NKS work Sigurður Emil Pálsson will leave his position. The chairman expressed his and the Board's gratitude for his excellent and ambitious work through many years as project leader and program manager. The program managers presented the R&B status reports and their proposals for funding. Due to the large number of good R proposals extra funding was allocated. Since the number of B applications did not reach the expected level, a new CfP will be announced. The Board stressed that non Nordic participants to NKS seminars have to be cleared with the program manager. The owners have decided that the role and tasks of the coordinator will be gradually diminished and taken over by others.

- **May 2008:** The Board recommended that all applications for NKS funding under the CfP procedure be written in English. The extraordinary CfP for the NKS-B program resulted in a number of new activities. The Board decided that NKS does not support seminars outside the Nordic countries, with rare exceptions for the Baltic states when motivated. This was the Nordic secretary's / coordinator's last appearance at an NKS Board meeting.

- **Nov. 2008:** A new CfP for NKS-B activities will be announced in the spring of 2009 since considerable funding was still available. The chairman suggested that Board members should assess all R&B applications from future CfP procedures to ensure balanced priorities and secure national interests. A joint R&B seminar will be arranged in Stockholm in March 2009. The Board was positive to publishing NKS accounting and audit reports on the website. From now on material to be discussed at Board meetings will be available for download on the website. A special thanks was directed to Torkel Bennerstedt who left his position as Nordic secretary / coordinator at the last Board meeting. On behalf of the Owners the chairman will ask him to write the history of NKS for the years 1997 – 2007. (*Author's comment*: This was later corrected to 1994 – 2008.)

The Nordic Secretary

The Nordic secretary (also referred to as executive secretary) was appointed by the owners. The post as Nordic secretary was discontinued in 2008. A formal job description written by the owners never existed. Below follows a list of the most important tasks of the Nordic secretary. For more details, see Appendix 9. The tasks varied somewhat over the years as the programs and support structure of NKS changed.

- Participated on a regular basis in the most important NKS meetings: the owners group; Board; reference groups; Bureau; coordination group; Secretariat.
- Reported to the owners and the Board.
- Served as the official head of the Secretariat.
- Prepared Board meetings (agendas, documents, budgets etc.).
- Compiled directives for pre-project work and evaluators, drafted policy papers and similar documents.
- Planned, prepared and supervised larger conferences.
- Coordinated the every-day work of NKS and kept an eye on the finances.
- Was at the disposal of the owners, the Board and to a certain extent the project leaders for *ad hoc* tasks.

The tasks of the Nordic secretary were specified in the administrative handbook and a contract between NKS and the person in question. For a number of years 75% of a full time was required to fulfill the tasks. With a tougher economic situation, cost reductions became necessary, especially as regards organizational structure and administrative matters. Thus, in later contracts the percentage was reduced to, first, 60%, and later to 40%, then to 25%. Effective from June 2006, the formal title was changed from Nordic secretary to NKS coordinator at a meeting on Nov. 17, 2005, and the tasks were adjusted accordingly. The position as Nordic secretary was discontinued by the owners as announced at the May 11, 2007 Board meeting. Starting in June 2008 the tasks of the Noric secretary were taken over by the NKS Chair, the Secretariat and the program managers.

The NKS Bureau

In Feb. 1994 the Board created the NKS Bureau. It served as the Board's working group in 1994 – 2006. It had three members: the NKS chairman, the secretary of the Board and the Nordic secretary. Its main task was to prepare and follow up Board meetings, supervise the work of the project leaders / program managers and the Secretariat and perform whatever routine or *ad hoc* tasks the Board decided. The Bureau had no budget, unless explicitly allocated by the Board for specific purposes. Contrary to a widespread misconception, the Bureau had no general mandate to make decisions other than as concerned its own work. From time to time the Bureau initiated, e.g., structural or administrative changes and policy related developments by presenting written proposals to the Board.

	Members of the Bureau
1994 – 2000	Magnus von Bonsdorff, Helge Smidt Olsen, Torkel Bennerstedt
2000 – 2002	Magnus von Bonsdorff, Sigurður M Magnússon, Torkel Bennerstedt
2002 – 2006	Helge Smidt Olsen, Sigurður M Magnússon, Torkel Bennerstedt

When the bureau and the post as secretary of the Board (N.B.: *not* the Nordic secretary) were abolished by the Board in 2006, the chairman and Nordic secretary divided the tasks between them. An informal coordination group of the chairman, the program managers, the Secretariat and the Nordic secretary was formed and met twice a year to follow up on the activities, structure and practical matters, and to prepare for the next Board meeting.

The NKS Secretariat

In 1994, at the onset of the term covered by this report, the Secretariat consisted of Henny Frederiksen (part-time secretary to Franz Marcus) and H C Sørensen who from his abode in the south of France took care of economic matters, bookkeeping etc. Since these two fine collaborators were about to retire, the Secretariat was taken over on Jan. 1, 1996 by FRIT, which was then a division of Risø and nowadays a private company located within the premises of Risø. The persons engaged were Annette Lemmens (secretary, bookkeeping) and Finn Physant (economy). The Secretariat was intact throughout the 15 years covered by this report. Of all its achievements, one of the most important was the creation of the NKS website (the first one appeared in 1996), the electronic reports, CDs and DVDs, and electronic newsletters. Formally, the Secretariat was headed by the Nordic secretary.

Audits previously performed by the Economy Department at Risø were taken over by Ernst & Young, starting with the bookkeeping for the fiscal year 1998. This has meant a closer scrutiny of the bookkeeping. Initially, a number of improvements were suggested and implemented. Since then, only minor modifications in bookkeeping and presentation have been necessary. The audits have never given rise to negative remarks of any kind.

The NKS Secretariat

- Torkel Bennerstedt, TeknoTelje HB
- Finn Physant, FRIT
- Annette Lemmens, FRIT

The most important tasks of the Secretariat (in addition to the tasks of the Nordic secretary as described above):

- Support function for the rest of NKS.
- Participation as needed in Board meetings and other meetings.
- Economic services, bookkeeping, invoicing, VAT matters, reporting.
- Regular contacts with the project leaders / program managers, especially as regards financial matters and publications.
- Editing and publishing of NKS reports, operating the website, publishing of electronic newsletters, CDs and DVDs.
- Development of administrative routines and the administrative handbook.
- Central archive function (library, reports, contracts, economic material etc.).
- *Ad hoc* services as requested by the Board or others.

Throughout the years the Secretariat has looked for possibilities to increase the net income from bank transactions and interests. It has for a number of years meant a contribution to NKS funds of some DKK 100 000 per year.

The Board has, both collectively and individually, on numerous occasions expressed its satisfaction with the fine and dedicated work of the Secretariat.

The NKS Secretariat Photo: Claus Rubin

Evaluations

-Each 4-year NKS program has been evaluated by independent evaluators at the end of the program. On one occasion NKS organization including the Secretariat and the total administrative support function were evaluated, along with the scientific work.

During the years covered by this report, the following evaluations were performed:

Fifth 4-year program 1994 – 1997	Antti Vuorinen
Sixth 4-year program 1998 – 2001	Gustaf Löwenhielm, Raimo Mustonen, Martin Høiby
R&B program 2002 – 2006	Risto Sairanen, Per Persson, Per Hedemann Jensen, Tore Lindmo

Summaries of all evaluations of the NKS programs from 1994 and onward are given under the respective NKS program below. An overview of the programs and evaluations since the first 4-year program 1977 – 1980 is found in Appendix 3.

Development of the NKS Policy

In 1994 NKS work was conducted according to the guidelines of a project handbook, and an administrative handbook laid down rules for practical day-to-day work of project participants and the Secretariat. Owners Group and Board meetings could add new policy statements and decisions as reflected in the minutes of these meetings. But there was no comprehensive policy document to govern the NKS work. To increase transparency, the Nordic secretary initiated in 1995 a document called This is NKS to complement the project handbook. Later, the two documents were joined in the first and still, in the summer of 2011, valid policy document that appears as Appendix 6.

The NKS policy has been remarkably consistent over the years, since long before 1994, and evolved slowly over the years. The consensus among the owners and other Board members has obviously been strong that NKS work should be characterized by

- joint Nordic funding based on a letter of intent that is revised and renewed when needed
- participation of at least three Nordic countries and several organizations in all major activities
- quality assurance through seminars, publications, Board discussions, evaluations etc.
- comprehensive and easy to understand project criteria
- increasing the Nordic knowledge base, developing and maintaining skills through cooperation
- networking
- dissemination of results and other forms of technical information

Although the policy has evolved over the years, some characteristic traits have remained basically the same: the Nordic perspective, networking, project criteria, quality assurance, dissemination of information and international cooperation. The areas of research may have varied, depending on the curreent situation – fallout from the atomic bomb tests in the 1950's and 60's, the safety concerns after the Three Mile Island accident and the aftermath after the Chernoby accident may serve as examples – but the underlying issues do not change very much.

The need for fast and correct information – to international organizations, Nordic, regional and other national authorities, media and the general public – has increased with time, especially in the last decade of swiftly expanding possibilities for communication and data retrieval. Very few reports are printed any longer; they are posted on the website or published in CD or DVD format. All reports are available free of charge.

New: young scientists encouraged to participate. Nowadays travel grants are available in some cases. PhD and MS work is encouraged. These trends are believed and hoped to augment. International cooperation is believed to become increasingly important.

Obviously there has been some confusion as regards the status of NKS reports and actions. In order to set things straight the Board in Jan. 1997 took the unusual decision to declare that all NKS activities shall be performed in such a fashion that they cannot be misinterpreted as regulations or recommendations issued by national authorities.

An entirely new financial situation has emerged the last couple of years. Funding from national authorities has varied widely over time. The results of NKS do not appear to have suffered – at least not yet. But both the scientific work and the secretarial support need a critical mass to function well. A word of caution might be in order.

Criteria for NKS Projects and Activities

The entire NKS program as well as the various activities shall fulfill the following criteria:

- Relevance to financiers and end users
- Demonstrated compatibility with the current framework program

- A clear Nordic added value, including increased competence, networking and dissemination of information
- Participation of at least three Nordic countries in all major activities
- High international standard of the technical/scientific work
- Comprehensive and transparent activities, open to the widest possible range of participants, including young scientists
- Distinct and measurable goals, including deliverables, economy and time plans

NKS aims at an approximately even overall distribution of funding between the present R&B programs as well as between participating Nordic countries and organizations within the various activities. Gender neutrality and participation of young scientists is encouraged. When possible and relevant, MS and PhD support may be included in ongoing or proposed activities as well as NKS activities coordinated with international projects. Measures are taken to ensure cost-efficiency, save resources and protect the environment.

Simply put, NKS should engage in select and timely activities, for the right reasons, while striving for optimal quality, at a reasonable cost with maximum positive impact, benefitting as many of the stake-holders as possible.

I skate to where the puck is going to be, not where it has been.
(Wayne Gretzky, NHL Hockey Pro)

Testing the Limits Photo: Lena Bennerstedt

Quality Assurance

The quality of the work performed and the activities at large is constantly being surveyed and assured through

- assessment of applications received during the Call for Proposals process
- participation of end users throughout the entire process: planning, execution, deliverables, implementation, and evaluation
- reporting and discussions at Board meetings
- publication of results in reports and refereed journals
- dissemination and discussions of NKS results in Nordic and international fora (conferences, seminars, topical meetings, workshops etc.)
- regular evaluations of the entire technical/scientific program and the administrative support structure

Quality is not in the eye of the beholder.
Quality is getting everything right from the very beginning.
(Personal definition by Torkel Bennerstedt, former Nordic secretary)

International Cooperation

There is no formalized NKS cooperation with other international organizations. Participation in international projects is to follow decisions and conditions given by the Board. NKS should strive to create and maintain relevant international contacts and keep the international audience informed on NKS progress. Whenever feasible and desirable, NKS activities should be coordinated with similar Nordic and international activities in order to increase efficiency and improve exchange of results and experience. When needed, NKS can be used as a platform for international coordination and promotion of Nordic views. Non-Nordic participation in NKS activities must be approved by the relevant program manager beforehand and will not be financially supported by NKS.

One particularly important area of international cooperation has been with Estonia, Latvia and Lithuania. Some of the projects and the positive results are presented under the various research programs below. As decided by the Board (cf. Board notes from Sept. 20, 1995 and Aug. 27, 1996), this cooperation took place without extra cost to NKS; yet, the benefits for all participants have been widely recognized.

Dissemination of Information

The major channels for distributing NKS information are:

- the NKS website
- electronic newsletters and newsflashes
- electronic and (occasionally) printed reports and pamphlets
- conferences, seminars, workshops and international cooperation projects
- scientific articles in refereed journals
- internal NKS correspondence and communication

Some statistics from May 2008:

- Some 11,000 website visits per month
- Normally 4 – 6 newsletters per year (NewsLetters + NewsFlashes)
- Some 330 subscribers to the electronic newsletters

The Last 4-Year Programs

General

In spite of the fact that this report only covers the years 1984 – 2008, all 4-year programs since the start in 1977 are listed in Appendix 3 for handy reference. Although the structure of NKS and its policy have varied over the years, these features and the responsible bodies are fairly representative of all 4-year programs:

- Funding, policy questions, contractual issues: the Owners Group
- Decisions on budgets, projects etc.: the Board
- Supervision of projects: the reference groups
- Scientific work: Pre-projects, projects and subprojects
- Deliverables: semi-annual, annual, technical and final reports; seminars, workshops etc.
- Follow-up: implementation, evaluation, conclusions
- Administrative support: the Nordic secretary and the Secretariat

The 4-year program period can be divided into a number of phases:

- Preliminary discussions on the new program (owners, board, Nordic secretary)
- Appointment of one or more working groups (board)
- Decision on pre-projects: directives, staffing, mandate, budget, deadline etc. (board)
- About one year later: pre-project reports, discussions (stakeholders, incl.board)
- Decision on the new program: project plans, project leaders, budget, time schedule, deliverables etc. (board)
- Some three years of project work including technical reports, semiannual reports, annual reports and final reports (project leaders supported by their respective reference group)
- Approval of final reports and the results of the projects (board)
- Evaluation of the 4-year program (evaluators, appointed by the board)
- NKS seminar to present the results of the old program and discuss plans for a new program

Implementation of results and feed-back from end users and others constitute a final stage once an NKS program, project or activity has been concluded.

In practice, it is hard to draw an exact line at what point in time a nominal 4-year program was finished. Some projects or evaluation reports were delayed. Some end users may report back quickly on the relevance and practicability of the results. Others may be late in doing so, or perhaps not respond at all. But an overall estimate is that a planned 4-year program period actually lasted anywhere from 4.5 to 5.5 years in extreme cases.

Staying Focused Photo: Torkel Bennerstedt

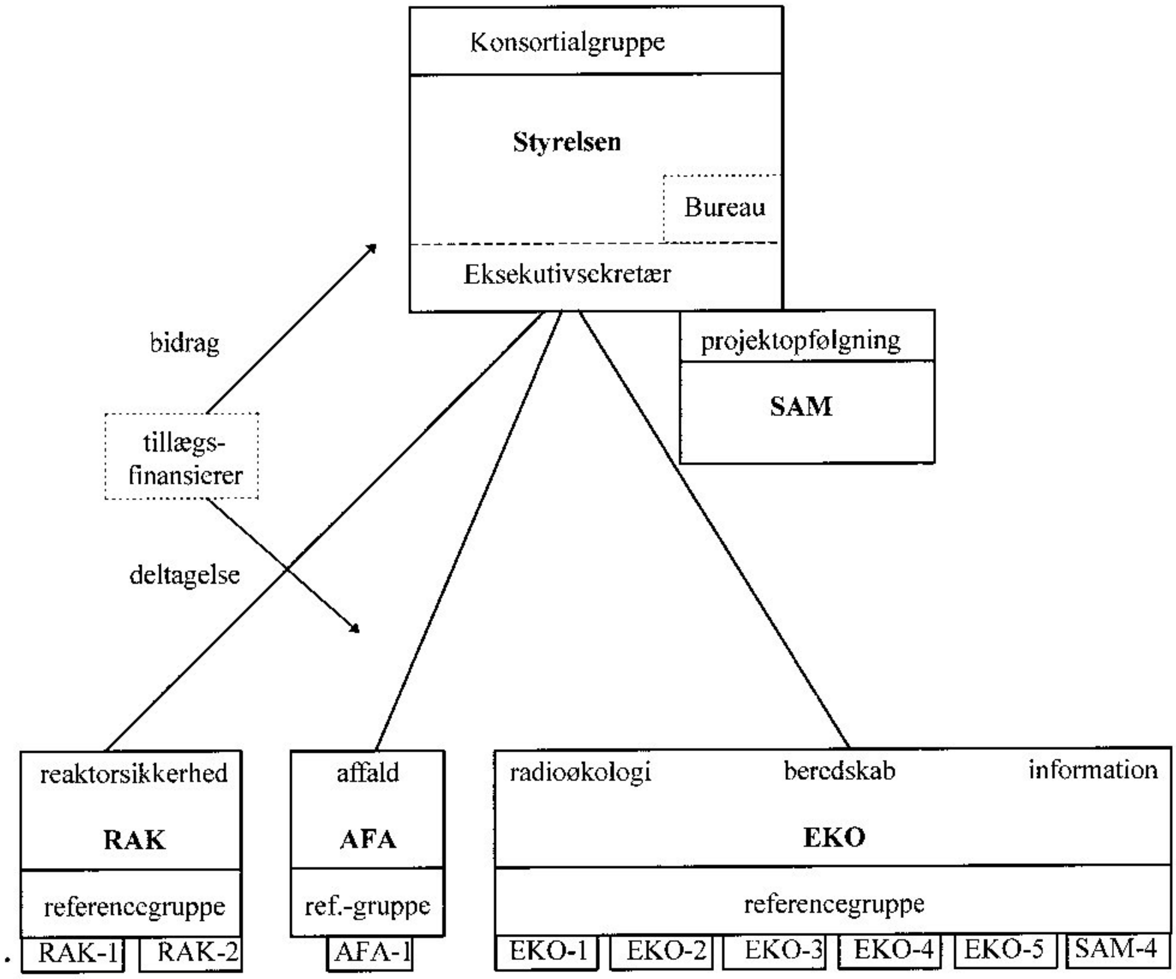
The Fifth 4-Year Program (1994 – 1997)

General Recommendations After the 1990 – 1993 Program

The evaluators recommended annual project seminars to disseminate information and discuss results, and suggested that a midway evaluation of the projects should be performed after about two years. Furthermore, they recommended that a certain portion of the budget for every project be withheld until the final report has been delivered. For more information: see the full evaluation report on the webpage.

NKS Organization

The organizational chart for the fifth program was quite impressive but perhaps not that informative. Many people said that they enjoyed working with NKS activities but never really understood the structure and organization behind it. In retrospect it is easy to see why – just take a look below!



The top rectangle is the wallet, brains and executive branch of the steering group of NKS: the owners (*konsortialgruppe*), the board (*styrelsen*), its working group (*bureau*) and the Nordic secretary (*eksekutivsekretær*). The secretariat (*projektopfølgning*) was called SAM (Scandinavian abbreviation for coordination). There were three program areas: RAK, AFA, EKO and their respective projects (explained below) and reference groups (*referencegruppe*, abbreviated *ref.-gruppe*). A number of additional financiers (*tillægsfinansierer*) contributed financially (*bidrag*) and participated in the practical work (*deltagelse*).

Preparing for the New Program

Some conclusions and recommendations of the evaluation of the preceding fourth 4-year program 1990 – 1993 were summed up in a report edited by Franz Marcus, NKS(94)7:

- The evaluators recommend to ascertain, at the outset, the preparedness of project participants and their organizations to dedicate time according to the plans. Project plans need to be revised at mid-term to enable corrections and updating.
- During the project period, NKS should make use of specific criteria in order to judge progress and success. Each project leader must make sure that the various subprojects are tied together into a unified project. The project leader should resort to economic pressure in order to adhere to time tables.
- The majority of recommendations deal with reporting and presentation of results. Thus, it is the project leaders' task to convey information on the professional level, and to organize seminars with an extended attendance. The NKS annual reports should be conceived so that they can also be used for external information.
- It is recommended that NKS establishes a policy aiming at enhanced information about its projects. Final reports should contain conclusions and recommendation which can subsequently be followed up. Thus, the directors of the competent authorities in the Nordic countries should be requested to give their views on the recommendations, and industry likewise on the usefulness of the results. The evaluation group even proposes that NKS consider presentation of the outcome to responsible ministers and their staff. For this purpose summaries in all Nordic languages would be needed.

The fifth Nordic safety research program started with a general planning period in 1993, with participation of Bjarne Regnell (NKS chairman), Sören Norrby (SKI), Eiliv Stennes (University of Trondheim) and Klaus Singer (Risø), led by Franz Marcus. It resulted in a report, NKS(93)8Rev., with plans for 1994 – 1997. After this followed seven pre-projects in 1994, with the following leaders:

Pre-project leaders:
- Kjell Andersson, Karinta-Konsult (RAK-1)
- Ilona Lindholm, VTT Energy (RAK-2)
- Karin Brodén, Studsvik RadWaste (AFA-1)
- Sigurður Emil Pálsson, IRSA (EKO-1)
- Hanne Solheim Hansen (EKO-2)
- Jens Hovgaard, DEMA (EKO-3)
- Eldri Naadland, NRPA (EKO-4)

Some of the evaluators' recommendations above were taken into account during the pre-project period. Others were subsequently dealt with by the NKS Board. The pre-project work followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. The report NKS(94)8 presented the results of the pre-project and discussed the continued work

Program Overview

Acronym	**5th 4-Year Program: Projects 1994 – 1997**	**Reference group chairman / Project leader**
RAK	Reactor Safety	Bjørn Thorlaksen, DEMA
RAK-1	Strategy for Reactor Safety	Kjell Andersson, Karinta-Konsult
RAK-2	Prevention of Severe Accidents	Ilona Lindholm, VTT Energy
AFA	Waste Management	Erling Stranden, NRPA
AFA-1	Safety in Waste Disposal	Karin Brodén, Studsvik RadWaste
EKO	Environmental Effects	Sigurður M Magnússon, IRSA
EKO-1	Marine Radioecology	Sigurður Emil Pálsson, IRSA
EKO-2	Long Ecological Half-Lives in Semi-Natural Systems	Tone D Selnæs (later Bergan), IFE

EKO-3	Preparedness Strategy and Procedures	Jens Hovgaard, DEMA → Anneli Salo
EKO-4	Emergency Preparedness Exercises and Information	Eldri Naadland (later Naadland Holo), NRPA
EKO-5	Pre-Planning of Early Clean-Up	Thomas Ulvsand, FOA NBC Protection
SAM	NKS Coordination	
SAM-1	Secretarial Services, Administration	Torkel Bennerstedt & FRIT
SAM-2	Coordination of NKS-Baltic activities	Torkel Bennerstedt
SAM-3	Coordination of NKS-EU contacts	Torkel Bennerstedt
SAM-4	Overriding Information Issues	Vibeke Hein, DEMA

N.B.:

1. The EKO-2 pre-project leader was unable to continue as project leader due to promotion within her own organization. Other than that, all pre-project leaders continued as project leaders.
2. The EKO-5 project was added to the EKO program in 1996 with 100% external funding.
3. Toward the end of the 4-year period Anneli Salo, private consultant and former STUK employee, took over as project leader for EKO-3 since Jens Hovgaard was recruited by a Canadian company manufacturing and marketing systems for mobile measurements of radioactivity.
4. No pre-project was carried out for the information project (SAM-4).

Project Summaries

Based on the project leaders' Summary Reports; see report no. NKS(98)2.
Project budgets: See Appendix 5.

RAK-1: Strategy for Reactor Safety **Kjell Andersson, Karinta-Konsult**

The general objective of the RAK-1 project was to explore strategies for reactor safety as applied in Finland and Sweden. On a more concrete level the project aims were to:

- Investigate and evaluate the safety work
- Increase realism and reliability of the safety analysis
- Suggest how safety can be improved in selected areas

The project consisted of five subprojects:

RAK-1.1	Mapping and evaluation of the safety work
RAK-1.2	Initiating events
RAK-1.3	Integrated sequence analysis – especially human errors
RAK-1.4	Maintenance strategies and aging
RAK-1.5	Modernization

RAK-1.1 made a survey of safety work in Finnish and Swedish nuclear installations, and addressed the issue how we can assess the suitability and effectiveness of the safety work. The subproject report is based on extensive interviews with plant and authority staff. It turns out that the operation of nuclear power plants demands considerably more resources than earlier expected. A combination of more resources and higher efficiency seems to be the way forward. E.g., there is a need to increase the efficiency of inspections and safety reviews performed by the authorities.

RAK-1.2 tackled the problem of how to improve WASH-1400 values for LOCA frequencies for pipe ruptures, and explored LOCA risk dominating mechanisms.

RAK-1.3 addressed how complex event sequences can be analyzed with new approaches integrating different disciplines. The concept of Integrated Sequence Analysis (ISA) was introduced.

RAK-1.4 discussed how to optimize maintenance and testing with improved maintenance strategies, and developed tools for this purpose. E.g., a maintenance data information system (RelDAT) was developed and installed at the Barsebäck plant. Tools were tested for decision analysis with respect to maintenance programs, and the importance of human error in maintenance was studied.

RAK-1.5 was devoted to plant modernization and explored how we can meet up with modern safety standards. The final report advises both the utilities and the authorities to actively follow the evolving safety standards for new reactors, e.g., the development of the European Directives. This is irrespective of whether new reactors are planned or not, since the new standards may have implications for assessing the safety of the existing reactors as well.

Some RAK-1 contributions to reactor safety:
- Initiating event protection
- Integrated sequence analysis
- Improved PSA for some sequences
- Better estimations of LOCA frequencies
- Improvement and development of plant maintenance

The work and results of the RAK-1 project led to initialization of a Concerted Action within the Nuclear Fission Safety Program of the European Union.

RAK-2: Prevention of Severe Reactor Accidents **Ilona Lindholm, VTT Energy**

RAK-2 comprised three research areas:

RAK-2.1	Studies of the consequences of selected severe accident scenarios and phenomena in Nordic reactors.
RAK-2.2	Development and testing of a computerized accident management support system (CAMS).
RAK-2.3	Data collection on different mobile reactors and the British reactor types for extension of the Nordic database started in the previous NKS 4-year program covering the reactors in Nordic surroundings.

RAK-2.1, severe accident phenomenology, focused on studying in-vessel melt progression and core coolability at various stages of a severe accident. It was divided into five subtasks.

1. The first subtask was the investigation of core coolability in the original core boundary. The performed analyses suggest that fuel damage can be prevented under certain temperature conditions. Core spray is more efficient in cooling of an overheated core than downcomer injection. A small time window exists where reflooding of the Boiling Water Reactor (BWR) is likely to reach criticality. The scoping studies for containment response to recriticality suggest that a stabilized power level of 20% of the nominal power would be too high for prevention of containment failure with the current safety systems. The RAK-2 work in this area laid foundation for continued work in the EU SARA project 1997 – 1998.
2. If core degradation proceeds to the late-phase, where core melt migrates into the lower head, the performed studies suggest that the Reactor Pressure Vessel (RPV) failure in an ABB ATOM type of BWR most likely occurs due to instrument tube nozzle failure. Large differences exist in the predictions of the codes used for timing of local creep rupture. The coolability of debris in the lower head by late reflooding was also predicted differently by the two integral codes used.
3. A 2-D numerical model was developed to address the heat transfer phenomena in a homogeneous, hemispherical melt pool. When applied to a typical Nordic BWR and boundary conditions, the model predicted a lower head wall ablation failure in 2 – 5 hours.
4. Numerical analyses of the effects of High Pressure Melt Ejection (HPME) on the containment suggest that the pedestal and the drywell will experience a pressure for the first minutes. Even more damaging to the containment penetrations may be the gas temperatures in the containment.
5. Source term analyses for Swedish PWRs were initiated toward the end of the 4-year period and will be continued with national resources.

RAK-2.2 included the development and testing of a Computerized Accident Management System (CAMS). It provides support in normal as well as accident states. Support is offered in identification of the plant state, in assessment of the future development of an accident, and in planning of accident mitigation strategies. It does not give support in execution of the chosen mitigation strategy.
The first phase of the subproject focused on

- information needs during normal and accident conditions in a nuclear power plant
- methods that can be successfully applied to CAMS
- man-machine interaction and human factors requirements

The second phase of the subproject was to test the system in a simulated environment.
During CAMS design considerable effort has been made to maintain the generality of the CAMS concept. Although the referenced process was a BWR plant, the use of this structure and design can be applied to other processes, also non-nuclear.

RAK-2.3 dealt with the investigation, collection, arrangement and evaluation of data on reactors in the Nordic neighborhood to be used by the Nordic nuclear preparedness and safety authorities. It was an extension of previous NKS work (SIK-3 in 1990 – 1993). Now, British reactors of all types were included, together with mobile reactors (satellite, submarine and nuclear ship reactors). Accidents on nuclear ships were also addressed. A database of NPPs (including the ones covered by SIK-3) within about 150 km from Nordic borders plus British reactors was prepared, for authority use in emergency situations.

AFA-1: Safety in Waste Disposal

Karin Brodén, Studsvik RadWaste

The objective of AFA-1 was to give authorities and waste producers in the Nordic countries background material for decisions on management and disposal of radioactive waste. The primary focus was on long-lived low and intermediate level waste from research institutions, hospitals and industries. Most of the work was performed by a broad group of experts from all five Nordic countries. This has contributed to a better understanding of national situations and – in some cases – to common recommendations.

The AFA-1 project was subdivided into three subprojects:

AFA-1.1	Waste Characterization
AFA-1.2	Performance Assessment for Repositories
AFA-1.3	Environmental Impact Assessment (EIA)

AFA-1.1 included an overview of waste categories in the Nordic countries and methods to determine or estimate the waste content. New available methods were presented based on answers to questionnaires distributed to suppliers. The study also included recommendations regarding the characterization of waste under treatment and the characterization of existing and old waste packages. It is advisable to obtain information concerning waste under treatment. New regulations for the inventory of a repository may demand new assessments of old radioactive waste packages. Additional measurements may be necessary.

AFA-1.2 dealt with the performance assessment of the engineered barrier system (near-field) of the repositories for low and intermediate level radioactive waste. The geological host medium was intentionally excluded in the study, since different media can be considered in the Nordic countries. The results from the study include a short overview of different waste management systems existing and planned in the Nordic countries. However, the main emphasis of the study was on a general discussion of methodologies developed and employed for performance assessments of waste repositories. Some of the phenomena and interactions relevant for generic types of repositories were discussed as well.

AFA-1.3 results included included information on similarities and differences between Environmental Impact Assessments (EIA) in the Nordic countries and a review of experiences from national EIA processes, both in the nuclear field and in other fields. The national EIA system is dependent on the legislative structure, the application of legislation, administrative practice and general social objectives. It is therefore natural that the EIA systems differ from country to country, even if EU directives and internationally accepted principles are adopted. Differences can also be found in responsibilities concerning Environmental Impact Statements (EIS). The proponent of the project bears the responsibility for the EIS in Finland, Iceland, Norway and Sweden. In Denmark the responsibility rests with the authority.

EKO-1: Marine Radioecology

Sigurður Emil Pálsson, IRSA

In the original EKO-1 project plan it was stated that:

The main aim of this project is to enable better and faster assessments to be made of the effects of releases of radionuclides to the marine environment, taking health and economic factors into account.

Assessments are generally based on models describing the main processes influencing the behavior of the radionuclides. In the marine ecosystem these main processes are:
1. Water movement and mixing
2. Sediment-water interaction
3. Biological transfer (e.g., the uptake of radionuclides by fish)

Of these processes the interaction with sediments with water has been studied relatively less than the others. It was therefore decided to focus on sediments and water and their interaction. Various site specific factors can affect this interaction, e.g., sedimentation rates. The ability of the sediment to bind radionuclides from sea water is also an important factor.

EKO-1 project work was planned as follows:
1. *Model work* – Identifying, estimating and validating parameters of main interest
2. *Research*
    - 2a) *Field studies:*
        - 2a1) Environments typical for various Nordic regions
        - 2a2) Environments with special physical or chemical characteristics
    - 2b) *Laboratory studies*
3. *Dissemination of information* – Seminars, reports, articles

In the project work emphasis was also put on other aspects viewed to be important for the aim of the project:
- Quality assurance
- Use of internet technology for more efficient dissemination of information
- Maintaining a link with related work done within EKO-2.3 on freshwater ecosystems
- Following what was being done internationally in a similar field and avoiding duplicate work
- Supporting developments of plans for a Nordic course on radioecology

Maybe the most important outcome of EKO-1 is the increased Nordic competence and cooperation in marine radioecology, especially concerning the interaction of radionuclides with sediments. The quality of the the research done is manifested in the scientific articles that have been published, and in the number of PhD and MSc theses based on EKO-1 work.

Models are important tools for assessing the (real or possible) consequences of releases of radionuclides to the environment. EKO-1 supported model studies for the Baltic Sea area and the long term effects of reactors dumped in the Kara Sea and the Komsomolets submarine. Model studies have shown that the collective dose to the year 2050 is dwarfed (by a factor of 20,000) by natural radionuclides such as polonium-210.

The laboratory studies have helped to gain a better understanding of the water-sediment interaction process. They showed a variation in the distribution coefficient with, e.g., sediment type and salinity. The results imply that floods moving contaminated sediments from freshwater systems to the sea could cause release of radionuclides from the sediments. The results from the laboratory studies are also important for model work where the distribution coefficient is an important parameter.

Process studies of environments with special physical or chemical characteristics focused mainly on the behavior of plutonium n sediments and its interaction with water. A study at Framvaren fjord in Norway was first to prove that remobilization is taking place and a model explaining the behavior of the plutonium was constructed. The model fits well with the observed data.

Field studies were carried out in various environments typical for the Nordic countries. The study area spanned from Thule on the west coast of Greenland to the Arctic Seas north of Siberia. The Baltic Sea was included, as were parts of the Atlantic Ocean. The studies helped to determine site specific characteristics and parameters for the different areas. They also showed that the sedimentation rate could not in some cases be correctly determined by using just one single method; more than one method should thus be used when possible.

Quality assurance was an important ingredient in EKO-1 work. Emphasis was put on *sampling* and *analysis*. A survey was made of the samplers in use and a report was written listing the results and discussing the advantages and disadvantages of each type of sampler. In an intercomparison of Nordic, Baltic and other laboratories two samples were sent to the participants for analysis. Many laboratories did not show satisfactory results. This was especially true for the beta emitting radionuclides. But the study also showed that the analysis of gamma emitters such as cesium-137 can be improved considerably. The participation of invited Baltic laboratories did not require any NKS funding.

Two major seminars were arranged during the 4-year period:
- Sedimentation processes, Kristineberg, Sweden, September 20-21, 1995
- Dating of sediments and determination of sedimentation rate, Helsinki, Finland, April 2-3, 1997

NKS has created a network of competent people in the field of marine radioactivity in the Nordic countries. Other forms of international cooperation and projects cannot replace this network.

EKO-2: Long Ecological Half-Lives in Semi-Natural Systems

Tone D Bergan, IFE

Foodstuff from semi-natural areas, such as uncultivated pastures, mountain areas and uplands account for a considerable portion of intake of radiocesium and radiostrontium, and thus to dose to man. Within EKO-2 three problem areas were chosen:
- Sheep grazing on uncultivated pasture
- The influence of mushrooms
- Freshwater fish

The main aim has been to identify the contribution from semi-natural systems by determining ecological half-lives for specific foodstuffs from these areas, and thus determine dose to man. Data were produced or compiled for 8 – 11 years after the Chernobyl accident.

The recovery of Nordic ecosystems from Chernobyl is gradually slowing down, at the same time as areas vary widely in susceptibility and recovery rates. Accordingly, ecological half-lives are gradually increasing and cannot be treated as constants, neither over time nor space. Although it has not been easy to determine simple or general ecological half-lives the projects have given us useful understanding of the mechanisms governing the transfer of radionuclides, and more knowledge about typical Nordic ecosystems.

The sheep project involved studies of the soil – vegetation – sheep system in Denmark, the Faroe Islands, Iceland, Norway and Sweden. Coordinated sampling started already in 1990 and continued until 1997. Large differences in transfer were found, and by studying the production intensity, biomass production, climate conditions, the presence of mushrooms, intake of soil and experimental studies of stable elements in the soil it was possible to explain some of the differences. Since soil represents an important reservoir for radionuclides in the terrestrial system the soil characteristics have been the most important factor for the different transfer factors that were observed in the various grazing areas.

The forest project studied the consumption of food products from the forest system. A questionnaire was performed on the consumption of wild berries and mushrooms. A survey in Sweden revealed the amount of radiocesium transferred yearly to man via mushrooms. Most animals show increasing levels of radiocesium when mushrooms are available in August-September. Roe deer are among the largest mushroom consumers. Up to 20-30% of their paunch content is mushroom in this period.

The freshwater fish project studied limnic systems, focusing on ecological half-lives in Nordic lakes. The main aim was to investigate the processes and mechanisms leading to radiocesium being easily available for uptake in fish. A Nordic map was developed, containing descriptions of fallout, limnic data (such as water quality, size and water transport), radiocesium levels in freshwater fish and water, as well as runoff from surrounding areas. Resuspension of sedimented radiocesium, along with runoff from catchment areas, are important sources for biological uptake, forming the dominating factor contributing to long ecological half-lives in freshwater fish. It is important to follow the time development of cesium-137 in fish and the controlling factors of critical catchments and lakes.

The main conclusions of the EKO-2 project are that semi-natural systems were at the time becoming increasingly more important with time when it comes to transfer of radionuclides to man, and that ecological half-lives were increasing with time.

EKO-3: Preparedness Strategy and Procedures Jens Hovgaard, DEMA → Anneli Salo

The overall objective of EKO-3 was to assist Nordic authorities in improving their emergency response and international cooperation in selected issues. The project was divided into four subprojects:

- Mobile measurements
- Quality assurance in sampling and analysis
- Operational Intervention Levels (OIL)
- Intervention issues in agriculture and food chains

In 1995 an NKS exercise called RESUME (Rapid Environmental Surveying Using Mobile Equipment) was conducted in Sweden with Nordic participation plus teams from Canada, France, Germany and Scotland. The results demonstrated the excellent capability of the airborne teams. Of the ten teams eight were able to deliver cesium-137 maps very soon after the surveys were completed, in some cases within a few hours. In general, the cesium deposition map from the airborne and carborne teams showed the same spatial features but with some variation in absolute levels. Most of the observed differences can be attributed to difference in calibration methodology and spatial attributes of the various measuring techniques. It was found that accurate flight-path navigation and software for presentation and analysis played an important role in the search for hidden sources. – RESUME95 was followed up with similar exercises in 1999 (Sweden) and 2002 (Scotland).

With regard to quality assurance in environmental sampling and analysis, the project provided an up-to-date picture of the state-of-the-art in gamma spectrometry in the Nordic countries. Problems were identified and solutions suggested. One of the improvements needed was to develop access to software for gamma spectrometric analysis. A manual was produced for one such program. Software inter-comparison showed that considerable differences occur among programs in their quality of peak area estimates.

A survey of measurement geometries in use in the Nordic countries revealed the wide variety of sample containers used. Several advantages were identified in having the same geometry. It is therefore recommended to agree on a few of these containers to be used as reference containers, and to participate in ongoing international work. An intercalibration exercise was carried out for whole-body measurements, which led some laboratories to improve their calibrations. An outline for a quality manual was prepared. With regard to the accreditation of gamma laboratories, the work resulted in clarifying the process, but implementation remains the task of the institutes in question. It is important to maintain Nordic contacts during the process since it may save time and effort. Finally it was recommended that trends in information technology be carefully monitored.

Operational intervention levels (OIL) were treated within a probabilistic framework in which only a few basic facts concerning the accident are known at the time of decision making. The probabilistic approach developed offers a method for characterizing the uncertainties in the efficiency of early intervention measures. The recommendation is that OILs are defined within a probabilistic framework. In this framework an optimized OIL is given as the measurement value, for which the average avertable dose is equal to the (generic) intervention level. Furthermore, it is recommended that the probabilistic approach be developed as a tool for optimizing existing and future measuring strategies. This may involve optimizing the type and number of measurements and the time scheme for deployment of mobile measurement units.

As for agricultural measures, a satisfactory preparedness scheme of action should exist already before the alert phase after a release. Deliberations clearly showed that many differences are present among the Nordic countries regarding the agricultural situation, and that too hasty conclusions about harmonization of countermeasures should be avoided. Cooperation between the radiation protection, agricultural and food producing communities was necessary and very fruitful. It is essential that involved authorities develop an adaptable preparedness organization that can implement the necessary measures in a quick and efficient manner. Knowledge of alternative measures and their consequences is a prerequisite for efficient and timely implementation of these measures. A forum should exist where agricultural, food and emergency preparedness experts can exchange views and experiences.

EKO-4: Emergency Preparedness Exercises and Information **Eldri Naadland, NRPA**

The objectives of EKO-4 were to:

- Contribute to competence development of personnel in emergency organizations
- Draw attention to and further develop contingency plans for nuclear accidents
- Contribute to joint professional evaluations and coordination between the Nordic countries
- Improve the understanding of various types of actions and decisions taken in neighboring countries through joint Nordic exercises and improved systems of exchange of information and data between the Nordic countries

Implementation of the results of an exercise is not regarded as being part of the exercise itself, and was therefore not an objective of this project.

Exercises were arranged frequently to validate plans and procedures and stimulate early notification and exchange of information. Although Nordic agreements exist in certain areas of work, no joint contingency plan exists between the countries. Exercises are scenario-driven activities, each having different scopes and objectives. They all develop in three phases: planning, execution and evaluation. The activity can be executed in real time or independent of time. All three phases require resources; however, joint Nordic exercises and participation in international exercises render the work more cost-effective.

During the 4-year project period several functional exercises and similar activities were arranged:

- Seminar on evaluation of accidents and analysis of the source term (1997)
- Exercises and seminars on atmospheric dispersion (1995 and 1996)
- Exercise and seminar on dose calculation (1995)
- Decision conference on clean-up actions in urban environments (1995)
- Information exercise in connection with RESUME95 (1995; cf. EKO-3)

After the series of functional exercises a large-scale exercise was arranged in which Nordic objectives were linked to the international exercise INEX-2-FIN, arranged by OECD/NEA.

Further development is required in a number of areas, e.g.,

- Methods and tools for dispersion models, dose calculations and source term determinations

- Systems for communication and exchange of data and other types of information
- The content of the information to be exchanged and formats to be used
- Joint terminology and methodology for, e.g., scenarios, types of exercises (full-scale; table-top; decision conference, etc.) and evaluation

When planning exercises scenarios must be developed. Different groups have different requirements as regards detail. There seems to be a tendency in Nordic exercises to create scenarios with very serious consequences. Exercises should not contribute to creating myths as to what type of situations will have to be handled. One must also ensure that the security of the plant in question is not weakened by participation in the exercise.

The exercises carried out during the project period have provided useful knowledge and many proposals for the further development of nuclear emergency preparedness in many different professional areas, both nationally and jointly in the Nordic countries. However, there seems to be a need to develop more long-term plans and strategies for Nordic contingency planning and Nordic exercises, as well as a greater awareness of what is an appropriate exercise format to achieve a given objective. This can contribute to reduce costs and optimize the benefits of the exercises which are arranged.

Exercises can be regarded as a **means** to develop, harmonize and validate plans, procedures and tools. But work with exercises can also be regarded as an **objective** in the same sense that it can contribute to optimize the use of resources allocated for exercises. Increased awareness of *inter alia* these problems will be advantageous to continuing work with Nordic exercises. Increased awareness will also contribute to “practice makes perfect”.

EKO-5: Pre-Planning of Early Clean-Up

Thomas Ulvsand, FOA NBC Protection

The purpose of EKO-5 was to work out guidelines to be used in the planning of *early* clean-up actions, i.e., actions which have to be taken during the first three weeks after an accident in order to be meaningful. Only actions for reducing doses from external radiation in inhabited areas were considered. The project was ordered and totally financed by the Swedish Rescue Services Agency. The main target group was persons responsible for planning contingency operations following a radioactive release.

The following actions can be regarded as early:
- Hosing of roofs, walls and paved areas
- Lawn mowing and removal of grass cuts
- Pruning of trees and bushes
- Removal of snow
- Vacuum cleaning of streets

Calculations were made for a reference deposition of cesium-137 considering urban and suburban environments such as
- detached wooden or brick houses
- semi-detached houses
- terrace houses
- city center multi-storey buildings

In the case of dry or wet deposition, the document describes the expected effects of the various actions and the practical, economical and protective-relevant consequences generated by them.

In the guidelines resulting from this work, the reduction of life time dose has been considered as the relevant parameter. The actions giving the *largest effects*, measured as life time dose reduction, are *lawn mowing, removal of snow* and *pruning of trees and bushes*.

The document finally discusses clean-up actions and their effects on the rural living environments. The relevant actions are the same as in urban and suburban areas. In more densely populated areas the actions will to a great extent be managed and performed through societal efforts. But in rural areas the results very much depend on private initiatives by, e.g., farmers who have the necessary equipment and perform the recommended actions themselves.

The document ends with guidelines, describing each of the 44 considered cases. The guidelines are directed to the planners and are presented as tables, with the following headings:

- House type
- Expected effects
- Staffing and costs
- Equipment and costs
- Practicability, waste
- Protection
- Influence on other procedures

SAM-3: Coordination of NKS-EU Contacts **Torkel Bennerstedt, NKS**

In order to introduce NKS and its research activities to EU, two visits were paid to DG XII during the period. Also, a joint CEC-NKS Seminar on Possible Information Exchange and Cooperation in Nuclear Safety and Radiation Protection was arranged at STUK in Finland on Jan. 9, 1996. Information was shared between EU and NKS, and issues of mutual concern were discussed and summarized in a memo by the secretary of the NKS Board. It was agreed that this type of information exchange should be continued in the future. This led to a workshop in Brussels in June 1998; for more information, see next 4-year period below.

SAM-4: Overriding Information Issues **Vibeke Hein, DEMA**

During the pre-project period an information project was proposed but not accepted by the Board. But the heads of the information departments of the Nordic authorities found the need for a new project so pressing that they maintained the initiative, and at the semi-annual review of ongoing projects SAM-4 was launched. It consisted of ten subprojects focusing on four subject areas:

- *How to inform about a difficult subject in a modern society*
  Nuclear energy, radiation and emergency preparedness may be strange, even frightening concepts to some people. At the same time, the volume of information increases over time. So there is a need to identify target groups and the best channels and means of communication. A seminar was arranged, featuring Dutch experts on crisis management in connection with disasters. The public expects a high level of safety, security and service. It was found that our modern society can be seriously affected even by simple, uncomplicated events.

- *How to provide advance information*
  The authorities depend heavily on news media to communicate their message in case of an incident or accident. Hence, journalists must be prepared and preferably trained in advance. This cannot be done on the day of a serious, acute situation. It is important for all parties that journalists are briefed beforehand on the subject matter. A seminar was arranged on the occasion of the 10th anniversary of the Chernobyl accident, and a study tour to the Kola nuclear plant was organized. The immediate possibility to inform the citizens continues to be covered by, e.g., brochures and webpages. An existing list of information material published by Nordic authorities was updated, and – for the first time – a comprehensive list of NKS project reports was compiled.

- *How to inform when the accident has occurred*
  It is important to let experts and journalists exercise together, to learn each other’s language and needs. Besides, exercises are instrumental in doing away with myths and preventing that they arise. Thus, Nordic authorities and SAM-4 participated in two international emergency preparedness exercises arranged by OECD/NEA. The first exercise, INEX-2-CH in November 1996 with Switzerland as Acciland, sparked a certain exchange of information among the Nordic countries, primarily concerning precautions, travel restrictions etc. E-mail was tried as a mode of communication, with moderate success. In the second exercise, INEX-2-FIN in April 1997 with Finland as

Acciland, the Nordic countries took active part right from the beginning, including the planning phase. Nordic criteria were stressed, including information to media and the public. It was decided to exert a uniform Nordic media pressure by means of journalists nationally dispatched to the scene of the accident. As this was a very realistic situation it provided important training for the participants.

- *How to inform about NKS and its projects*
  A communication strategy, including an information policy, was produced and accepted by the Board. The external image of NKS will be strengthened by means of a graphic profile for all publications, to be implemented under the next 4-year program. To provide inspiration for the information task a seminar was held in Stockholm, October 1997, for project leaders and project participants.

BER-6: Reclamation of contaminated urban and rural environments following a severe nuclear accident

In the fall of 1997 the much delayed final report appeared. It was the last report from the 1990 – 1993 BER program.

Major Seminars, Exercises and Other Events

NKS supported Nordic courses and related activities that led to financial support to the publication of two books:

- Nordic Radioecology – The Transfer of Radionuclides Through Nordic Ecosystems to Man.
  Editor: Henning Dahlgaard, Risø, Denmark. Elsevier 1994.
- Radioecology – Lectures in Environmental Radioactivity.
  Editor: Elis Holm, Lund University, Sweden. World Scientific 1994.

Final seminars (cf. Board minutes from Snekkersten Sept. 4, 1997):

- RAK-1.2, RAK in 1997
- EKO-1 and EKO-2 (joint), emergency part of EKO in 1998
- Joint final seminar for the entire NKS program in Stockholm March 1998

Joint RAK-1 and RAK-2 seminar, Stockholm, Sweden, Nov. 25 – 27, 1997.

EKO-1: Sedimentation processes, Kristineberg, Sweden, September 20-21, 1995

EKO-1: Dating of sediments and determination of sedimentation rate, Helsinki, Finland, April 2-3, 1997

EKO-3: RESUME95, NKS exercise (Rapid Environmental Surveying Using Mobile Equipment) with international participation, Sweden 1995.

ETEX-1 (European Tracer Experiment), full-scale exercise arranged in France October 1994.

OECD/NEA exercise INEX-2-CH in November 1996 with NKS/SAM-4 participation.

OECD/NEA exercise INEX-2-FIN in April 1997 with NKS/ EKO-4 and SAM-4 participation.

Seminar with Dutch experts on crisis management, Nov. 1996 (SAM-4).

In connection with the 10th anniversary of the Chernobyl disaster: Seminar plus study tour to Kola NPP (SAM-4).

Information seminar for project leaders and participants, Stockholm, October 1997 (SAM-4).

The Nordic secretary arranged a 3P seminar on information and communication issues.

Final seminar: Eight Years With NKS, Saltsjöbaden, Sweden March 11 – 12, 1998, on the results of the NKS program 1994 – 1997 and plans for the 1998 – 2001 program.

Evaluation of the Scientific Program 1994 – 1997

Evaluator: Antti Vuorinen. See report no. NKS(98)2.

Prof. Antti Vuorinen, former director of STUK, kindly agreed to singlehandedly evaluate the entire fifth 4-year program. It proved to be a formidable task, requiring much more time and effort than anticipated. The evaluation followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. In conclusion, NKS came out quite favorably, and when presenting his report to the Board, prof. Vuorinen stated that his view of NKS was far more positive now than at the start of the evaluation. These are some of his findings.

The general aim of the fifth 4-year program 1994 – 1997 is well in line with the goals and objectives described in the Owners Group's contract and reflects the ambitions summarized in the document "This is NKS". The planning and execution of the program has been systematically documented. With a few exceptions, deadlines have been met; and budgetary constraints were respected.

The activities in the **Nuclear Safety** area have concentrated on the comparative analyses of nuclear safety work in Finland and Sweden; severe accident analyses of Nordic boiling water reactors; approaches to improve the methodology and the basic data for PSA (Probabilistic Safety Analysis); and the development of the methodology for maintaining and upgrading nuclear power plants. All subprojects were relevant and the objectives sufficiently ambitious.

The RAK-1 project was well managed and divided into five subprojects:

RAK-1.1	The responsibility of the plant operator is stressed; but the responsibility of the authority has unfortunately been ignored. The summary report on reactor safety and safety work in the Nordic countries offers an important analysis of the situation at the time and hints at improvements.
RAK-1.2	This subproject produced a useful tool for practical purposes and is of a certain scientific value.
RAK-1.3	Many areas lack practical, uncomplicated analytical methods. Therefore the work produced here should be greeted with satisfaction.
RAK-1.4	To make sure that the results of this type of projects are fully exploited it must be embraced by the top management of the company and the dedicated participation of the plant staff.
RAK-1.5	The final report is recommended reading for all who are involved in the modernization process.

The RAK-2 project consisted of three subprojects.

RAK-2.1	To select a severe accident and possibilities to control it, and to concentrate mainly on Nordic BWRs is certainly a good choice. The results are of great interest to both regulatory bodies and utilities. Although the computer codes used predicted the progression of the core damage slightly differently, the results are believed to be of value to the emergency operating procedures.
RAK-2.2	The CAMS project was one of those important long-term projects needed to provide practical results which are badly needed to increase confidence in the safety of NPPs. CAMS will provide a common information platform to the plant personnel and people at the licensing body.
RAK-2.3	The technical reports contain clear presentations and form as such a practical library of documents in line with the objectives of the subproject.

Among the problems on **Radioactive Wastes**, long-lived low and medium level waste management practices in the Nordic countries as well as approaches to analyze the environmental effects due to waste storing were under study and deliberation.

The AFA-1 project was professionally planned and consisted of three subprojects.

AFA-1.1	Nordic waste characterization methods were described and evaluated and lacking methods identified. The final report is useful reading for persons responsible for management of radioactive waste and repositories.
AFA-1.2	After the first AFA-1.1 activities the identification and description of the components of a performance analysis could be performed. The project report describes present and planned methods and systems for waste handling in the Nordic countries. It is useful reading for all in the waste handling business.
AFA-1.3	After the opening seminar in 1995 actual work was not begun until 1997. EIA requirements were fairly new at the time. Hence, this was a very rewarding NKS subproject, which might be followed by similar activities.

The minutes of the reference group meetings show that the AFA-1 project steering on this level was of a rather general character. Finnish and Swedish participation from authorities as well as the industry was scarce, which might reflect the choice of project contents.

Main efforts in the area of **Radioecology** were allocated to the modeling and analyses of long term radioactive contamination in a Nordic environment, including future effects of dumped radioactive wastes into the northern seas. Joint training and exercises were organized to test and develop emergency preparedness emphasizing the possibility of a nuclear accident.

The EKO-1 project can be considered as consisting of three subprojects:

EKO-1.1	Development of models
EKO-1.2	Research: field and laboratory studies
EKO-1.3	Dissemination of information

There is a great interest in the type of work that EKO-1 encompasses, both scientifically and politically, not least among the media. This includes dumped radioactive material as well as releases from nuclear installations. Responsibility and work was distributed between all Nordic countries. The importance of integrating NKS work with planned or ongoing national projects is stressed. Contacts were made with Russian institutions to make studies of contamination of northern areas possible. The results of EKO-1 were compiled in a comprehensive report. The produced results will be of interest also to others than Nordic experts. At the time of the evaluation of the NKS program only a draft EKO-1 report was available.

The EKO-2 project plan is easy to read and contains all pertinent details.

EKO-2.1	Transfer of radiocesium and radiostrontium from soil to plants and sheep
EKO-2.2	Transfer of radiocesium via mushrooms to reindeer and man
EKO-2.3	Ecological half-lives in limnic ecosystems

Even though all three subprojects are quite specific, they attracted wide Nordic interest. The last status report delivered by the project clearly outlines the disposition of the planned final report. At the time of the evaluation of the NKS program only a draft EKO-2 report was available. It contains interesting information on the project, but alas practically all conclusions and recommendations are missing. This is a disadvantage since they should be a valuable input in discussions on the next 4-year program.

The EKO-3 project, together with EKO-4, marked a continuation of the BER projects of the fourth 4-year program. It was divided into four subprojects (the last one added after two years).

EKO-3.1	*Mobile measurements.* The very complex and well planned exercise RESUME95 was a successful and valuable experience. It was a major undertaking, and the organizers must be congratulated on a work well done. It showed that international cooperation in an acute situation is possible, but further harmonization of systems and intercalibrations might be a theme for the upcoming RESUME98 which is being planned together with EU. (*Author's comment*: There were two more RESUME exercises, in 1999 and 2002, respectively.)

EKO-3.2 *Quality assurance in sampling and analysis.*
The subproject focused on gamma spectrometry in conjunction with laboratory analysis and *in situ* measurements. The work was partly coordinated with EKO-1.The subproject was successful and will raise the standard of the participating laboratories.

EKO-3.3 *Operational Intervention Levels.*
The selection of the subject is excellent. The work is very well done and clearly presented. This subject has been discussed in the Nordic countries extensively in the course of several years; however, the progress in crystallization of the results has been rather slow. That is why this study is very welcome, although the terminology used in connection with intervention is somewhat vague.

EKO-3.4 *Measuring strategies, decision making and actions in the agricultural area.*
This subproject was added in 1996 and was divided into six areas. The plans could serve as a good example in planning and presentation. The suggestions and recommendations presented are well founded.

The EKO-4 project, together with EKO-3, marked a continuation of the BER projects of the fourth 4-year program. EKO-4 had two subprojects.

EKO-4.1 *Exercises and scenario development.*
The work was organized in a number of packages including reactor safety; dispersion models and trajectories; harmonization of action levels; information services in connection with EKO-3.1; and dose calculations. Nordic countries participated in the full-scale tracer experiment ETEX-1 arranged in France in 1994, and EKO-4 hosted a follow-up meeting. The attempts to solve the problems should be started from the strategy of emergency preparedness and closer to the strategy of countermeasures. What is really needed, and when, should be discussed before too much efforts are devoted to harmonization. At a decision conference on urban clean-up experts and decision makers met. This is important; but training should probably be organized nationally.

EKO-4.2 *Nordic system for exchange of data and information.*
A contact seminar was organized and the handbook on Nordic nuclear preparedness revised. It is an important and useful tool both during exercises and in case of acute situations. It is a living document that must be updated on a yearly basis.

At the time of the evaluation of the NKS program only a draft EKO-4 report was available.

The EKO-5 project was added to the EKO program in 1996 with 100% external funding. Two documents, both very valuable, were produced on early clean-up following a nuclear accident, with the objective to reduce individual lifetime doses. As a continuation of this decontamination project one might want to consider whether the requirement to minimize dispersion of radioactive substances to surrounding areas and the environment would influence the choice of countermeasures. It is vital that the reports be published in Nordic languages as well, since they are of significant value.NKS has demonstrated great flexibility when accepting this project midway into the 4-year program. The project was efficiently carried out and well reported.

The **administrative functions** plus a project on information were organized under a separate heading called SAM (short for *samordning*; Scandinavian for coordination). There were four subprojects.

SAM-1	Overall program management, economy and administration
SAM-2	Coordination of NKS-Baltic activities
SAM-3	NKS-EU contacts
SAM-4	Overriding information issues

The SAM-1 project: The administrative functions and the corresponding documentation has improved vastly the last couple of years. The level of competence is high and SAM-1 has served the program well.

The SAM-2 and SAM-3 projects were not commented by the evaluator.

The SAM-4 project was added to the NKS program in 1996 after a proposal from the Nordic information chiefs of the various authorities. The suggested information project was formally incorporated with the SAM program but practically handled in the same reference group as the EKO projects. The project consisted of eight interesting and important subareas but was probably too ambitious. Perhaps it would have been wiser to work more intensely with a smaller number of questions. There are a number of angles on the issue of the information policy of NKS. NKS is basically intended to be a forum of research, with the aim to produce good results and train the participants. But the outside world should also be made aware of the possibilities and results of the work of NKS. How well known, then, is NKS and its work? A number of participants of an NKS seminar answered a questionnaire that was handed out by the evaluator. 40% claimed to know fairly well what NKS is. 35% responded that they had used NKS results; however, 55% found NKS activities useful! 40% found NKS work efficient; 25% felt not, and 35% offered no opinion. Some remarks were: NKS should concentrate on exchange of information; focus on fewer but larger projects; coordinate with EU work; and simplify the organization.

The selection of technical / scientific RAK, AFA and EKO projects was done after careful pre-studies; the projects cover rather evenly the cooperation area. Some of the projects represent the top level of scientific technical knowledge, others represent more or less preparation of state-of-the-art reports. Important results have been presented and useful information collected for further use, e.g., material for educating young experts and maintaining and further developing the competence of senior experts.

The joint RAK-1/RAK-2 seminar at the end of the 4-year period was very successful.

The benefits of NKS work should be systematically discussed and evaluated, and the results implemented in such a manner that it serves to improve the *supervision and control* of NKS work. The most essential factor in reaching success is to select projects that are of current importance to NKS promoters and of special interest to project leaders and their team of researchers.

It is evident that the basic administrative structure of NKS is in good condition. However, there are some features that could be simplified and the number of less effective technical meetings could be reduced. The Nordic secretary could have intervened more strongly to avoid some of the delays of the scientific program. The NKS Board should seriously consider the pros and cons before adopting new information projects (other than communication techniques).

The reporting of administrative matters should be done on time, clearly and concisely, avoiding repetitive parts. Technical reporting should be done only if real advancements can be presented or if there is a need to bring some special aspects to a broader forum for discussion.

In recent years NKS has taken a rather broad approach to information. Prof. Vuorinen concludes his evaluation by stating that it might be advisable for NKS to focus its information activities mainly to the experts who are the potential users of NKS results. NKS is a good forum for preparation of special material for public information purposes; nevertheless, interaction with mass media is justified only when NKS has *news* to offer journalists.

Final Seminar: Eight Years With NKS

A two-day seminar called Eight Years With NKS was arranged in Saltsjöbaden, Sweden in March 1998. The seminar covered NKS results in 1994 – 1997 and plans for 1998 – 2001.The target groups were

- the owners, board and other financiers and supporters of NKS work
- decision makers and other end users of NKS results
- persons who wanted to learn about and discuss the results of the last program period and the plans for the next program

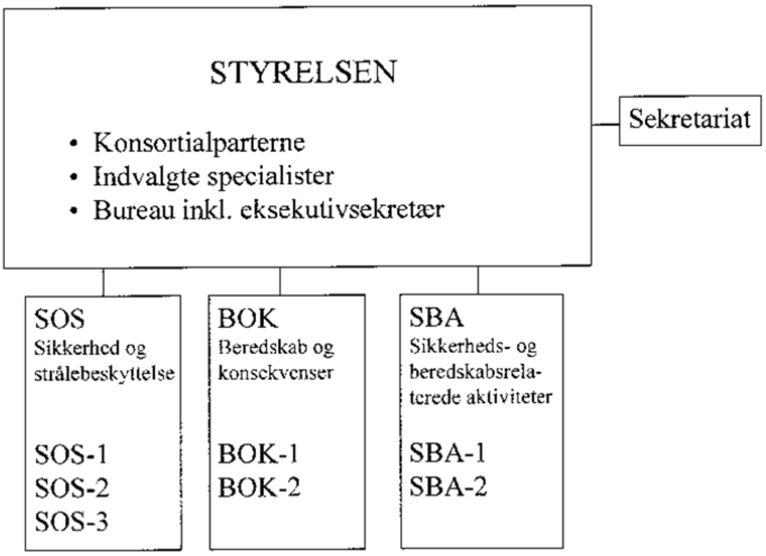
After opening the seminar, the Nordic secretary gave an overview of the recently concluded research program. After this, the project leaders presented the work and most important results of their respective project. Ample time was reserved for questions and discussions. Then Antti Vuorinen presented his evaluation report and especially his conclusions and recommendations, upon which followed an intense discussion. The Secretariat gave a short presentation of its achievements, after which the Noric secretary summarized the last four years of NKS work. The first day was rounded off by Franz Marcus in his talk on half a century of Nordic nuclear safety cooperation and EURATOM treaty issues.

The second day was spent discussing NKS and the future. In his keynote address the new director of STUK, Jukka Laaksonen, shared his views and expectations, and again time was set aside for a good discussion. This was followed by an in-depth presentation of the proposed new 4-year program, led by Sigurður M Magnússon. A number of groups of varying size were formed to penetrate the proposal, comment and complement it and report back in plenum in a final joint discussion. After a brief summary by Sigurður M Magnússon, the seminar was closed.

The Sixth 4-Year Program (1998 – 2001)

NKS Organization

By and large, the NKS organization was basically the same as in the previous program period. The organizational chart was simplified but still somewhat complex.



The top rectangle represents the board (*styrelsen*), with three main parties: the owners (*konsortial-parterne*), recruited specialists (*indvalgte specialister*) and the bureau including the Nordic secretary (*bureau inkl. eksekutivsekretær*). Administrative tasks were handled by the secretariat (*Sekretariat*). The three main program areas (SOS, BOK and SBA) are explained below. The scientific reference groups linked to the different 4-year programs in the past were abolished by an Owners Group decision on Feb. 5, 1998, effective from the start of the sixth 4-year program.

Planning, Pre-Projects and the New Program

NKS report NKS-5 summarizes the planning of the 1998 – 2001 program and gives details on the project plans. They included reactor safety, radioactive waste, emergency preparedness, radioecology and cross-disciplinary studies including information.

The work to develop the sixth 4-year program started with the evaluation of the previous program summarized above and the subsequent discussions on the findings and recommendations of the evaluation. At the same time, suggestions and proposals for the new program were invited, both on a national level and from involved organizations and researchers. A special program group was established to find a coherent project structure based on the more than 200 suggestions that were received. Their work is reported in NKS(98)1. The Board then decided to carry out a number of pre-projects and feasibility studies under supervision of a temporary reference group chaired by Sigurður M Magnússon, IRSA. This work attracted some 70 persons from all five Nordic countries and almost all relevant organizations. The pre-project leaders and reference group members appointed by the Board are listed below.

Pre-project leaders:
- Lennart Hammar, ES-konsult (SOS-1)
- Kaisa Simola, VTT Automation (representing KTM; SOS-2)
- Magnus Westerlind, SSI (SOS-3)
- Per Hedemann Jensen, Risø (BOK-1)
- Sigurður Emil Pálsson, IRSA (BOK-2)
- Inger Margrethe H Eikelmann, NRPA (SBA)

Reference group:

- Bjørn Thorlaksen, DEMA (Denmark)
- Timo Haapalehto, KTM (Finland)
- Sigurður M Magnússon, IRSA (Iceland; chairman)
- Erling Stranden, NRPA (Norway)
- Christer Viktorsson, SKI (Sweden)
- Ulf Bäverstam, SSI (Sweden)

The pre-project work followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. Draft final reports of the pre-projects were presented to and discussed by the Board. Some revisions were made at the Board meeting in February 1999, after which the project plans were adopted. At that meeting decisions were also made on budgets, time schedules and project leaders. After this, the actual NKS project work began.

Program Overview

The 1998 – 2001 NKS program finally adopted by the Board was divided into three categories of altogether seven research projects as listed below:

SOS	Nuclear and reactor safety, waste management
BOK	Emergency preparedness, radiological and environmental consequences of radioactive releases
SBA	Information about nuclear facilities in the neighboring areas of the Nordic countries and about cooperation of competent authorities

Acronym	**6th 4-Year Program: Projects 1998 – 2001**	**Project leader**
SOS	Nuclear Safety and Radiation Protection	
SOS-1	Risk Assessment and Strategies for Safety	Kjell Andersson, Karinta-Konsult
SOS-2	Reactor Safety	Kaisa Simola, VTT Automation
SOS-3	Radioactive Waste	Karin Brodén, Studsvik RadWaste
BOK	Nuclear Preparedness and Consequences	
BOK-1	Nuclear Emergency Preparedness	Bent Lauritzen, Risø National Laboratory
BOK-2	Radiological and Environmental Consequences	Sigurður Emil Pálsson, IRSA
SBA	Safety and Preparedness Related Activities	
SBA-1	Nuclear Threats in Nordic Surroundings	Inger Margrethe H Eikelmann, NRPA
SBA-2	Information Issues	Vibeke Hein, DEMA → Anders Jörle, SKI

Due to a number of unacceptably long delays in previous programs, resulting in final reports appearing a year or more later than planned, the Board decided that NKS should write contracts with the project leaders' home organization, specifying the time schedule and stating that the final payment (usually in the order of 30% of the agreed cost) would be withheld until the project was finished and approved by the NKS Board. This proved to be a very effective remedy.

Project Summaries

Based on the project leaders' Summary Reports; see report no. NKS(98)2.
Project budgets: See Appendix 5. (Approximate project spending under the heading Facts in figures at the end of this chapter.)

SOS-1: Risk Assessment and Strategies for Safety Kjell Andersson, Karinta-Konsult

Formally, the SOS-1 project was divided into three subprojects:

SOS-1.1	Risk Assessment
SOS-1.2	Safety Analysis
SOS-1,3	Strategies for Safety Management

SOS-1 highlighted current developments within the nuclear energy area on a broad basis. It took the view that safety essentially should be understood as awareness among those concerned in regard of the control of risk. This means that safety cannot be said to be provided for until it has been communicated, implemented and well understood. There is thus a close connection between risk communication both within (and between) the expert groups, and between them and concerned citizens.

The project made an attempt to describe nuclear safety with a broad spectrum of perspectives. This has been done with a variety of methods, such as questionnaires, interviews, seminars, special research projects and focus group discussions. Mostly people working with nuclear safety (in industry, regulatory bodies, universities and consultant companies) were involved. Parts of the project were also approached by lay people, but with some connection to nuclear safety. In a broad sense, the the project was devoted, first, to how one can organize for safety; and second, to how risk communication can be improved.

Experience from high reliability organizations has brought many insights in how to organize for safety, but has also demonstrated various mechanisms, which may introduce hidden deficiencies in safety activities. The challenge is to detect and correct such deficiencies before the risk is realized. Three key concepts for this, which were subject to special attention in the project, were safety culture, safety indicators and quality systems.

The concept of **safety culture** that emerged after the Chernobyl accident has a considerable impact on the nuclear safety work, even if it may be hard, or probably impossible, to define it so that it can be measured. The interpretation of the concept as the ability of an organization to create safety by knowledge and involvement seems constructive and inspiring. A special aspect of the concept concerns the regulatory bodies, since for them it has a two-fold purpose. They have to review the safety culture at the utilities at the same time as they in their own work need commitment and responsibility to develop and maintain a safety culture appropriate for a regulator. The safety culture must continuously be encouraged and stimulated by management, especially since it can be exposed to negative pressure from both inside and outside factors. Many see deregulation as a potential threat to the safety culture and others have mentioned the difficulty of attracting young professionals to the nuclear area.

Even if the concept of safety culture cannot be accurately defined, it is connected to the concept of **safety indicators**, which is used to reflect the safety of a nuclear facility. The indicators should also be able to provide warnings that future performance might be in danger. Furthermore, safety indicators should reflect a development over time to make a judgment if present development is for the better or for the worse. There are many benefits with the use of indicators, but they need to be reviewed and changed regularly to better reflect the goals of the organization.

The concept of **quality systems** has also been subject to special interest in SOS-1. On a generic level it can be seen to contain documentation of an agreed quality together with a description of how that quality is reached. It seems clear that the quality systems have an important task of ensuring a systematic knowledge sharing and learning.

How, then, could risk communication be improved? It can well be said that the nuclear waste area is a forerunner in developing methods and frameworks for transparency and public participation, which have also been applied, e.g., in the site selection process. The Environmental Impact Assessment (EIA) has been an “umbrella process” for this both in Finland and Sweden, within which many new and innovative initiatives have been taken. It is believed that some of the methods developed could set examples not just within the nuclear sector, but also for other complex areas such as biotechnology. The report suggests some elements in a strategy for risk communication:

- The overall attitude (among decision makers, industry regulators etc.) must become more communicative, with the point of departure that decisions on nuclear power, siting of repositories etc. are grounded in public values.
- The nuclear waste issues and possible new reactors have shown that communication can be based on an all-covering “umbrella process” such as EIA or SEA (Strategic Environmental Assessment).
- Within the umbrella process there is room for testing many kinds of means such as different forms of hearings, consensus conferences etc.
- There is room for the regulatory bodies to play an active role in this communication.
- One should not underestimate “the public” which also possesses various areas of expertise.

The safety analysis is at the core of risk assessment for decision making both in reactor safety and for waste disposal. One key element in the improvement of risk communication is thus the development of more communicative ways for safety analysis and performance assessment. The **SOS-1 economy** was discussed at a midway status seminar at VTT; see below under the heading **Facts in figures**.

SOS-2: Reactor Safety

Kaisa Simola, VTT Industrial Systems (earlier VTT Automation)

The project focused on certain safety-related topics that were identified to be of common interest within the Nordic nuclear community, and that were not covered by other international research projects. SOS-2 was realized in three subprojects, each consisting of several tasks and research topics:

SOS-2.1	Safety development The subproject concentrated on the problems related to risk-informed decision making, especially on the uncertainties and incompleteness of probabilistic safety assessments (PSA) and their impact on the possibilities to use the PSA results in decision making.
SOS-2.2	Management of plant maintenance and renewal One aim of this subproject was to promote the analyses of human and organizational factors in maintenance. Another aim was to enhance understanding related to maintenance management.
SOS-2.3	Severe accidents This subproject concentrated on phenomenological studies of hydrogen combustion, formation of organic iodine, and core recriticality due to molten core – concrete interactions in the lower head of the reactor vessel. Also the current status of research and management of severe accidents in the Nordic countries was reviewed.

In **SOS-2.1** a comparative study of two PSAs of nearly identical nuclear power units, both with significantly different results, was conducted. The aim was to identify, clarify and explain the differences between PSA studies, and to give recommendations for the comparison of PSA studies. The impact of assumptions and uncertainties on the results was evaluated. The study resulted in recommendations concerning the documentation of PSAs. A need for harmonization of certain parts of the studies also arose. A second study highlighted the need for structural analysis and presentation of uncertainties to facilitate the communication between different experts and authorities. The emphasis was on the identification and documentation of various types of uncertainties and assumptions in the modeling of the phenomena. A study on active human errors, also known as commission errors, was conducted. According to the study, a significant number of events were due to human actions outside the control room, which should be reflected in the PSA models. A review on decision criteria was done and the principles for evaluating the criteria were identified. A pilot study was conducted to develop a safety classification proposal based on risk for selected equipment of a nuclear power plant (in this case unit 1 of Loviisa NPP). As the risk-informed in-service inspection applications have become increasingly attractive, the quantitative estimation of pipe break frequencies has become an interesting topic. A comparative analysis of pipe failure probabilities due to stress corrosion cracking based on two alternative analysis methods was performed. The main reasons for the differences in the numerical results were analyzed, and the applicability and restrictions of the approaches were discussed.

SOS-2.2 addressed the quality of maintenance work by considering the role of human errors in maintenance with respect to operability and safety. In Finland, systematic and in-depth analysis of operating experience of human errors related to maintenance was started during the 1994 – 1997 NKS program and continued in 1998 – 2001. Human common cause failure studies at Finnish power plants show that maintenance work order data are helpful in the identification and analyses of human failure events. A structured classification and analysis facilitate the identification of failed barriers and the error mechanisms behind them. A review of research needs in the area of human factors in maintenance in Sweden was done by interviewing both the authority and the utilities. The needs for future research and development projects were classified and summarized. Since transformer explosions are also a risk, recommendations on condition monitoring of the transformer isolation and oil were reported. A discussion group on maintenance decisions was established, consisting of power plant representatives. Exchange of information was carried out in order to compare and identify good practices, especially to assure economically competitive electricity production without decreasing reactor safety. A survey on the management of condition monitoring information was conducted by interviews at several Nordic power plants. Predictive maintenance strives to prevent component failure by utilizing condition monitoring and information systems for maintenance steering. The interviews and plant visits show that the maintenance strategies are only slowly turning condition-based in spite of access to proper methods and equipment.

Severe accident research in **SOS-2.3** consisted of a review of the current status of research and management of severe accidents in the Nordic countries. The phenomenological studies focused on hydrogen scenarios and formation of organic iodine. In addition, a study on recriticality of a BWR core after molten core – concrete interactions in the lower head was conducted. A scenario of a hydrogen detonation in a BWR reactor building was investigated in order to evaluate the integrity of the containment in case of detonation loads from the outside. The study consisted of analyses of detonations based on earlier calculations of hydrogen concentrations, and of structural calculations. The formation and behavior of organic iodine was addressed by two literature surveys and small scale experiments, aiming at creating an understanding of the underlying chemistry. In the experimental studies the dependence of the formation of organic iodine on the pH of the filter solution was verified. A study was conducted to determine the potential for recriticality of the degraded core of a BWR. In the analyzed scenario a large amount of melt enters the lower head resulting in a melt – water interaction. A steam explosion or a strong evaporation in the lower plenum may push a water slug into the downcomer and core regions, which may lead to a prompt power excursion that in turn may fragment the fuel pins.

Some concluding SOS-2 remarks:

- The need for interdisciplinary work seems to be increasing along with the growing use of risk-informed regulation and plant management. The limitations of the PSA model have to be identified and evaluated in all applications where it s used as an aid for decision making.
- Maintenance management has not traditionally been considered a reactor safety research issue. However, lately the importance of human and organizational factors in maintenance work has received growing attention, and further research needs were identified.
- The deregulated electricity market has forced the utilities to identify cost savings, e.g., in maintenance actions. However, it should be achieved without compromising plant safety. Procedures, such as reliability-centered maintenance and risk-informed in-service inspections are aimed at optimizing the maintenance by taking into account the reliability and and risk analysis results.
- The SOS-2 studies have increased the understanding of some severe accident phenomena and identified remaining work in these topics.
- *As EU funding for nuclear reactor safety research is significantly decreasing, the importance of Nordic cooperation within NKS is increasing and the focus of Nordic research should be a subject of continuous discussion.*

SOS-3: Radioactive Waste **Karin Brodén, Studsvik RadWaste**

The project was divided into three subprojects:

SOS-3.1	Environmental Impact Assessments (EIA) (Continuation of AFA-1.3 1994 – 1997)
SOS-3.2	Intermediate storage (Continuation of AFA-1.1 and AFA-1.2)

SOS-3.3 Contamination levels in metals
(Continuation of KAN-1.1 in 1994)

Priority was given to a Nordic perspective with participation from all five countries. Therefore, the work focused less on waste from nuclear power plants than on waste from research institutions, hospitals and industry. The target group for the results is primarily authorities and organizations managing waste in the Nordic countries. However, the results are presumably useful in other countries as well. This applies particularly to the subproject on contamination levels in metals.

The management and disposal of radioactive waste is governed by national legal frameworks and international requirements and guidance on EIA. **SOS-3.1** included four EIA seminars on the use of EIA in the Nordic countries. The seminars focused on experiences from EIA procedures for the disposal of radioactive waste and other processes. Both Finland and Sweden have repositories for operational waste from nuclear power plants. Finland has experience of a performed EIA process regarding an encapsulation and disposal facility for spent nuclear fuel and similar EIA processes related to the modernization of existing nuclear power plants and a planned new plant. Sweden has experiences from an on-going EIA process regarding plans for disposal of spent nuclear fuel. Norway has experiences from a completed site with the construction of a combined disposal and storage facility for radioactive waste in Himdalen. Furthermore, Norway has experience of EIA work based on support of environmental clean-up activities in Russia. Denmark has initiated comprehensive planning for the decommissioning of all nuclear facilities at Risø. The initial steps in planning for a disposal facility have also been taken. Iceland has only small quantities of radioactive waste, but has experiences from EIA procedures related to other areas.

The objective of **SOS-3.2** was to analyze Nordic experiences of the storage of low and intermediate level waste, and to give recommendations on suitable intermediate storage conditions. Experiences of different intermediate storage conditions, and how these affect the containers and their content, are valuable both to authorities and industry when assessing and planning future storage facilities. An overview of the principles for intermediate storage of radioactive waste packages in Denmark, Finland, Norway and Sweden was made. Recommendations were given regarding different intermediate storage options, as well as control and supervision. The disposal of drums in Kjeller, Norway, was also included in the overview. This is an example of an intended disposal facility turned into what in practice has become a storage system.

SOS-3.3 included both a study on clearance in the Nordic countries and a study on radioactivity in commercially available metals. Within the study on clearance in the Nordic countries, an overview of official requirements for clearance and information on clearance experiences was prepared. Practices from both nuclear and non-nuclear activities were presented. Clearance of radioactive material, in particular scrap metal, is a quite important issue, nationally as internationally. The volume of scrap metal cleared for recycling is expected to increase as the nuclear installations grow older and the need for refurbishment and modernization increases. However, controlled clearance is not the only source of radionuclides in materials and products. Other sources are naturally occurring radionuclides, accidental smelting of radiation sources, fall-out from nuclear weapons tests, etc. Within the study on radioactivity in commercially available metals, samples from different steel, aluminum and magnesium producers in the Nordic countries were analyzed at different laboratories. The samples were analyzed with gamma spectrometric equipment. In some cases, beta measurements or neutron activation analyses were also performed. No activity at all or activities in the same range as the detection limit were found in the steel samples. Very low activities of natural uranium and thorium were found in some of the aluminum and magnesium samples. No indication of elevated radioactive contamination due to recycling of metals from the nuclear industry was found. Nevertheless, the results may be valuable for comparison with future measurements in order to detect any changes in activity levels.

BOK-1: Nuclear Emergency Preparedness **Bent Lauritzen, Risø National Laboratory**

The project comprised a number of activities aimed at developing and improving nuclear emergency preparedness. The activities included surveys of techniques and equipment, workshops and exercises. The project included research activities concerning monitoring and modeling the radiological impact of nuclear accidents, aiming at developing emergency response plans. Radiation protection authorities, governmental agencies, universities, research organizations and laboratories have been partners in the project, which have had participants from all of the Nordic and Baltic Sea countries.

The project was divided into six subprojects.

BOK-1.1 *Laboratory measurements and quality assurance.*

The objective was to develop the quality of laboratory measurements of radioactivity, aimed both at emergency situations and at radioecology studies using radioactive tracer elements. To this purpose, two intercomparison exercises of alpha, beta and gamma measurements on environmental samples were carried out. Two consecutive intercomparison exercises of gamma spectrometry software were conducted to check the ability to handle emergency situations. Seminars on accreditation and measurement techniques were arranged and a study of source preparation techniques for alpha and beta measurements was undertaken. In addition, a survey of sampling techniques employed in the Nordic countries was carried out. The Nordic intercomparison exercises of laboratory analyses revealed large differences in reported results, and were found to be important both for quality assurance / control reasons and as a part of basic training for new staff.

BOK-1.2 *Mobile measurements and measurement strategies.*

The objective was to test, compare and integrate different types of field measurements using mobile equipment. Mobile gamma spectrometry aims at mapping contamination levels following a nuclear accident or searching for lost radioactive sources. A Nordic exercise for car-borne gamma spectrometry (CGS), RESUME99, was carried out in Sweden in September 1999, and spectral data collected during the exercise were used in a study of CGS techniques and interpretation of such data. As part of the Barents Rescue 2001 LIVEX in September 2001, the “Gamma Search Cell” exercise was aimed at the search for and identification of lost radioactive sources by airborne and car-borne teams. The BOK-1 project was engaged in the planning and evaluation of this exercise and provided financial support for Nordic participation.

BOK-1.3 *Field measurements and data assimilation.*

Data assimilation denotes the integration of available data following a nuclear accident, with the purpose of improving early prognoses on the radiological consequences of the accident. Activities included a PhD program on data assimilation of atmospheric dispersion, focusing on making a source term estimate based on off-site dose rate measurements, and an Ar-41 field experiment for simultaneous monitoring of meteorology, source term, plume and radiation field. Both the PhD program and the experiment produced valuable information on, e.g., modeling short-range atmospheric transport.

BOK-1.4 *Countermeasures in agriculture and forestry.*

The main objective was to produce a Nordic handbook on agricultural countermeasures, intended for a target group of nuclear and agricultural authorities, the agricultural community and the food industry end users. Quantitative information has been compiled on dose-reducing countermeasures in agriculture and forestry, and presented in a datasheet report and in an electronic database. A late-phase exercise, Huginn, was conducted to test the ability, based on the datasheets, to calculate the radiological and economic consequences of an agricultural countermeasure following a nuclear accident. In addition, a survey of environmental transfer factors for nuclear emergency preparedness was undertaken. In a separate study, forest remediation techniques in the Nordic countries have been reviewed. Increased collaboration between the Nordic agricultural and radiation protection communities was a valuable outcome of this subproject.

BOK-1.5 *Emergency monitoring in the Nordic and Baltic Sea countries.*

A survey of radiological monitoring systems in the Nordic countries, Russia, Estonia, Latvia, Lithuania, Poland and Germany was carried out. The survey was presented in a joint publication of NKS and the Reference Group for Baltic Sea States on Emergency Monitoring Integrated Systems and Early Warning.

BOK-1.6 *Nuclear exercises.*
A workshop, Baltic Nuclear, was held with participation by nuclear authorities and the top management of nuclear power plants in the Baltic Sea region, with the purpose of testing the ability to handle the information pressure encountered during a nuclear emergency. A study of a mobile Internet for nuclear emergency preparedness was undertaken and the system was tested at nuclear emergency exercises.

Many of the results obtained in the subprojects have been communicated in project reports and through dedicated seminars, but also through the use of web pages and internally at numerous project meetings.

BOK-2: Radiological and Environmental Consequences

Sigurður Emil Pálsson, IRSA

The project focused on radioecology in the Nordic countries and areas of interest to them. An important aim was to provide a stimulating environment and to encourage contacts and cooperation between young and experienced researchers, between scientists in different fields (within and outside traditional radioecology) and between scientists within the Nordic countries and neighboring regions. This was done through meetings, seminars and dissemination of information, including use of the Internet. The Nordic network within radioecology is important for national authorities and for new people in the field and for making it possible to start close cooperation quickly between countries, e.g., if needed because of a nuclear accident.

In accordance with the suggestions of the NKS program group, it was decided to structure the BOK-2 project as follows:

BOK-2.1 *Important Nordic food chains.*

BOK-2.1.1 *Radioecological vulnerability.*
The main emphasis was on using old fallout data to improve methods of estimating the effects of radionuclide deposition. This was done by using traditional UNSCEAR models on a combined data set of fallout and Chernobyl data, and by using precipitation data to predict deposition. Each approach was used successfully by participants from the Nordic countries; combined they involved all five Nordic countries and the Faroe Islands.

BOK-2.1.2 *Internal doses.*
The aim was to improve methods for dose calculations based on dietary methods (indirect method) and whole-body counting (direct method). It has, e.g., involved two courses with practical exercises, calibration and intercalibration of equipment and preparation of a handbook for use in emergency situations.

BOK-2.2 *Radioactive tracers in Nordic sea areas.*

BOK-2.2.1 *Sea water transport.*
The subproject focused mainly on radioactive tracers in Nordic waters Tc-99, Cs-137 and, to a lesser degree, I-129.Particular use was made of the Tc-99 peak in a release from Sellafield in 1995. This release has been followed through the Danish straits into the Baltic Sea (with Cs-137 moving in the opposite direction) and along the Norwegian coast into the Arctic Ocean. At the end of the project period no significant increase of Tc-99 had been observed at the Faroe Islands, but indications of increased concentrations in seaweed were found at the northern coast of Iceland.

BOK-2.2.2 *Biological and biogeochemical processes.*
This part of the project focused on processes in the Baltic Sea. Main emphasis was on evaluating existing sediment data, comparing it with recent data, improving the coverage of sampling in the Gulf of Bothnia and improving the knowledge on the role of sedimentation in losses of radionuclides from the water column to the seabed. The last part of this study was to investigate the role of river discharges from Finland into the Baltic Sea.

BOK-2.3 *Applications of ICP-MS for measuring radionuclides.*
This subproject was introduced late in the project period in order to meet increasing interest in investigating the applications of mass spectrometry for measuring long-lived radionuclides. It involved a training course, opportunity for work on own samples and experimental work.

BOK-2.4 *Methodology for defining exemption levels of radionuclides in timber.*
This subproject was also introduced late in the project period. It involved a study on methodology for defining exemption levels for radionuclides in timber.

The BOK-2 project has through the tasks mentioned above provided a stimulating environment for cooperation in various fields of Nordic radioecology. Eight meetings and seminars were held during the project period and feedback obtained from participants indicates that the Nordic network is a highly valued part of the project work.

SBA-1: Nuclear Threats in Nordic Surroundings **Inger Margrethe H Eikelmann, NRPA**

The main task was to aggregate already compiled knowledge of nuclear threats in the vicinity of the Nordic countries into a *base of knowledge*, presented by means of modern information technology and made available to Nordic authorities as a supplement to national emergency preparedness systems. Other users of the website could be media and the general public. The project focused on potential events in nuclear installations and the possible consequences for the Nordic countries and especially on vulnerable food chains, dose to man, environmental contamination and emergency preparedness. The main installations in question were nuclear power plants, nuclear powered ships and nuclear fuel and waste storage facilities. A literature database is presented on a website and as a report with some 500 references, including the most relevant publications, papers and reports on the topic at hand.

At the Workshop 2000 experts from the different Nordic countries presented each country's evaluation of the threats against their territory together with discussions on source terms, models and consequences of nuclear threats.

Atmospheric emission, distribution and deposition of radioactive particles of different size, composition and density were the main topics of a subproject on gravitational settling of particles in dispersion model simulations using Chernobyl data. In another subproject a nuclear emergency preparedness handbook for the Nordic countries (*"Håndbok for atomberedskap i Norden"*) was updated. The new version also includes contributions from Estonia, Latvia, Lithuania and Poland.

A workshop on information preparedness in nuclear emergencies was organized in conjunction with the Barents Rescue Exercise 2001. The fact that it always takes too long for authorities to inform the public in the event of an emergency was discussed. Other topics were how the authorities can set up independent channels to the media; and information handling during a crisis. The authorities can prepare for this by creating contact networks and using modern information technology.

SBA-2: Information Issues **Vibeke Hein, DEMA → Anders Jörle, SKI**

Clear goals were never formulated, but the project intended to answer very much the same questions as the information project of the previous 4-year program. A workshop on information for NKS project leaders and participants was carried out and a combined course and field trip to Sellafield for journalists was arranged. No reports were published. In 1999 a series of organizational and other changes affected the job situation of the project leader and two other central information officers. They all left their positions and no longer were available for NKS work. The Board appointed a new project leader and accepted a new project plan in the fall of 1999. When the new project leader's organization would not support the activities, the Board at its fall meeting in 2000 decided to cancel the information project.

SEK: The NKS Secretariat / NKS-EU Contacts **Torkel Bennerstedt, NKS**

During the 1994 – 1997 program period it was decided jointly by EU/EC and NKS to continue the exchange of information initiated during that period. To that end a joint EC-NKS workshop was held in Brussels in July, 1998, with a greater EU / DGXII attendance than was possible at the STUK seminar in the previous NKS program period (see above). The objective of the workshop was to exchange scientific information and future work plans, identify possible gaps and overlaps in the EU and NKS programs, identify possible fields of cooperation, and lay a foundation for more intensified cooperation in the future. The scope of the workshop was EU and NKS activities (present and planned) in the fields of reactor safety; radwaste management and decommissioning; radiation protection; radioecology; and emergency preparedness.

NKS representatives: Magnus von Bonsdorff, Sigurður M Magnússon, Erling Stranden, Christer Viktorsson, Torkel Bennerstedt.

EU representatives: Hans Forsström, Georges van Goethem, Gilbert Desmet, Giuseppe Cottone, Bertus Haijtink, Sandro Zero, Henning von Maravic, Gerhard Keinhorst, Neale Kelly, Kurt Flugrad, Alejandro Zurita, Joaquin Martin Bermejo.

The appendices of NKS report no. NKS-5 include a summary by the Nordic secretary and the EU conclusions of the workshop in a report by van Goethem. Also see the Board meeting notes from Sept. 17, 1998 at IVO, Finland. This NKS-EU workshop was followed up by a national STUK-EC seminar in Helsinki in September 1998.

Facts in figures:

(Based on information in the evaluation report, NKS-66)

SOS-1	Approximate total NKS spending: DKK 3.7 million 1 summary report 6 technical NKS reports 7 seminars (6 summarized in NKS reports) 3 conference presentations
SOS-2	Approximate total NKS spending: DKK 5.3 million 1 summary report 17 technical NKS reports plus 4 other technical reports Over 10 publications (conference presentations and articles)
SOS-3	Approximate total NKS spending: DKK 2.3 million 1 summary report 3 technical NKS reports 4 seminars (all summarized in NKS reports)
BOK-1	Approximate total NKS spending: DKK 7.7 million 20 technical reports 9 seminars A number of courses and exercises 45 active project participants
BOK-2	Approximate total NKS spending: DKK 7.1 million A great number of reports and publications 4 seminars or courses 70 active project participants
SBA-1	Approximate total NKS spending: DKK 2.0 million 1 literature database on the Internet 1 knowledge database on the Internet 6 reports 6 seminars and workshops Some 40 active project participants
SBA-2	Approximate total NKS spending: DKK 0.7 million 1 workshop for project leaders and participants 1 course and field trip to Sellafield for journalists

Economic issues

During the 1998 – 2001 program two unforeseen economic problems evolved, one of a troublesome nature, the other less unfortunate. A brief account follows in that order.

As a part of the continuous evaluation of the NKS program, the Board ordered a midway status seminar to be held at VTT in November 2000. The evaluation was in most parts positive, and no major changes or corrections of the course ahead were called for. After the seminar there was a serious discussion on some aspects of the **SOS-1 economy** which called for and initiated further action. The Nordic secretary reported on the actions taken during the summer and fall. The Bureau had ordered an investigation by the auditor, and the results were now discussed by the Board. This problem would not have occurred had the project leader been more diligent in following up the expenditures; and the Nordic secretary was too late in realizing the seriousness of the situation. The information from the Secretariat to the project leader had been correct, but it was understandable that he could miss the warning signals, given the format for presenting the figures. The figures were there for everyone to see, also the Board, but nobody reacted in the early phases of the development; and the Nordic secretary did not sound the alarm as early as could be expected. However, the internal system of checks and balances worked, although a bit late. The secretarial routines and formats for presenting economic reports were revised. SOS-1 was later granted additional funding, and the project leader reduced his fee so the total cost matched the given budget. For more information, e.g., on figures and dates, see the minutes of the Board meeting in Roskilde Nov. 7, 2001.

A less serious problem to tackle was what was referred to as "the luxury problem": the growing amount of funds on the four national NKS accounts. The development of present funds at the end of the fiscal year, as can be seen from the records distributed annually by the Secretariat, was the following:

1997	DKK 4.7 million
1998	8.4
1999	11.4
2000	11.1
2001	5.6
2002	4.0

The situation led to several Board discussions on the reasons and the way forward. The owners (or the home organization, be it a department, ministry etc.: or the taxpayers, for that matter) did not want to spend money on accumulating NKS funds. If nothing was done to rectify the problem, chances were that NKS funding would dwindle in the future. The root of the problem was two-fold: the Board could have commissioned more work to be carried out; and the organizations performing the work – especially in the BOK area – were usually late in billing NKS for their work. The obvious long-term solution was to review the budget process as regards new project proposals (which was done under the new R&B program starting in 2002), acutely add a couple of new projects to the ongoing program (see below) and not least, to make sure that all organizations under contracts with NKS send their bills regularly, as stated in the contract. As can be seen from the table above, this had an immediate effect, and the problem has not occurred again.

Additional activities

In addition to the the regular NKS program described above, the Board sanctioned NKS participation in one large-scale international exercise (Barents Rescue, presented under BOK-1.2 above) and two seminars, all in cooperation with non-NKS organizations.

In the first of the two seminars, NKS commissioned its Norwegian owner, NRPA, to arrange and host – with generous NKS financial support – a seminar entitled " Radiation Protection in the 21st Century: Ethical, Philosophical and Environmental Issues" in Oslo, Norway in October 2001. NRPA cooperated with the Agricultural University of Norway and The International Union of Radioecologists. In a number of sessions and with several invited speakers the following topics were covered:

- Risk assessment and management
- Practical application
- Public perception, communication and participation
- Waste management
- Protection of the environment from ionizing radiation
- General philosophical and legal issues
- Ongoing work
- Uncertainty and the precautionary principle

In a concluding session, called Consensus Conference, participants were served a draft Consensus Statement, which caused some controversy. After intense discussions the majority of the participants signed the final, somewhat diluted document which was published separately as a folder. At a later stage the NKS Board decided not to sponsor this type of events in the future and declared its unwillingness to participate in consensus seminars or similar events in general.

The second extracurricular NKS activity was a seminar in Malmö, Sweden, in November 2001 on the theme "Quality in Radiation Protection Work in Nuclear Installations". The project was initiated by the Nordic Society for Radiation Protection (NSFS) and carried out in close cooperation with staff from the Barsebäck NPP (BKAB) in Sweden. The intention was cost-sharing and close cooperation between NSFS and NKS. It soon turned out, however, that NSFS would not contribute in any fashion. Had it not been for the sponsoring, enthusiasm, vast network and dedication of the Barsebäck representatives, there would not have been a seminar. Now some 70 people gathered to listen to presentations and take part in in-depth discussions on practical, hands-on radiological work in a diversity of situations during normal operation conditions. The presentations covered areas like the following:

- What is required in radiation protection work
- What quality in radiation protection work means and how to achieve QA
- What environmental and quality certification processes mean in practice
- The future of nuclear power in the Nordic countries
- Challenges in nuclear safety in a longer perspective, including decommissioning

A questionnaire showed that the majority of the participants were satisfied or very satisfied with the seminar and wanted to see a new seminar on the same theme in about two years. (*Author's comment:* A second seminar on the same theme was arranged by NKS and BKAB in Malmö, Sweden, in February 2004.)

Major Seminars, Exercises and Other Events

Pre-project seminar on Sept. 16, 1998, the day before the Board meeting at IVO, Finland.

Status seminar on Feb. 9, 1999, the day before the Board meeting at DEMA, Denmark.

Status seminar on Sept. 14, 1999, the day before the Board meeting at SKI, Stockholm, Sweden.

Midway seminar with tentative evaluation of current results on Nov. 7 – 8, 2000 before the Board meeting in Helsinki.

The Eighth Nordic Seminar on Radioecology, STUK, Rovaniemi, Finland 2001 (with an NKS session).

SOS-1:

- SOS-1.1 seminar on Risk Assessment in Bergendal, Sweden in April 1999.
- SOS-1.1 presentation at the international VALDOR conference in Stockholm, Sweden in June 1999.
- SOS-1.1 seminar on Risk communication in Oskarshamn, Sweden in October 2000.
- SOS-1.3 seminar on Safety Analysis at Risø, Denmark in March 2000.

- Joint SOS-1.2/SOS-3.1 seminar on EIA and SEA in Turku, Finland in August 2001.
- SOS-1.3 seminar on Safety Indicators at VTT, Finland in March 1999.
- SOS-1.3 seminar on Safety Culture in Olkiluoto, Finland in October 1999.
- SOS-1.3 seminar on Quality Assurance in Ringhals, Sweden in January 2001.

SOS-2:
- SOS-2.1 Seminar on Risk Informed Principles in Bergendal, Sweden in April 1999.
- SOS-2.1 participation at the ESREL conference in France, March 2002.

SOS-3:
- Four SOS-3.1 EIA seminars: Gardermoen, Norway in November 1998; Roskilde, Denmark in August 1999; Mývatn, Iceland in September 2000; and Turku, Finland in August 2001.
- SOS-3.1/SOS-1.2 seminar on EIA and SEA in Turku, Finland in August 2001.

SOS-3 EIA Seminar in Mývatn Photo: Lena Bennerstedt

BOK-1:
- BOK-1.1 seminar on detectors and techniques for analysis of radionuclides in Sweden March 2001.
- Two BOK-1.1 seminars on accreditation: Skagen, Denmark 1999 and Oslo, Norway 2000.
- Two intercomparison exercises on gamma spectrometry.
- BOK-1.2: RESUME99 – International exercise on mobile gamma spectrometry, Sweden, September 1999 plus follow-up seminar.
- BOK-1.2: “Gamma Search Cell” exercise of Barents Rescue 2001 LIVEX in Sweden September 2001 plus follow-up seminar.
- BOK-1.3: Participation in an international experiment on monitoring and mapping an Ar-41 release in October 2001. NKS, SCK-CEN/Mol, Belgium and Risø, DTU and DEMA, Denmark.
- BOK-1.4: Nordic table-top exercise Huginn in 2000 to calculate radiological and economic consequences of a nuclear accident.
- BOK-1.6: Baltic Nuclear Workshop in Lidingö, Sweden 2001 on on crisis management and crisis communication.

BOK-2:
- BOK-2.1.2: Two courses in internal dose calculations (STUK, Finland in October 1999 and one planned for the fall of 2001 but postponed to the spring of 2002).

- BOK-2.3: Training course in mass spectrometry at NLH, Norway in November 2000.

SBA-1:
- Workshop 2000 in Oslo, Norway, on nuclear threats in Nordic surroundings.
- Participation in Barents Rescue 2001 LIVEX in Sweden September 2001 with a Nordic workshop on information preparedness in nuclear emergencies.

SBA-2:
- Workshop 1999 on information issues for NKS project leaders and participants.
- Combined course and field trip to Sellafield for journalists in 1999.

EC-NKS Workshop at DGXII in Brussels in July 1998 on the topic of possible future cooperation and exchange of information.

NKS/NSFS/Barsebäck NPP seminar on quality in radiation protection work at nuclear facilities (November 2001) in Malmö, Sweden.

Radiation Protection in the 21st Century: Ethical, Philosophical and Environmental Issues. Consensus Conference on Protection of the Environment. Formally arranged by NRPA and NLH on behalf of NKS, in cooperation with IUR. (Oslo, October 2001.)

Transition seminar "NKS today and Tomorrow" (March 19 – 21, 2002) on the results of the old NKS program and plans for the new program; in Roskilde, Denmark.

Evaluation of the Scientific Program 1998 – 2001

Evaluators: Gustaf Löwenhielm, SKI, and Raimo Mustonen, STUK. See report no. NKS-66.

The scientific achievements of the sixth and last 4-year program were evaluated by Gustaf Löwenhielm, SKI (focusing on SOS and SBA issues) and Raimo Mustonen, STUK (focusing on BOK and SBA issues). The scientific evaluation followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. One of the major recommendations was to introduce the added Nordic value as a new criterion when assessing new proposals. The evaluators supported the proposed future division of NKS work into two areas (R&B). These are some of their findings.

More than 200 experts from the Nordic countries participated in the SOS, BOK and SBA projects of the sixth NKS 4-year research period. The program clearly proved that this kind of cooperation is needed to develop the joint Nordic view on radiation and nuclear safety issues and to maintain and develop direct personal contacts between the authorities and researchers. In this sense NKS is not only a forum for research cooperation, but also an important contact organ between the competent authorities. The general objectives of NKS cooperation are described in the contract of main sponsors (nowadays called the owners), but it is obvious that further and wider information about the objectives is needed.

General remark: It is not always clear what the aims of a project or subproject are (expected results, deliverables etc.). At times it is unclear when and why a subproject was added. Things like that should be clearly reflected in the minutes of the Board meetings.

The SOS program (Nuclear safety and radiation protection):
SOS-2 focused on reactor safety and SOS-3 on waste safety. SOS-1 was more aimed at meetings to discuss "soft" issues, e.g., safety culture and risk assessment, which led to interesting discussions between Nordic organizations. SOS-2 addressed technical questions such as PSA and severe accidents, and many interesting results were published in NKS reports and other publications. One of the SOS-3 subprojects addressed EIA in yearly meetings, and participants from all Nordic countries attended these meetings. The other subprojects gave a good survey of Nordic interim storage for low and intermediate level waste and also for clearance levels for metals.

SOS-1 ***Risk assessment:*** The work was carried out in cooperation with the EU project RISCOM-II. Focused on Oskarshamn NPP and communication with the public. The report is of great interest.

Safety analysis: No clear definition of the objectives has been found. A continuation of the subproject is not necessary.

Strategies for safety management: A concise set of objectives is hard to find. Dealt with issues relevant to safety management. The utilities participated, which is very valuable. The latest international trends and development should have been included – the Nordic situation does not give a full grasp of the situation. It is however important to continue this work.

SOS-2 General remark: A very productive project when it comes to the number NKS reports and international publications. Much less focus on seminars. The results of SOS-2 are interesting and valuable to the end users.

Safety development: Continuation of RAK-1. Connected to SOS-1. Good that the dependence of PSA results on the object and evaluators is brought up. Risk informed methods are of great value to utilities and authorities alike.

Management of plant maintenance and renewal: Continuation of RAK-1. Of interest both to utilities and authorities, especially in view of the deregulation of the electrical power market and the rising demand on increased profits.

Severe accidents: Continuation of RAK-2. Compiling state-of-the-art information is worthwhile and should be done on a regular base. Important to maintain Nordic competence as regards organic iodine. The results are valuable and work should be continued either by NKS or the power plants. The hydrogen issue is interesting in the case of BWR; it is not obvious why the PWR case was included.

SOS-3 Oddly enough there does not seem to exist any overall objectives for the entire project, just goals for the three subprojects. The work was led by the project leader personally, not with the assistance of a project group, as the others. This had advantages and disadvantages (resources vs. overview). In this case (SOS-3.2 and SOS-3.3) a project group hade been preferable.

Environmental impact assessments: Continuation of AFA-1.3. The aim was to highlight the differences in EIA policy and work in the Nordic countries. This was achieved through a series of seminars where some non-nuclear cases were also studied. The seminars were successful and had deserved a larger audience. The Nordic perspective was strongly stressed, and the Icelandic participation was valuable.

Intermediate storage: The objective was to analyze Nordic experiences of storage and deposition of low and medium level waste. Swedish NPPs were not included. Iceland was not mentioned. The work at Kjeller, Norway, was delayed which affected SOS-3.2.

Contamination levels in metals: Measurements show no or insignificant amounts in the studied samples. Hence, doses to the public will be small. This is an interesting result in itself, and should be communicated. The compilation of Nordic regulations on clearance is valuable.

The BOK program (Nuclear preparedness and consequences):
Management of nuclear emergencies and consequences of radioactive releases into the environment are of common interest to all Nordic countries. The projects in this field (BOK-1 and BOK-2) gathered plenty of participants from all the Nordic countries. In this sense BOK-1 and BOK-2 had a very wide Nordic dimension. Activities in BOK-1 aimed at more coherent procedures in the authorities' arrangements in emergency management and produced a real Nordic added value. BOK-2 was a more heterogeneous project than BOK-1, but on the other hand BOK-2 produced new knowledge which can be applied in development of emergency management. BOK-2 also succeeded to attract young scientists to join NKS work. This is of special importance in a business where concern about the future of competence has increased. That is why it is important that NKS continues to develop contacts with different universities in the Nordic countries.

BOK-1 The project had its background in the earlier BER and EKO programs. It attracted participants from all Nordic and Baltic Sea countries, Belgium, Canada, EU and Scotland. The coordination and administration of the project was excellent. The Nordic perspective was well taken care of.

Laboratory measurements and quality assurance: All activities were valuable. It was demonstrated that the Nordic countries are well prepared to make good quality measurements in case of an emergency. But there is a common need to continue the work. Cooperation pays off.

Mobile measurements and measurement strategies: Basically the same conclusions as for the subproject above.

Field measurements and data assimilation: This was the only BOK-1 subproject that was not Nordic, with just Danish and Belgian participation. It was the first NKS sponsored PhD study.

Countermeasures in agriculture and forestry: Continuation of EKO-3.4 and EKO-5. The database created here should be integrated with RODOS and ARGOS. This subproject has strengthened the Nordic outlook and approach to these issues. Good compilation of Nordic procedures.

Emergency monitoring in the Nordic and Baltic Sea countries: Update and extension of BER-2.1, initiated by the Council of the Baltic Sea states. This valuable handbook covers 11 countries. Good compilation of involved organizations and their tasks.

Exercises: This subproject has strengthened the Nordic outlook and ability to cooperate and exchange information under emergency conditions.

BOK-2 The project had its background in the earlier RAD and EKO programs and was more heterogeneous than BOK-1. The many environmental surveys are more costly than other types of NKS work. This required cooperation and co-financing of a number of organizations. NKS funding was only a small fraction of the project budget. BOK-2 was a good Nordic forum for networking and training, with some Baltic participation. The importance of involving universities could be stressed even more, and the NKS Board should consider ways to support this.

Important Nordic food chains: It is obvious that the term ”radiological vulnerability” has been used without prior definition. However, the spectrum of the nuclides studied is wide and the results are of great use in radiation protection. It was shown that frequent intercalibrations are needed in whole body measurements.

Radioactive tracers in Nordic sea areas: The Tc-99 studies were valuable, not only because of public concern regarding some actual releases. The Nordic competence has increased. The vulnerability of he Baltic Sea was clearly demonstrated.

Development of application of ICP-MS: It was demonstrated that this technique, with some caution (interference with other isotopes than the one being studied), is applicable both for heavy and lighter isotopes.

Methodology for defining exemption levels of radionuclides in timber: Different clearance levels and dose limits were studied. The results should be of commercial interest to the forest industry.

The SBA program (Safety and preparedness related activities):
The SBA projects were an attempt at dealing with aspects of the SOS and BOK areas simultaneously in transdisciplinary studies.

SBA-1 The project was divided into two parts. One aimed at creating an Internet literature database with publications on nuclear installations in the Nordic countries and surrounding areas. Approximately 500 publications were included. The other part of the project was to create an Internet base of knowledge on risks and nuclear threats to the public and the environment. It is important that these excellent databases are made and kept operational, and that NKS or relevant authorities take on the responsibility of updating and developing the databases. This task might be handled by the NEP group. SBA-1 depends on the SOS and BOK programs for input, and this work was not completed at the time of the evaluation. Overall, the project reached its goals fairly well.

SBA-2 No goals or objectives were defined for this project, which instead set out to answer a number of essential questions. Due to a number of circumstances mostly beyond the control of the project as such (plus perhaps a lack of proper planning) a restart was required. The project never quite recovered after this, in spite of a new project leader and changed plans. Thus, the Board decided to close the project in the fall of 2000. By then SBA-2 had arranged a combined course for journalists and a field trip, plus a workshop for project participants. The project failed to achieve most of its planned activities. No reports were produced. The necessary task of developing the NKS website was taken over by the Secretariat. *As for NKS information activities in general, the proper authorities and financiers should define what services are required from NKS* – any actions should be end-user driven. Future plans – if any – should be more concrete.

The evaluators' recommendations:

- Coordination of NKS cooperation with national and European programs will become more and more important since the resources are limited. It is therefore recommended that NKS applies a new criterion – **the Nordic added value** – when assessing new project proposals. This criterion should answer the question why a certain project should be carried out at the Nordic level rather than the national or European level.
- Radioecological studies should aim at resulting in environmental models to be incorporated with national decision making tools.
- Strive for development of a joint Nordic strategy for actions in case of a radiological emergency (Strategy of Emergency Response):
  - Joint generic criteria for protection of the general public
  - Jointly agreed cooperation procedures in emergency situations (who will do what?)
  - Joint basis for decision making in radiological emergencies
  - This Nordic strategy is to be accepted at the highest possible authority level
- Develop procedures for evaluation of new project proposals (continuous call).

The evaluators' concluding remarks

The proposed division of the new NKS program into two main areas, each led by a relatively independent program manager, is supported.

As a part of the evaluation, a questionnaire was sent to the most important potential end users of the NKS results. The following organizations did not respond:

- DEMA and SIS in Denmark
- TEM and TVO in Finland
- NRPA in Norway
- SSI in Sweden

(*Author's comment*: It is of inerest to note that four out of six owners did not respond to the questionnaire.)

Evaluation of the NKS Structure

Evaluator: Martin Høiby, NRPA. See report no. NKS-67.

Normally, only the scientific work and results have been evaluated, with the possibility for the evaluator(s) to comment on structural and administrative questions as needed. But in this transition period between the old 4-year programs and a more flexible structure, it was decided to evaluate non-scientific issues as well. To this end, Martin Høiby, NRPA, was engaged. The structural and administrative evaluation followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. Overall, the evaluation was quite positive; however, the cost for the administrative services was found to be a bit high. These are some of the evaluator's findings.

The main object of the collaboration under the auspices of Nordic Nuclear Safety Research (NKS) is to promote greater safety, expertise and knowledge in the field of nuclear safety. The institutions that fund NKS decide what projects the organization is to carry out.

In principle NKS purchases all requisite services. This includes executive secretary and secretariat services as well as project management. The executive secretary prepares and monitors implementation of decisions, coordinates east-west cooperation and contact with EU and, in conjunction with the secretariat, provides administrative support to the entire organization. The safety, radiation protection and emergency preparedness authorities in the Nordic area (the consortium partners, now called the owners of NKS) and other interested parties finance the program with financially debitable funds and cover the costs of releasing staff for NKS operations.

NKS operations were at the time of the evaluation planned on a cyclical basis. The governing bodies adopted a program for a given period on the basis of the wishes and needs reported by the interested parties. The program was divided into projects, and the actual research and report work was done by a project group headed by a project manager. The program was funded, implemented and evaluated.

In connection with the evaluation of the 1998 – 2001 program the Board decided to commission an evaluation of the organization. The mandate for this evaluation was to

- establish whether the work of NKS has been well planned and cost-effective in organizational and administrative terms, and the results properly disseminated
- assess the role of the Board and its working group (the Bureau) as well as the administrative support given to the program as a whole and for the respective projects
- learn lessons from the experience and make recommendations for a possible new research program

In terms of method, the basis for the evaluation was three-fold:

1. A questionnaire circulated among Board members and project managers
2. A review of material forwarded by the secretariat concerning finances and administrative matters
3. Attendance at the Owners Group and Board meetings in May 2001 in Reykjavík

The conclusion of the above review is that

- the overall impression is excellent
- the NKS organization – i.e., the Board, its working group, executive secretary and secretariat – generally prepares the ground well for research and report work carried out under the program, including the necessary planning
- the technical support of some of the projects could have been somewhat more intense and/or consistent in the program period
- the internal dissemination of results from research and report work (i.e., among colleagues and the parties) is good, but could be improved somewhat where external institutions are concerned
- the administrative support is excellent; the costs make up about 20% of total debitable expenses
- budgeting is unrealistic

In order to put the overall basis for the program period on a firmer footing, this review proposes drawing up a strategic, long-term plan for NKS collaboration. The strategic plan should, in addition to technical aspects, indicate where the line should be drawn between program projects on the one hand and work done at the national level and in other international nuclear safety contexts – both at the governmental level and other levels – on the other. Plans for the NKS program in the program periods should then be linked up to the strategy document. In order to achieve better separation of roles and responsibilities, the task of the consortium partners could suitably be confined to appointing the Board, which in turn would have all the tasks traditionally assigned to a board. On grounds of practicality and efficiency this review recommends downsizing the Board somewhat, with nine persons given as an example.

When it comes to bringing research and report results to a wider audience than the inner circle of NKS, and to market NKS competence to take on commissioned assignments, steps should be taken, for each project, to consider selective information measures vis-à-vis relevant users.

Achieving improved financial management requires realistic budgeting to ensure that costs accrue in the period to which the allocation applies and that actual costs are formally debitable. This will significantly improve the opportunity to discover variance and – not least – enable audits to be carried out early enough for a balance to be maintained year by year across the period. A further effect of realistic budgeting, which is crucial to future NKS funding, is that it enables financiers to run their own financial management according to the cash principle, which is a basic premise where the Norwegian consortium partner is concerned. In order to facilitate and quality assure the basis for the governing bodies' decisions, a requirement could be introduced to ensure that written documents from the secretariat are available for all business to be dealt with where they may be of use. Such documents should show what type of case is involved; whether for information purposes, for discussion or for a decision to be made. The documents should in such case accompany notice of the meeting in question.

House with Japanese Garden, Roskilde
Photo: Lena Bennerstedt

Shaping a New NKS: The Transition Seminar in Roskilde 2002

The discussions on a new NKS program structure were formally initiated by the Owners at a meeting in February 2000, when there still remained two years of the sixth 4-year program. It was decided to start national processes to review the overall structure and organization of NKS work and outline a new program. A series of interviews, meetings and discussions were arranged in the five owner countries, especially in Finland where a number of very constructive meetings were held with all involved parties. The Bureau initiated an iterative process where the Bureau presented a proposal to the Board; the proposal was discussed and commented by the Board; the Bureau worked out a revised proposal; etc. This eventually resulted in a comprehensive document, NKS(01)2, identifying the major areas of work, each led by a program manager reporting directly to the Board:

- NKS-R: Reactor safety
- NKS-B: Emergency preparedness

Once finalized, it was decided to present the plans to a wider audience at the transition Seminar ”NKS Today and Tomorrow” in Roskilde, Denmark, March 19 – 21, 2002. There were three main agenda points for the seminar:

- Results of the 1998 – 2001 NKS program
- Invited international speakers
- Plans for a new NKS structure

This seminar marked the formal termination of the old program and the commencement of the next. It also meant new leadership for NKS, since Magnus von Bonsdorff had declined to continue as chairman; instead, the Owners had appointed Helge Smidt Olsen as his successor.

The Roskilde Seminar March 19 – 21, 2002

After a short opening statement and welcoming address by the chairman and the Nordic secretary followed a number of presentations, and – where time so allowed – discussions. These were the presentations.

The sixth 4-year program

- BOK-1: Bent Lauritzen, Risø, Denmark
- BOK-2: Sigurður Emil Pálsson, IRSA, Iceland
- SOS-1; Kjell Andersson, Karinta-Konsult, Sweden
- SOS-2: Kaisa Simola, VTT Automation, Finland
- SOS-3: Karin Brodén, Studsvik RadWaste, Sweden
- SBA-1: Inger Margrethe H Eikelmann, NRPA, Norway
- NKS Secretariat: Finn Physant and Annette Lemmens, FRIT, Denmark
- Scientific / technical evaluations: Gustaf Löwenhielm, SKI, Sweden, and Raimo Mustonen, STUK, Finland
- Organizational / administrative evaluation: Martin Høiby, NRPA, Norway

Since all the above material has already been presented elsewhere in this report, it is not further commented or quoted here.

Invited speakers

- Nuclear Power: Past Accomplishments, Future Challenges
  Gail de Planque, former commissioner at the US Nuclear Regulatory Commission
- Radiological Protection at the Start of the 21st Century: A Progress Report
  Roger H Clarke, Chairman, ICRP

The international session was opened by Sigurður M Magnússon, IRSA, Iceland, who also introduced the two distinguished speakers. They had been invited by NKS to share their expertise and offer inspiration when planning for future R&B work.

In her presentation, **Gail de Planque** pointed to the fact that nuclear power undeniably is a mature industry with worldwide positive trends. Operational parameters have improved substantially. The public safety record is superb. Economics have improved dramatically. International infrastructures are in place to ensure continued progress, safety and cooperation. So, she asked, what about the next 40 years? The worldwide demand for electricity is going to continue to increase. This will require the contribution of nuclear power; some even argue that this will be the generation mode of choice. However, many factors, beyond logic and statistics, will influence the actual outcome. These factors can be broadly categorized as technical, economic, infrastructural, social and political with many elements falling in more than one category, forming a complex matrix of challenges to the future of nuclear power.

The technical issues are most easily identified and addressed. They involve plant aging management and the need to develop and commercialize plant designs for the future. Also included is the need to advance other aspects of the fuel cycle technically. Not so obvious are human resources and expertise, where technology can play a meaningful role in ensuring these essential resources.

Economic issues are also relatively straightforward. The bottom line is that nuclear power must be competitive with respect to both time and money in terms of

- construction costs
- fuel and other operation costs
- waste management and disposal
- liability issues

Critical to economic viability is the overarching need for known and stable regulatory environments, which in turn are influenced by socio-political and infrastructure considerations.

The more difficult areas are social and political, which of necessity must be considered in combination because they are inextricably intertwined. Since 9/11, security has perhaps emerged at the top of the list of socio-political issues, with proliferation not far behind. Then there is the issue of energy independence. Not far behind is the concept of ”sustainable development”, which is overladen with philosophical, social and politically controversial baggage. But perhaps most critical to the future of nuclear power is the need for public support and political will which are almost totally interdependent.

To flourish in the future, nuclear power needs adequate international infrastructures

- to provide international consensus standards
- to enable rapid exchange of technical knowledge and experience
- to foster creative economic mechanisms and solutions
- to provide transparency with respect to all matters affecting societal risk in the areas of safety, health and environmental integrity
- to provide channels of credible scientifically-based information

Will the above requirements be met in a way that will secure a future for nuclear power? Well, this wasn’t purported to be simple or easy.

”It is difficult to make predictions, especially about the future.”
(Baseball player Yogi Bera, as quoted by Gail de Planque)

After this, **Roger Clarke** reported on the ongoing deliberations regarding new recommendations for radiological protection, to replace those given in ICRP Publication 60. ICRP (International Commission on Radiological Protection) has stated that its basic recommendations are either restated or revised at intervals of about 15 years. ICRP 60 was adopted in 1990; a revision is expected to appear in 2005. (*Author’s comment:* I.e., some 3 years after the Roskilde seminar. Actually, ICRP 60 was not superseded by ICRP Publication 103 until 2007.) The new recommendations will

- emphasize egalitarian values more than utilitarian ones
- be holistic rather than anthropocentric
- be formatted as a relatively concise set of actual recommendations underpinned by separate publications elaborating on the detail

The initiative represents a genuine attempt to simplify the system of protection to one that is more coherent and easily explicable.

In 1977 ICRP quantified the process of optimization from single radiation sources and adopted, implicitly, a utilitarian ethical policy when it recommended the use of cost-benefit analysis which aims to answer the question, ”How much does it cost, and how many lives are saved?” This involved calculating collective dose and thereby emphasized the protection of society over that of individuals. So ICRP modified the principle of optimization by introducing the concept of a constraint. This is an individual-related criterion, applied to a single source in order to ensure that the most exposed individuals are not subject to excessive risk.

The recommendations for justification given in ICRP 60 require that the practice should do more good than harm. This procedure implies a quantified balance of costs and benefits, but in practice, governments, physicians, or individuals do not make decisions about courses of action in a predominantly quantitative way. A qualitative approach is more common and usually more appropriate.

The responsibility for judging justification usually falls on governments or government agencies. In medical exposure of patients, using a generically justified technique, the responsibility falls on the relevant medical practitioners. For non-medical exposures, it is the ability to take action to control the individual dose from a particular source (natural or artificial) that is the important issue.

The first consideration in the proposed system of protection is to provide, for each source where action is practicable, a minimum level of health protection for individuals by means of setting Protective Action Levels. The need for protective action is influenced solely by the individual dose, and not by the number of exposed individuals. Control at the source will always be preferred, but where it is feasible only to modify the pathways by which people are exposed, consideration can also be given to the development of protective action levels.

The second consideration stems from the recognition that that there is likely to be some risk to health, even at small doses. This introduces a moral requirement, for each controllable source, to take all reasonable steps to restrict both the individual doses to below the action level and the number of exposed individuals. Under ICRP 60, the optimization of protection provided that criterion.

A set of suggested basic protective action levels was presented. They do not apply to justified medical exposures. Protective action levels can be considered as establishing a minimum level of health protection, which may be applicable globally. However, for any particular source there is a need to reduce the doses to a level that is as low as is reasonable under the prevailing circumstances. The residual doses, after application of the protective action levels, should be kept ”as low as reasonably practicable” (ALARP). The process of optimization in the future may best be carried out by stakeholder involvement to determine or negotiate for the best level of protection under the circumstances. The achievement of consensus would replace the previous formal cost-benefit analysis.

ICRP is rethinking its anthropocentric policy, i.e., that if humans are protected to the degree thought necessary, then other species are adequately protected. Radiological protection of the environment may need to be considered in its own right, leading to a more holistic system. ICRP needs a more comprehensive system that should be in line with control of other pollutants, transparent, and with proper scientific references.

The R&B program

- Where does NKS stand today?
  Status report by Magnus von Bonsdorff, former NKS chairman
- Principles and processes: The R&B program
  Magnus von Bonsdorff, former NKS chairman
- Expectations of the Owners Group
  Ole Harbitz, NRPA, Norway, and Lars Gunsell, SKI, Sweden
- Expectations of the nuclear industry
  Karl-Fredrik Ingemarsson, FKAB, Sweden, and Heikki Raumolin, TVO, Finland
- The NKS-R&B program
  Program managers Timo Okkonen, STUK, Finland, and Sigurður Emil Pálsson, IRSA, Iceland
- NKS in the future: An introduction
  Helge Smidt Olsen, new NKS chairman

The former NKS chairman **Magnus von Bonsdorff** presented his paper in two parts. The first part highlighted the state of NKS at the end of the sixth 4-year program. As stated in the second part, the transition to the new R&B program from 2002 onward was intended to bring about a number of important administrative and organizational changes.

In his first presentation, Magnus von Bonsdorff touched upon the importance of seriously rethinking the objectives of NKS and developing a long-term strategy. In addition to well-known criteria such as the Nordic perspective and the technical / scientific contents of the program, a definition is needed of the actual added value that NKS is intended to generate for its owners, participating organizations and end users. NKS should be the perfect Nordic forum for achieving true harmonization among relevant authorities as regards, e.g., emergency response and crisis information. Mutual understanding of the Nordic neighbors’ national criteria and routines is not enough in the long run. Concrete common directives would serve to avoid confusion in critical regional or international situations. A general observation is that NKS interest seems to a certain degree have shifted from hardware centered questions to softer issues like human behavior. It might also be of interest to incorporate activities on societal issues in order to avoid misunderstandings and misconceptions in the nuclear debate. The value of competence building should not be ignored, especially as regards the young generation actively looking for interesting career alternatives.

In his second presentation, Magnus von Bonsdorff introduced the new dynamic concept of the two major fields of research, R&B, and some of its advantages over the older, more static system of relatively inflexible 4-year programs. The background and merits of the two program managers were introduced. Both the scientific structure and the NKS organization and many of its administrative routines will be simplified and made more cost effective. (*Author's comment:* More on this in sections to follow.) New ways of boosting the nuclear industry's interest in NKS work and attracting more of its experts must be created. The speaker recommended that NKS, its structure, work and results be evaluated every four years or so. (*Author's comment:* The years 2002 – 2005 were evaluated in 2006; see below. By the same token, the following four years, 2006 – 2009, should have been evaluated in 2010. Perhaps it is time to start preparing for an evaluation late in 2011?) In conclusion, the former chairman looked to the future with great confidence and expressed his thanks for the invaluable spirit of cooperation that helped shape his eight years as chairman.

Then two speakers presented the owners' expectations on the new NKS structure and the coming R&B activities.

Ole Harbitz of NRPA, Norway said that the financiers expect the produced results to be useful, cost-effective and flexible. Originality, scientific importance and quality are decisive parameters for NKS activities, with the objective of producing relevant new knowledge. Radioecological studies concerning previous incidents and fallout should be continued, especially as regards regions of specific Nordic interest (including arctic and marine environments) and other nuclides than cesium. Studies of accumulation in the food chains and transfer of radionuclides in seminatural ecosystems should also be included. Dose assessment models should be further developed. Since four of the Nordic countries face decommissioning of nuclear facilities, NKS-R should deal with the challenges that await.

NKS should strive to improve and encourage education, new competence, recruiting, increased Nordic cooperation and harmonization of views in the nuclear field. Young scientists need knowledge, international experience and networking. Organizations involved in NKS work must supply ample competence and capacity to carry out the planned NKS activities. Supporting MSc programs could be one way of increasing the present level of education. The Nordic dimension must not be forgotten – at least three Nordic countries should participate in all major activities.

One of the corner stones of NKS is improved emergency preparedness. Dialog and interaction between emergency preparedness, radioecology and communication must be prioritized. Several decision support systems are used (e.g., ARGOSand RODOS). Differences between the systems could be assessed and needs for development identified. Radioecological tools for estimation of transport – uptake – dose should be studied in terms of validation, sensitivity analysis and (perhaps) harmonization. Joint exercises are valuable, including late-phase scenarios and food production. Studies of nuclear threats in Nordic surroundings must be continued. Policies for coordinated crisis management and exchange of information are important. A virtual Nordic command center might be developed, the starting point being a common password protected webpage. Various types of measurements should be harmonized and standardized.

Continued owners group interest in NKS work demands that all proposals for new activities are more specific as to dissemination of information and implementation and use of the results. A special responsibility rests with the involved authorities, in that they must set aside the resources needed to participate in the NKS activities and be prepared to implement the results. The authorities – not NKS – are the owners of the results and should coordinate the way the results are put to use, e.g., via the Nordic Directors Group.

NKS work must take similar activities on an international scale into consideration, be it ICRP, IAEA, OECD/NEA, EU, regional (Barents Sea or Baltic Sea) or bilateral, in order to fill in gaps and avoid overlaps. Can NKS contribute an added Nordic value? Environmental impact assessments and IAEA "Joint Convention" work may serve as examples.

Lars Gunsell of SKI, Sweden, said that a very simple answer would be that

- the new NKS program is carried out according to plans and the owners' intentions
- the changes in structure and forms of work lead to improvements
- the owners decide on the direction and way ahead; whereas the Board approves the programs and activities and assume responsibility for the fulfillment of the expectations

By initiating and supprting research, competence building and exchange of information NKS should contribute to improved nuclear safety and emergency preparedness. The results of the work should be easy to recognize and assess. The end users should get more involved in the NKS work, and the results should be used and implemented more frequently than before. It is important that the plans for increased flexibility are carried out in practice, and maintained over the years.

On a higher level, it is hoped that NKS contributes to a common view as regards nuclear safety and emergency preparedness among all involved decision makers and experts at the relevant authorities and other institutions. NKS should encourage Nordic cooperation, and its work should be characterized by transparency and mutual trust. This is especially important since two of the countries have rather extensive nuclear programs. The Nordic perspective becomes all the more important when it comes to competence building – it is impossible for a single country to have the necessary competence, experience and knowhow. Finally, NKS could play an important role in a world of increased global networking and international cooperation. For the Nordic region, EU is the obvious partner.

The expectations of the nuclear industy were presented by **Karl-Fredrik Ingemarsson**, FKAB, and **Heikki Raumolin**, TVO. Unfortunately, their presentations were not retrievable when writing this report, which indicates that their manuscripts were never sent to the Secretariat for filing.

The NKS-R and NKS-B programs are presented at some length in the following sections; therefore, the presentations of the program managers have been omitted here.

The new NKS chairman, **Helge Smidt Olsen**, shared some of his views on the development and future work of NKS in a short-term perspective. What are the current issues that will have to be addressed? How should NKS be organized to improve quality, efficiency and relevance of its work? It is necessary to be attentive to the wishes of the owners, to deliver and disseminate results of high standard and to strive for more cost-effective structures and routines. The evaluation reports for the last two 4-year programs offer a number of good recommendations, and some of them have already been implemented. The future of NKS is highly dependent on the future of nuclear power in Finland and Sweden as well as internationally. Hence, the degree of acceptance of nuclear power as a sustainable and necessary source of energy will be important. So will the authorities' need for quality control and good inspection tools. This applies to nuclear safety as well as radiation protection, radioecology and emergency preparedness. Some claim that the international deregulation of energy markets might lead to greater focus on economy and increased profits, as opposed to safety research and safety measures. This should increase the demand for joint research activities, such as offered by NKS. But NKS must actively work to get this fact across to the nuclear industry. Issues on radiation vs. the environment are a matter of global concern. (*Author's comment:* This is in line with the presentation on new ICRP recommendations above.) NKS should follow this debate closely. It is also important to contribute to the education of young scientists and to promote work in the field of nuclear energy and nuclear safety as important and attractive career openings. Maintaining and building of competence should therefore be a prioritized area. To sum up, there will be no shortage of tasks for NKS in the future.

After this, the Nordic secretary closed the seminar.

At the Crossroads Photo: Torkel Bennerstedt

The R&B Program: Toward Increased Flexibility

A New Structure

Program Areas

Nuclear safety and emergency preparedness have been major Nordic priorities for many years. As the contents of the programs have changed over the years, Board discussions on structure and organization have been frequent, in quest for the optimal overall solution. The minutes from the Board meeting in Helsingør, Denmark on Sept. 3, 1992 offer an evidence of this: would it be possible to exchange the rather static 4-year programs for something more dynamic? It was a fairly general discussion, but nevertheless an early precursor of what was to come some ten years later.

Two of the greatest challenges of NKS studies are the complexity of the systems and the need to integrate knowledge from many different areas (reactor technology, nuclear physics, measurement techniques, environmental sciences, radiobiology, information and communication technology to mention a few). Continuous development and improvement is necessary: new knowledge must be gathered and tools created and kept operational. Optimized use of national resources and the potential need for cooperation and assistance between neighboring countries is of the essence; so is communication with media and individual members of the public. Common Nordic views and approaches are important in order to maintain public confidence in authorities and other actors in the nuclear field.

Therefore, in 2001 the NKS Board adopted a dynamic scientific framework program, divided into two main areas, each led by a program manager:

- NKS-R: Reactor Safety
- NKS-B: Emergency Preparedness

The NKS-R and NKS-B frameworks form part of the policy document in Appendix 6.

The new NKS program, starting in 2002, marks a radical departure from the type of work done in the previous program periods. Now there is no more a 4-year framework for activities. The new framework requires potential participants to be active, not only in defining interesting studies, but also to initiate Nordic cooperation where appropriate and to make sure that the proposed work is relevant for the Nordic authorities and that the results are likely to be used.

It will be an iterative process to adjust the framework and working procedures in the new program. It will be a challenge for all (the Board, program manages and participants) to utilize as fully as possible the opportunities that the new structure provides and at the same time to preserve the best elements of the old structure.

Practical work began in 2002. Financial support is to be given fairly evenly to NKS-R and NKS-B in a long-time perspective.

"Why not the other way around?"
(Motto of Ulf Bäverstam, former Swedish owner representative)

Comments from the Nordic Directors Group

The directors of the Nordic radiation and nuclear safety authorities meet regularly, at least once a year, to discuss issues of mutual interest. They are referred to as the Directors Group and their meetings as the Directors Meetings. One of the issues of mutual interest is NKS and its activities.

At the NKS Board meeting at SSI, Sweden, on May 7, 2002 (see minutes in Appendix 2) the Icelandic owner reported the following from a recent meeting of the Directors Group:

- The Nordic secretary informed on the newly adopted NKS program and its structure.
- The Directors were positive toward the program and supported the plans for technical and scientific activities. It is of the utmost importance that the structure of all NKS activities is such as to ensure efficiency and cost effectiveness.
- Some concern was raised as to the transparency and legal aspects of the NKS administrative structure as well as ethical aspects related to the composition of the NKS Board.
- The Directors Group supported the ongoing discussion on NKS structure and activities and stressed the need for a thorough discussion of the long-term strategy of NKS among the consortial partners (owners of NKS).

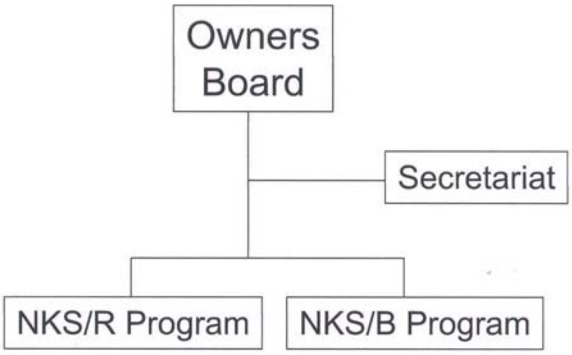
Basic Definitions

The work is divided into work packages called **activities** of varying size and duration and may consist of *studies* (research, investigations, exercises etc.) or *dissemination of information* (conferences, seminars, workshops, courses, websites, scientific papers, technical reports etc.), or (usually) a combination of both. The aim is to maintain and build up *competence* and to develop close informal *networks*. In order to make seminars more valuable, the Board has recommended that participants also take part in the preparations and follow-up work, e.g., writing the final report. Care should be taken to use related Nordic, European and other international seminars for exchange of information and networking, where appropriate.

The contents, time frames and budget of the program and its many activities are decided by the Board, in accordance with the **NKS-R and NKS-B frameworks** as outlined below. All activity proposals are assessed against a set of criteria established by the Board. Changes in work plans are made when called for. Activities may be expanded, reduced, or cancelled; new activities are added. The program is constantly renewed through a regularly occurring procedure of **Call for Proposals**, which is open to all relevant Nordic organizations. When an activity has been finished and the final report accepted by the Board, the results will be disseminated and can be implemented by the end users.

Presently, all major activities are handled by two program managers, one responsible for reactor safety (NKS-R), one for emergency preparedness (NKS-B).

New Organization of NKS



Self-explanatory as it is, bordering on the simplistic, the figure offers an almost sublime presentation of NKS, especially when compared to the previous schemes adopted at the start of the fifth and sixth 4-year programs, respectively.

The Administrative Support Function

Central NKS administration has been slimmed and trimmed, expenses cut, routines made simpler and more transparent. In the early days NKS published semi-annual, annual and status reports, plans for next year's work and address lists. A pre-project that could last up to six months was carried out before the projects were launched. Reference groups followed the ongoing work and reported to the Board. All technical, administrative and other reports were printed and postage paid to distribute them. This is all long since gone. Later, the secretary of the Board, the Bureau and the Nordic secretary were abolished. Tougher rules for reimbursement of Board members' travel expenses were introduced.

Board decisions were traditionally made only at formal meetings. If an agreement could not be reached, the question would be adjourned until next meeting. With time, if a document had to be revised or additional facts retrieved before a decision could be made, the question was discussed in an iterative process between meeting, until everyone was satisfied. This was cumbersome and time consuming. So a new approach was tested in a couple of instances, in the form of a Silent Procedure, where one person distributes a proposal and anyone not protesting before a certain date is considered to have accepted the proposal. Now this has become a relatively normal routine. It speeds up things and simplifies life for all involved.

In spite of the many administrative changes, the Secretariat was kept intact. Since FRIT took over the Secretariat in 1996 there has been a constant development of their services, both in quality, quantity and types of tasks. New media took over the old paper-based routines. Documents for the next Board meeting were no longer distributed via snail mail but only in electronic form. There was of course the inevitable initial grunt from some, but after a short while it became the accepted and natural mode of operation. Now, new media as the Internet, email, electronic forms of reporting (webpage, newsletters, CD, DVD) have taken over almost completely. The Secretariat was very quick to recognize the advantages of modern technology, and together with one of the project leaders they led NKS into the simpler, faster, more cost-effective future.

In addition to this, traditional secretarial work and auditing continued as before.

The NKS-R Framework: Reactor Safety

Program manager: Timo Okkonen, STUK → Petra Lundström, Fortum → Nici Bergroth, Fortum → Jesper Kierkegaard, Vattenfall → Patrick Isaksson, Vattenfall (→ Karoliina Myllymäki, Fortum in 2011)

This section is based on the presentation given by the initial NKS-R program manager, Timo Okkonen, STUK, at the transition seminar held in Roskilde, Denmark, in March 2002 (see separate chapter above).

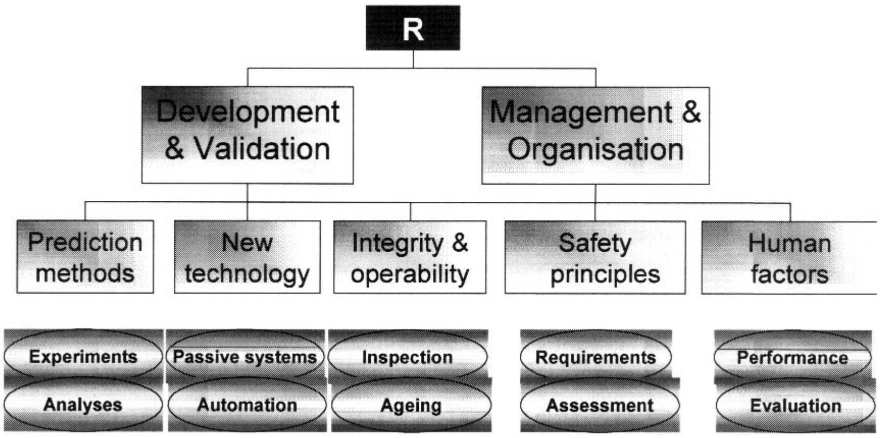


Figure of the NKS-R program: research areas and a few possible candidate seminars. It shows the general focus of the research activities; whereas seminars are foreseen to cover the whole range of the NKS-R framework.

When preparing the initial NKS-R work, it was noted that the framework included some general points of focus; however, it was quite flexible when it came to detailed activities. The top-level goals of the NKS-R program were foreseen to involve the following:

- **S**: Safety advancements
  New R&D results and scientific / technological progress in safety assessment, validation of new technology, and safety / quality management, as relevant to the Nordic reactor applications
- **E**: Exchange of information
  Cross-national communication of knowledge and experiences in the reactor safety field, focused on Nordic interests and networking
- **C**: Competence and education
  Contributions to the competence buildup and education in the reactor safety field in the Nordic countries

All the above goals can be seen to involve the Nordic dimension, and the full set of NKS-R activities will be steered to benefit all Nordic countries. There will be two main types of activities: research and seminars. The research activities should typically show merits of type S (see the goals above), and in addition to this, even E and/or C. The seminars are expected to be stronger on the E and C sides; and, in fact, even a lonely but strong E may provide a good justification for a seminar to be held. The seminars may vary from small meetings or workshops to larger events, and also educational events (courses).

The NKS-R program is planned to involve two main themes (see the figure above):

DELI	Development & Validation of assessment methods and new technology. This theme covers the challenges related to plant safety assessment and the introduction of new technology into the plants.
MANGAN	Management & Organization of safety and quality assurance. This theme covers the challenges related to the implementation and assessment of effective safety and quality management, and to human performance in different situations.

Under these two main themes, five main topics have been identified:

1. Prediction methods
   Experimental and analytical methods, primarily for the prediction of plant response to disturbances and accidents. Within this topic, there are questions associated with uncertainties that need to be further explored, such as the BWR suppression pool behavior under accident conditions, and the containment response in severe accidents.

2. New technology
   Evaluation of and experiences from new technical solutions and new technology, such as *modern automation technology and passive systems*. Such development offers both new opportunities and new challenges, ranging from the validation of new technology to the successful performance of plant modernization projects and their safety reviews. Just like the topic below, the application of new technology is associated with both of the main NKS-R themes (i.e., involves both technical questions and questions related to safe and efficient project management).
3. Integrity and operability
   Evaluation of and experience from verification and *inspection* methods, including *aging* aspects related to plant cmponents (mechanical, electrival etc.). The importance of this topic increases with plant aging – involving great challenges with inspecting the critical structures (physical release barriers) and veryfying the operability of important plant systems and related components (i.e., process / electric / automation functions needed to protect the integrity of the physical release barriers). This topic involves connections to both of the main NKS-R themes; for example, via development and validation of inspection techniques, and via management and organizational aspects of ensuring the fitness of systems, structures and components.
4. Safety principles
   Methodologies for achieving a harmonized, well-balanced *requirement* level and management of safety aspects during plant operation, maintenance and testing / inspection. The development of safety *assessment* methodologies makes it possible to (re)consider the way of ensuring a high safety level, from both the principal (regulatory requirements) and the operational (utility implementation) standpoint. Within this topic, the combination of the traditional defense-in-depth principles and the risk-informed approach is of great interest.
5. Human factors
   This topic covers a wide range of challenges from the *evaluation of human performance* in critical activities ("administrative safety barriers"), to ensurance of effective safety and quality management under changing conditions ("management of change").

The research activities are foreseen to coincide with the above-mentioned themes:
The DELI area:

- Pool behavior, focused on BWR suppression pool behavior.
- Melt behavior, focused on the core melt behavior in a severe accident, and in particular on the effectiveness of the containment barrier.
- Potential other parts to be decided upon based on detailed activity proposals; e.g., structural aspects or new safety analysis methods.

The MANGAN area:

- Decisions and activities during operation and shutdown, focused on the management and evaluation of critical decisions and activities.
- Design and technology, focused on the ways of minimizing human errors through design, including testing and inspection methods / tools.
- Potential other parts to be decided upon based on detailed activity proposals; e.g., interface issues and requirement specification in projects or new analysis methods.

Seminars are treated similarly to research activities, i.e., they are decided upon based on specific proposals.

The NKS-B Framework: Emergency Preparedness

Program manager: Sigurður Emil Pálsson, IRSA → Justin P Gwynn, NRPA

This section is based on the presentation given by the initial NKS-B program manager, Sigurður Emil Pálsson, IRSA at the transition seminar held in Roskilde, Denmark, in March 2002 (see separate chapter above).

The aim of the NKS-B program is to strengthen radiological emergency preparedness in the Nordic countries. Apart from activities directly targeted on emergency preparedness this also includes activities in related areas such as radioecology and effective communication and information management.

Two main aspects are given highest priority; namely maintaining and building up

1. competence
2. close informal Nordic networks between scientists as well as authority officials in emergency preparedness related disciplines

Potential activities should fall into any of the following three main areas and their sub-areas which constitute the NKS-B framework:

- Emergency preparedness – in general; and specific tools
  - Improving exchange of information and communication techniques
  - Decision support (handbooks on countermeasures, application of current radioecological knowledge in emergency preparedness)
- Measurement strategy, technology and quality assurance
  (this can include laboratory, mobile and whole-body measurements)
  - Quality assurance and improvements in the application of current technique
  - Testing the usefulness of new techniques, helping to createNordic cooperation in their use
- Radioecological studies of relevance for emergency preparedness
  - Nordic land use: effects of fresh fallout, long-term effects, effects of countermeasures
  - Studies for improvements of marine dose assessment models (i.e., transport with ocean currents, sedimentation processes, uptake in biota and pathways to man)
  - Syntheses of earlier radiological studies of Nordic interest (e.g., workshop / seminar)

The evaluation process will involve assessing, e.g.,

- how well the proposal falls within the defined NKS-B framework above
- building up of competence and maintaining it in the future
- value for cooperation of the Nordic authorities, including NKS criteria
- potential use of results and information – demonstration of interest by potential end users and authorities is an advantage
- how well it falls within the focus defined jointly at the time and also by the countries the potential participants represent
- the scientific and pedagogical merits of the proposal

The ongoing work in the program will form a type of a core for activities. New proposals will, all else being equal, have more chances of being accepted if they are linked to the ongoing core activities.

A proposed activity can involve one, two or all of these three fields:

Studies	The studies can be of vaious types, including research, assessments and exercises. The studies should maintain and buil up competence and thus be of high enough standard to be published in refereed journals. Studies can also be linked to work of PhD/MSc students.
Seminars	The aim of the seminars should be to continue and build on the type of networking already established in previous periods. A seminar should be preceded by preparation work by participants and should result in a report afterwards. – Care should be taken to use other related Nordic seminars for exchange of information and networking, as appropriate.
Education	Competence in radioecology / environmental radiation can be strengthened through education in different ways, e.g., by – organizing and supporting joint Nordic MSc-level courses – supporting individual PhD / MSc research projects Other forms of educational activities can also be considered, for example

- Workshops of various types, with invited lecturers, preferably producing proceedings in refereed journals
- Training, exchange visits between research centers

Call for Proposals

During an annual procedure of Call for Proposals the R&B program managers invite the Nordic nuclear community to submit activity proposals and apply for NKS funding. In later years it has happened that there have been two calls in one year.

The applications are scrutinized by the program managers, who prepare an evaluation where the proposals are assessed for compliance with NKS criteria, with the involvement of Board members. This ensures balanced priorities and secures national interests. Based on the outcome of the evaluation the program managers make proposals to the Board on funding. The Board decides which activities are accepted, how much NKS funding will be supplied, and whether any special conditions should be met.

The First Set of Activities

As a part of the preparations for the first period of R&B activities, the program managers communicated with board members, potential participants (organizations as well as key persons), arranged meetings, and distributed questionnaires, thus announcing the framework of coming activities in as many ways as possible. This was something new. Up till now, participating and supporting organizations and individuals had been used to pre-projects, directed by the Board. Now the participants were expected to take the initiative: to propose activities, make plans, suggest budgets, recruit colleagues and coworkers – with the Board assessing the proposals.

This led to some interesting results. In the case of NKS-R, for example, the program manager found much to his surprise that Sweden was not that eager to propose areas of work or volunteer manpower or other resources. The Finns, on the other hand, were more than willing to give it a go. In spite of a number of reminders, visits and personal calls to the Swedish stakeholders, the program manager was finally forced to present a first work plan that involved mostly Finnish organizations and experts, with a few Swedish and other Nordic participants on the side. The Board urged the program manager to keep inviting especially the Swedes, and try to distribute the funds more evenly between countries and organizations. But it was hard to change the direction of a ship already set in motion. It would take a couple of years to open the eyes of all of the Nordic countries to what possibilities lay ahead.

For a first period each program manager had DKK 2 million at his disposal. The list of initial NKS-R activities looked like this:

- PREPOOL (pre-project)
- Contextual assessment of maintenance culture safety and efficiency in Finland and Sweden
- Safety management: Existing case studies from a non-nuclear context as references for an investigation of assessments of nuclear safety management
- 3D transient methodology for the safety analysis of boiling water reactors
- Barriers, control and management – An analysis of concepts with applications in nuclear plant safety
- PREMELT (pre-project)
- Independent review of CCF models used in calculations for high-redundant systems in nuclear power plants of the Nordic countries (i.e., Finland and Sweden)
- Traceability and communication of requirements in digital I&C systems development
- Framework for a systematic approach and documentation for risk-informed decision making (pre-project)

The NKS-B program manager was well-known from the start in the academic circles and authorities involved in NKS work on radioecology and emergency preparedness during the last 4-year programs. So he probably found it a lot easier to evoke a positive response when asking for proposals. Generally speaking, B-type activities have always tended to be more Nordic than the more bilateral R-type activities. There is nothing strange about this: Finland and Sweden are the only countries with nuclear power reactors; the reactors in Denmark and Norway were intended for other purposes, and the reactors closest to Iceland sail the seas at some distance.

This is the list of initial NKS-B activities:

- Urban contamination seminar
- Additional funding of a PhD course in radioecology
- Emergency management and radiation monitoring in nuclear and radiological accidents
- New indicator organisms for environmental radioactivity
- Improving regional impact assessments
- Communication technology and emergency preparedness
- Nordic-EU collaboration on design and evaluation of the RESUME 2002 exercise
- Nuclear threats in the vicinity of the Nordic countries - A base of knowledge

Results of the R&B Programs 2002 – 2005

	Program managers
NKS-R	Reactor safety Timo Okkonen, STUK → Petra Lundström, Fortum → Nici Bergroth, Fortum → Jesper Kierkegaard, Vattenfall → Patrick Isaksson, Vattenfall
NKS-B	Emergency preparedness Sigurður Emil Pálsson, IRSA → Justin P Gwynn, NRPA

General

During the first years of NKS-R work, most participating organizations and persons came from Finland (for a number of reasons). After a couple of years, Patrick Isaksson abandoned Timo Okkonen’s system of Deli and Mangan; whereas Justin Gwynn kept the initial system for NKS-B activities, created by Sigurður Emil Pálsson.

A much closer cooperation than earlier was established between R&B under the leadership of Patrick Isaksson and Sigurður Emil Pálsson. This continued under Patrick Isaksson and Justin Gwynn.

On the average, R activities were generally fewer, larger and more costly than B activities.

NKS-B focused more on dissemination of information, networking, education of young scientists and strives for a wider Nordic participation than NKS-R. The downside to this has been some delays in final reporting of a few NKS-B activities.

The NKS-R and NKS-B budgets for the period 2002 – 2008 are listed in Appendix 5. For more detailed information on NKS-R and NKS-B activities and funding, please turn to Appendix 7 and Appendix 8, respectively.

It is far beyond the scope of the present report to reiterate the purpose, contents and results of each and every R&B activity. A selected number of activities are presented below. The information is based on abstracts, summaries etc. of the activities in question, as available in technical and final reports at the NKS website, including the evaluation report, NKS-145, presented in a later chapter in greater detail.

NKS-R Summary for 2002 – 2005

Below follows a brief review of the eight NKS-R activities that received the largest NKS funding in 2002 – 2005 (see budgets in Appendix 5). To this should be added the value of in-kind contributions, worth approximately as much as the NKS funding. The numbers of the items in the table below are the same as those used in the chapter on the evaluation of the first four years of R&B activities.

1. **BWR condensation pool experiments**
   NKS-104 DeliPool: BWR suppression studies were started in 2002 as a pre-project, PrePool, and later continued as DeliPool. POOLEX experiments were conducted at LUT and analyzed by VTT. A coupled fluid-structure calculation was performed. The motion of the wall of a test pool during a rapid bubble collapse was solved and taken into account during the CFD calculation. A fluid-structure interaction analysis was also conducted, in which the stationary state of the pool due to a gravity load was calculated. In addition, methods for estimating pressure loads in a water pool during steam injection were investigated. The Method of Images (MOI) for calculating the pressure loads during a steam bubble collapse was implemented and tested for the POOLEX experiment. The first version of the homogeneous two-phase model was implemented and tested in the quasi-stationary situation, where the steam that was blown down into a water pool was condensating inside the vertical blowdown pipe.

2. **Assessment of maintenance culture safety and efficiency in Finland and Sweden**
   NKS-108 MainCulture: The activity started in 2002 and was concluded in 2005 with VTT as the leading organization. Of all NKS-R activities in 2002 – 2005, MainCulture received the highest NKS funding, DKK 1900k. Change management has emerged as an important topic in safety-critical organizations. A lot of knowledge on change management exists, but still many projects fail and the safety consequences of various changes are unclear. It seems that the problems of change management are interdisciplinary. There is also empirical evidence that change has been experienced as stressful in nuclear power plants. The cultural perspective taken in this activity strives to combine technical approaches with human resources approaches. It raises new questions that are not usually explicitly taken into account in change management. Financial pressure, generation changes etc. have forced many organizations to downsize, outsource or reorganize.

3. **Safety management**
   NKS-88, NKS-95 SafetyManagement: The activity was conducted at Stockholm University in 2002 – 2005. The objectives were to create a theoretical framework, to use this framework for analyses of non-nuclear industries, and to investigate the potential relevance of the results for the nuclear power industry and nuclear regulators. The purpose was also to exchange knowledge between researchers in Nordic countries in the field of safety management and safety culture. Further studies are needed to develop a frame of reference for describing safety management across industries and activities; and to collect data illustrating good and bad safety management. A living system framework is outlined and related to the concepts used in organizational management. Some findings of potential relevance for safety management in the nuclear power domain are identified.

4. **Barriers, control and management**
   NKS-87, NKS-113, NKS-114 BarriersControlManagement: The activity was conducted by DTU in 2002 – 2004. The objective was to investigate how formalized concepts can be used to define concepts that can be used in design and assessment of nuclear power plant safety systems and procedures. Multilevel Flow Modeling (MFM) has proven to be an effective modeling tool for reasoning about plant failure and control strategies, and is currently exploited for operator support in diagnosis and on-line alarm analysis. The purpose of the activity is to show that such a theoretical foundation for modeling goals and functions of control systems can be built from concepts and theories developed by Von Wright and to show how the theoretical foundation can be used to extend MFM with concepts for modeling controö systems.

5. **Experiments on ruthenium behavior in severe accident conditions**
   NKS-92, NKS-100, NKS-118 RutheniumReleases: This was an experimental activity conducted by VTT. It started in 2002 and continued beyond 2005. During routine reactor operations, ruthenium (Ru) will accumulate in the fuel in relatively high concentrations. In a steam atmosphere Ru is not volatile, and it is not likely to be released from the fuel. However, in an air ingress accident during reactor power operation or during maintenance, Ru may form volatile species. Oxide forms of Ru are more volatile than the metallic form. Radiotoxicity of Ru is high both in the short and long term. The results of this activity imply that under oxidizing conditions during reactor core degradation, Ru releases increase as oxidized gaseous species are formed. A significant part of the released Ru is then deposited on reactor coolant system piping; but in the presence of steam and aerosols a substantial amount of Ru may be released into the containment atmosphere.

6. **Traceability and communication of requirements in digital I&C systems development**
   NKS-91, NKS-103, NKS-115 TACO: The activity was conducted by IFE in 2002 – 2005. On the basis of experiences in the Nordic countries, TACO aimed at identifying the best practices and most important criteria for ensuring effective communication in relation to requirements elicitation and analysis, understandability of requirements to all parties, and traceability of requirements through the different design phases. It is expected that TACO will provide important input to the development of guidelines and establishment of recommended practices to these activities. TACO objectives were concretized in a pre-project, and the work was presented at two Industrial Seminars in 2003 and 2004. To facilitate the utilization of the TACO results, the follow-up activity MORE was carried out in the years to follow; see the section NKS-R Summary for 2006 – 2008 below.

7. **Nordic thermal hydraulic and nuclear safety network**
   NKS-107 NOTNet: The activity was carried out in 2004 under the leadership of VTT, and in 2006 it resulted in a new Nordic cooperation in thermal hydraulics called Northnet. The idea of the network is to combine the resources of different research teams in order to carry out more ambitious and extensive research programs than would be possible for the individual teams. The end users were engaged in the activity from the beginning The aim of the network is to benefit the partners involved in nuclear energy in the Nordic countries (power companies, reactor vendors, safety regulators and research units).

8. **Ex-vessel coolability and energetics of steam explosions in Nordic boiling water reactors**
   NKS-112 ExCoolSE: This was an experimental activity conducted by KTH since 2004. It was proceded by a preparatory activity called PreDeliMelt. Severe reactor accidents involve melting of the core and release of radioactivity. Intensive research has been performed for years to evaluate the consequences of the postulated severe accidents. They pose a difficult set of phenomena and consequences to understand and predict. In the PreDeliMelt activity several critical issues were identified. Some Nordic NPPs have adopted the Severe Accident Management Strategy (SAMS) which employs the deep subcooled water pool in lower dry-well. The success of SAMS largely depends on the issues of steam explosions and formation of a debris bed and its coolability. Research plans are proposed to investigate the remaining issues, specifically on the ex-vessel coolability of corium during severe accidents.

NKS-B Summary for 2002 – 2005

Below follows a brief review of the eight NKS-B activities that received the largest NKS funding in 2002 – 2005 (see budgets in Appendix 5). To this should be added the value of in-kind contributions, worth approximately as much as the NKS funding. The numbers of the items in the table below are the same as those used in the chapter on the evaluation of the first four years of R&B activities. At least four Nordic countries participated in all the NKS-B activities presented below.

1. **Intercomparison of laboratory analyses of radionuclides in environmental samples**
   NKS-144 Labinco: 38 laboratories participated in an intercomparison exercise carried out in 2004 and 2005 on laboratory analyses of radionuclides in environmental samples and food. It involved artificíal and naturally occurring radionuclides including alpha and beta emitters. The analytical results compare well across many of the laboratories. However, the results indicate that there is room for improvement of the analytical quality at most laboratories. It is also noteworthy that the results on total alpha and total beta radioactivity in lake water show quite poor agreement, which is a matter of implication for national drinking water screening programs.

2. **Radiochemical analysis in emergency and routine situations**
   NKS-124, NKS-129 RadChem:An accurate determination of radionuclides from various sources in the environment is essential for assessment of the potentioal hazards and suitable countermeasures. Reliable chemical separation and detection techniques are needed for accurate determination of alpha and beta emitters. Rapid analytical methodes are needed in case of an accident. The objective of RadChem was to compare and evaluate radiochemical procedures used in Nordic laboratories. To gather information on the procedures in use, a questionnaire was sent to 16 laboratories. After this, RadChem focused on laboratory work in order to improve existing procedures and develop new ones. In addition, an intercomparison exercise was performed.

3. **Nordic collaboration on the use of mass spectrometers for the analysis of radioisotopes**
   NKS-134 NorCMass: This activity was performed in 2003 – 2005. The purpose was to identify and work on problems in isotope ratio and ultra trace measurements of primarily plutonium and uranium isotopes and Np-237 using ICP-MS. The activity also included an educational part aiming to describe fundamental aspects and practical steps for radioisotope measurements using ICP-MS. The activity was separated into 12 stages including an initial workshop, studies and measurements to produce reference material, a number of workshops, two seminars, production of a Guideline Book and planning of a practical training course in isotope ratio measurements.

4. **Improving radiological assessment of doses to man from terrestrial ecosystems**
   NKS-98, NKS-110, NKS-123 EcoDoses: The activity started in 2003 and was continued after 2005.The aim was to improve the radiological assessments of doses to man from terrestrial ecosystems. Nordic data for bomb-test and Chernobyl fallout were reviewed. Based on this, an improved model for estimating radioactive fallout was developed and effective halflives were calculated. The data were used to compare ARGOS modelling results with observed concentrations. The EcoDoses data base was extended and the radioecological sensitivity of Nordic populations were investigated. ARGOS and RODOS include foodchain modules and parameters that need to be adjusted in order to produce reliable predictions for Nordic areas.

5. **New indicator organisms for environmental radioactivity**
   NKS-140 Indofern: Of all NKS-B activities in 2002 – 2005, Indofern received the highest NKS funding, DKK 3030k. The objective was to identify new indicator organisms and biomarkers for assessment of environmental radioactivity in normal and emergency situations. New useful organisms accumulating effectively certain radionuclides in various Nordic ecosystems (forest, fresh water, marine) were found, and their indicator value was compared to those of the earlier known indicators. The activity yielded new data on the occurrence and transport of radionuclides in a wide scale of Nordic ecosystems. A summary of Indofern, together with summaries of the work done in all participating laboratories, were presented at the NKS-B Summing up Seminar in Tartu, Estonia, in 2005, which was a forum for presentation and discussion of the entire NKS-B program in 2002 – 2005.

6. **Decision support handbook for remediation of contaminated inhabited areas**
   NKS-175 UrbHand: Phase 1 was performed in 2004 – 2005, after which a second phase for 2006 – 2007 was planned. An early version of the handbook was followed by the final product in July 2008. It is aimed at providing Nordic decision makers and their expert advisors with background material for the development of an optimized, operational preparedness for situations where air-borne radioactive matter has contaminated a Nordic inhabited area. The focus is on the mitigation of long-term problems. It should be stressed that the information given in the handbook is compre-

hensive, and many details require careful consideration well in advance before implementation of countermeasures in a specific area. Training sessions are therefore recommended. The handbook describes the current relevant Nordic preparedness (dissemination routes) in detail, and suggests methods for measurement of contamination and prognoses of resultant doses, and data for evaluation of countermeasures and associated waste management options.

7. **Nordic network of meteorological services engaged in nuclear emergency preparedness**
   NKS-147 MetNet: The activity was conducted in 2003 – 2005, with a continuation into 2006. A draft report was followed by the final version in March 2007. The activity was intended as a forum of exchange of scientific information concerning atmospheric dispersion modelling as well as being a Nordic web-based backup facility for long-range atmospheric dispersion calculations and for exchange of real-time and forecast model results. A backup facility for the network was established regarding exchange of operational real-time long-range dispersion model calculations. Technical problems at one institute will not influence the calculations or presentations from the other participants, which makes the system robust. The activity fulfilled its main harmonization goal by bringing the Nordic emergency modelling toward more unified approaches of the presentation of the results and introduced a voluntary unification of the model output formats. Most of the Nordic models are capable of producing ARGOS compatible results.

8. **Emergency management and radiation monitoring in nuclear and radiological accidents**
   NKS-137 EMARAD: The activity started in 2002 and was prolonged into 2006. The management of various nuclear or radiological emergencies requires that the authorities have pre-prepared plans and various background material at their disposal. The purpose of EMARAD was to produce and gather data and information foreseen to be useful in preparing emergency procedures and radiation monitoring strategies. The deliverables of the activity were:
   - A website hosted by STUK containing most of the data and reports produced in EMARAD
   - Downloadable NPP accident consequence data for Nordic or neighboring NPPs (10 plants, 32 scenarios); and programs to process the downloaded data
   - Demos, documents, publications, scientific articles and presentations at international conferences

Major Seminars, Exercises and Other Events 2002 - 2005

NKS-R activities:

- 3D BWR Transient analysis methodology, Otaniemi, Finland, April 2003
- NKS-R cosponsored international conference: VALDOR 2003 (VALues in Decisions On Risk). Stockholm, Sweden June 2003
- Nordic seminar on nuclear regulatory work on reactor safety, Stockholm, Sweden, November 2003
- Nordic seminar on nuclear automation (in collaboration with IAEA and OKG), Oskarshamn, Sweden April 2004
- Knowledge management in Nordic NPPs, Halden, Norway, October 2004
- Nordic-group conference on safety management, Lund, Sweden, October 2004
- Seminar on experience from Nordic safety improvement programs toward nuclear power plants in Russia, Central and East European countries. Halden, Norway Nov. 2004
- Second TACO industrial seminar: Traceability and communication of requirements in digital I&C systems development, Helsinki, Finland, December 2004

NKS-B activities:

- Mini-seminar on airborne and carborne gamma spectroscopy, DEMA, Denmark, October 2002
- RESUME 2002: NKS – EU exercise in mobile measurements (AGS and CGS), Scotland 2002.
- MGS course in advanced methods for processing AGS and CGS data and similar sets of spectral data. Lyngby, Denmark Nov. 2002
- ComTech mini-seminar, STUK, Helsinki, Finland, February 2003

- NKS-B sponsored conference on radioactive contamination in urban areas ((UrbContSem). Risø, Denmark May 2003
- Mini-seminar on radioecology and measurement techniques, Risø, Denmark, September 2003
- RADSEM, Risø, Denmark, August 2004
- Mini-seminar on malicious use of radioactive material, Stockholm, Sweden, May 2005
- CommTech mini-seminars, SSI, Stockholm, Sweden, May/June 2005
- SAMPSTRAT mini-seminar on the theory of sampling. Risø, Denmark August 2005
- Summary seminar of the 2002 – 2005 program. Tartu, Estonia Oct. 2005
- Seminar on emergency preparedness, STUK, Helsinki, Finland, November 2005

Other activities:

- NKS + BKAB: Second seminar on Quality in Radiation Protection Work. Malmö, Sweden February 2004. (*Author's comment:* For scope and objectives, see the chapter on the 1998 – 2001 program, the first Malmö seminar under the heading "Additional activities".)
- NKS session at the XIV Regular Meeting of NSFS on the theme Radiological Protection in Transition, Rättvik, Sweden Aug. 2005. Presentation of NKS, quality in radiation protection, the R&B programs and some NKS-B activities. A number of other NKS-related activities were presented in other sessions, e.g., on radioecology.
- Nordic NKS – DD – BKAB seminar on decommissioning of nuclear installations, with invited speaker from OECD/NEA, Risø, Denmark Sept. 2005.

Annette Lemmens at the Registration Desk, Risø
Photo: Lena Bennerstedt

Relation Between the Directors Group and NKS

The Nordic Directors discussed at their meeting in Norway on **June 2 – 3, 2003** the relation between the Directors Group and NKS, and if maybe it was time for the Directors Meeting to take over the steering function of the NKS Owners Group. The outcome of this discussion was reported to the NKS Board meeting in Reykjavík on **November 13, 2003** as follows:

The Directors consider the NKS to be an important forum for Nordic collaboration. Recent changes in administrative structure and program are welcomed and further efforts toward an optimal administration of the NKS program are encouraged. The Directors had a fruitful and lively discussion of the future relations between the NKS and the Directors meetings. Different views exist between the Directors and NKS. Thus, no steps will be taken toward a merger of the NKS administrative structure and the Directors meetings. **The Nordic Directors Group therefore concluded that the Directors meetings and the NKS will for the foreseeable future continue to be two separate arenas with no formal links.**

The NKS Board took note of this conclusion. Even though there are now no formal links between the two, NKS and its activities continue to be on the agenda for the Directors Meetings.

Feedback From Program Managers and Activity Leaders

On Nov. 13, 2003 the Board instructed the Bureau to send a questionnaire to all activity leaders in order to poll the general opinion on the new program structure, organization and administrative support. Furthermore, the program managers were asked whether they could take on additional tasks, mostly of an administrative nature, as a measure to cut down on central administration.

The results were presented to the Board at its meeting on May 5, 2004. All respondents were happy with the new structure and the present routines. The program managers saw no possibility to take on new tasks under the present contract.

Evaluation of the R&B programs 2002 – 2005

See the evaluators' report NKS-145: Evaluation of NKS Activities During 2002 – 2005

Following a Board meeting in November 2005, NKS research work during the years 2002 – 2005 and its results were evaluated against a set of criteria defined by the NKS Board. The evaluation encompassed the NKS-R (reactor safety) and NKS-B (emergency preparedness) programs and was conducted by two persons per program; see below. Below follow some of their findings.

	Evaluators of NKS work 2002 – 2005
NKS-R:	Risto Sairanen, STUK Per Persson, consultant to SKI
NKS-B:	Per Hedemann Jensen, DD Tore Lindmo, NTNU

The mode of work of the two evaluation teams was adapted to the special conditions of the program at hand, one being aimed more at the nuclear industry and the other at a more academic surrounding; in both cases, however, with great involvement of relevant national authorities. The findings of the evaluators are summarized below. For the full text please refer to the report NKS-145. Financing and participating organizations, end users, deliverables, quality aspects, cost-benefit issues, time schedules, budgets and related issues are discussed in the report; however, for obvious reasons the present report covers but a small fraction of that information. Finally, the sections on NKS-R and NKS-B, respectively, include conclusions and recommendations for future work; the most important of which are included here.

If activity spending in each of the Nordic countries is compared with the financial contributions from the respective countries, it is obvious that Sweden has a significantly lower "return" than other NKS countries.

NKS-R: Reactor Safety

Risto Sairanen (STUK) and Per Persson (Consultant to SKI)

General

In the case of NKS-R, the criteria were translated into a list of 15 questions by the evaluators. Answers to the questions were collected from three sources:

- Interviews with persons from Finland and Sweden having experience of working with NKS-R
- A survey sent to end users of the NKS-R research results, and to activity participants
- Review of NKS deliverables by the evaluators

Considering the limited level of funding, the achievements of the NKS-R work in 2002 – 2005 have been very good. Only a few delays have been observed. In a vast majority of cases the activity leaders have conducted their activities according to plans and in a cost-effective way. The end users have considered the results applicable. All finished activities have fulfilled the formal NKS requirement of producing final documentation.

Some NKS objectives have not been completely fulfilled in NKS-R. Building of Nordic networks has been only occasionally achieved. Most of the activities have been mainly conducted by the leading organization. Contacts with power plants and with other established Nordic cooperation groups have been scarce in some cases.

The NKS-R evaluators recommend that the Nordic cooperation aspect should be enhanced in the future. Contacts with other established Nordic cooperation groups, with the end users and with NKS-B should also be reinforced.

Distribution of the NKS-R results should be improved, e.g., by arranging seminars presenting the results of the program activities.

Education activities, especially for the younger generation, could be a regular feature of NKS-R. (*Author's comment:* As they already are in NKS-B.) The education could efficiently utilize the facilities available in various Nordic countries.

NKS-R work 2002 – 2005 resulted in nine seminars and 28 reports in the NKS series alone. In addition, numerous reports have been published in scientific jornals, at conferences and as national research publications. The seminar participants have considered the NKS-R seminar activity useful.

The results of the survey and interviews

The NKS evaluation criteria were reformulated into 15 questions. The information from the survey answers and from the interviews is summarized below. Some of the questions could be answered by giving a score.

1 How well is the NKS-R research program known?
The program is quite well known, at least within the organizations and among the persons who answered.

2 To what extent are the results utilized?
The numerical results show a considerable spread, but the overall score is fairly good. It was pointed out that the NKS-R activities normally are a part of a larger entity, e.g., a national research project. Utility representatives pointed out that in order to ensure that the results are in a form that they can use, the utilities should be involved in the activities from an early stage.

3 How useful have the NKS-R seminars been?
Arranging seminars is a very important NKS activity, and the NKS-R seminars have been successful. It was recommended to arrange general NKS-R seminars approximately every four years. The internal seminars for activity leades that had been held were considered necessary for the conduction of the program.

4 Has the NKS-R program created and maintained Nordic networks in reactor safety?
This question received the most complex response. The numerical grades were fair. It was noted that there had been a lack of contacts to established Nordic cooperation groups like NPSAG and APRI. In most NKS-R activities the main work has been conducted by the leasing organization. But there are cases where networking has undoubtedly been good. It was suggested that each activity should have participants from at least two countries.

5 Has the NKS-R program built new competence or transferred competence within the Nordic countries?
The numerical results were good. It was suggested that organized education as a series of seminars and/or regular education might be supported by NKS.

6 Has the program provided possibilities for young scientists?
The score was quite good. Participation of young scientists is one of the evaluation criteria for applications. Therefore it has been considered in most activities. It was suggested that NKS could initiate some activity focused on young scientists.

7 What has been the scientific level?
The survey results gave rather high scores on this question. The interviewees considered the scientific level high in the areas they were familiar with. There was also a recommendation to encourage some visionary work, even if it does not produce any immediate results.

8 Has the program been balanced?
Generally, the program was considered well balanced. An increase in seminar activity and information meetings was requested; on the other hand it was pointed out that there is a limit to the number of seminars that can be attended; and that there is a need for a Nordic seminar. The current NKS method of working has decreased the direct influence of the governing bodies. The weight of NKS-R decommissioning is increasing, which was considered positive. It is important to involve utility representatives more, in order not to render the activities “academic”.

9 Are the priorities the correct ones? Are any important activities missing?
The Call for Proposals procedure does not rank the topics. Perhaps NKS should specify the research objectives more precisely. More weight should be put on the applicability of the results by defining the end users and involving them before submitting the proposal. It was recommended that NKS reviews the whole program at certain intervals and changes the structure if considered appropriate.

10 How relevant are the proposal evaluation criteria?
The persons actually involved in the application process were satisfied with the criteria, which well reflect the objectives of the NKS-R program. As regards the Nordic dimension, even if the research has been conducted by a single organization, the results have been applicable for more than one country.

11 Did the activities that were selected for funding have clear goals? Did the activity leaders follow the work plans and timetables?
The questions were put to the program managers, and the answer was yes on both counts, with some exceptions, where funding was frozen until the task was finished.

12 Has the program been conducted in a cost-effective way?
What are the positive and negative experiences from the NKS-R 2002 – 2005 work?
The main comment was that NKS-R produces good results with a small budget. Some end users felt that the NKS organization is heavy considering the volume of the program.

13 What was the positive and negative experiences from the NKS-R 2002 – 2005 work?
The work was considered interesting, giving a good opportunity to learn of different research topics and meet Nordic colleagues. The method of working was considered generally efficient. Concerning large experimental activities it was stressed that it is difficult to secure enough funding to carry out “real research”.

14 Is the overall quality of the results satisfactory?
This question remains unanswered in the evaluation report.

15 What are your recommendations for future work?

- Strive for a better distribution of NKS-R activities and results
- A stronger connection to the needs of the power plants is necessary
- Connect to existing Nordic and EU work groups
- A review every 4 – 5 years is needed

Summary evaluations of selected NKS-R activities

The eight NKS-R activities that had received the largest NKS funding in 2002 – 2005 were reviewed by the evaluators and by persons from the Finnish and Swedish regulatory organizations. Activity reports published in the NKS series were the mainsource of information.

1. *BWR condensation pool experiments*
   Title: Condensation pool experiments Acronym: PrePool / DeliPool
   Leader: VTT Report: NKS-104 Funding: DKK 1385k
   The connections to other Nordic organizations were few. The activity included experiments and analyses. It appears that the objectives and results of the study are rather limited. The study would have benefited from more extended comparisons with the experimental or analytical solutions. The scientific content is judged to be moderate.

2. *Assessment of maintenance culture and efficiency in Finland and Sweden*
   Title: Maintenance culture safety and management of change Acronym: MainCulture
   Leader: VTT Report: NKS-108 Funding: DKK 1900k
   There was an essential Nordic dimension in the activity, and networks were formed; and the researchers were young. This unique activity has a considerable new value with regard to the organizational changes which have been made during later years at Swedish and Finnish nuclear power plants as a consequence of the deregulation of the electric power market. It has been judged that there is a substantial use of the study both by the plants and the authorities because of creation of deepened knowledge.

3. *Safety management in non-nuclear contexts with potential relevance for the nuclear power industry and regulators*
   Title: Safety management Acronym: SafetyManagement
   Leader: Stockholm University Reports: NKS-88, NKS-95 Funding: DKK 720k
   The activity had an essential Nordic dimension. The research topics are in two highly current fields: safety management and safety culture related to nuclear power. The findings are new. Several of the participants were young researchers. The main achievement was the writing of the book “ Nordic perspectives on safety management in high reliability organizations”. This book can be used in education (competence development) and in that way it is useful for the end users.

4. *Barriers, control and management*
   Title: As above Acronym: BarriersControlManagement
   Leader: DTU Reports: NKS-87, NKS-113, NKS-114 Funding: DKK 695k
   The main theoretical novelty is the application of Von Wright’s action concepts to the plant modification and review processes. The work done within the activity gives interesting theoretical insights to the concepts routinely used in nuclear safety work. On the other hand, the methods are quite far from being applicable to practical cases. Significant additional work would have been required for the method to have added value in practice.

5. *Experiments on ruthenium behavior in severe accident conditions*
   Title: Ruthenium releases Acronym: RutheniumReleases
   Leader: VTT Reports: NKS-92, NKS-100, NKS-118 Funding: DKK 900k
   Ruthenium can be released in situations where air comes in contact with the reactor core. The work is thus of interest for all light-water reactors. The reports are of high international standard. Substantial parts of the work have been done by PhD students. Though the subject as such and the results of the work have a Nordic dimension, VTT and the end user STUK were the only participants. The activity results have been discussed in international, not in Nordic fora.

6. *Traceability and communication of requirements in digital I&C systemsdevelopment*
   Title: TACO Acronym: Digital Requirements
   Leader: IFE Reports: NKS-91, NKS-103, NKS-115 Funding: DKK 950k
   Only three organizations participated, and the number of young scientists was low. The results have been presented at industrial seminars in Finland and Sweden. It was pointed out that this type of fora for dissemination of information should also be used in other NKS activities. The subject is interesting and important. The developed structure is new but should be tested in some practical case in order to evaluate its usefulness. The scientific level is average or slightly above. The activity produced distinct and measurable goals in the requirements documentation scheme itself. They can serve as platforms for a structured requirements representation and tracing in lifecycle oriented project work. Future NKS work in the area is warranted, but more emphasis should be placed on practical implementation / utilization of results in actual power plant and/or regulatory work.

7. Nordic thermal hydraulic and nuclear safety network
   Title: As above Acronym: NOTNet
   Leader: VTT Report: NKS-107 Funding: DKK 300k
   The work documents the background for a decision to start a new network. The resources and needs for research on thermohydraulics in Finland and Sweden are reviewed. A possible plan for work structure in the form of three roadmaps with feedback from the stakeholders is described. Potential funding sources outside NKS are reviewed. Planning of the network began, and in 2006 several Nordic otganizations signed a cooperation contract for what is now calledNorthnet.

8. Ex-vessel coolability and energetics of steam explosions in Nordic boiling water reactors
   Title: As above Acronym: ExCoolSE
   Leader: KTH Report: NKS-112 Funding: DKK 980k
   ExCoolSE was an experimental activity conducted by KTH, and was preceded by the activity PreDeliMelt. ExCoolSE deals mainly with two questions related to Nordic BWRs: coolability of a molten core; and steam explosions. The same questions are considered within the cooperation project APRI (Accident Phenomena of Risk Importance) in which SKI and the Swedish nuclear power industry are involved. The ExCoolSE report is of high international quality and the questions raised are central for Nordic BWRs. The activity has contributed to the maintenance of Nordic competence within the field, and has involved young scientists – most of them PhD students.

Conclusions and recommendations by the NKS-R evaluators

Most of the interviewed persons and survey answers seem to be satisfied with the current way of working within NKS-R. There were no wishes to return to the old system, applied prior to 2002.

The scientific level of the 28 NKS-R reports is considered to be on an international level. Some of the nine seminars received a very positive feedback. Another type of NKS-R seminar activity has been internal seminars for activity leaders. These are also considered very useful for effective conduction of the program. There has been no general NKS-R seminar to give information on the total program results for a larger public. Such seminars should be arranged at certain intervals, e.g., 2 – 4 years.

The Call for Proposals procedure and schedule is not known to everyone, even though the information is available on the website since 2002. Some comments seem to refer to the old “top – down” system in which the initiating agent was NKS, whereas the initiative now comes from proposals of a fairly free format. Several persons commented that it would be easier to submit a proposal if only NKS would better specify what it expects from the activities.

VTT received by far the largest share of NKS funding in 2002 – 2005, almost 50% of the total. The current Call for Proposals procedure seems to favor large national research organizations (VTT, IFE) compared to the universities.

There are some NKS objectives that have not been completely fulfilled, e.g., the Nordic dimension and building of Nordic networks. Weak contacts with the power plants were mentioned in the survey and the interviews. Surprisingly, NKS-R contacts with the NKS-B part have been almost non-existent. No activities with joint objectives or joint participation have been initiated in 2002 – 2005. Young scientists have been involved in the activities to some extent. The generation shift is a concern for the Nordic countries; therefore development of competence is an important factor for all. Organized education could be considered.

It is recommended to evaluate the program regularly, e.g., every 4 – 5 years. (*Author's comment:* This would mean 2011 next time.)

NKS-B: Emergency Preparedness

Per Hedemann Jensen (DD) and Tore Lindmo (NTNU)

General

The NKS-B activities have been evaluated against activity proposals and against their scientific merits. The quality of the deliverables varies considerably. Also, the cost-effectiveness, i.e., the "return of the investment", in the different activities varies, as do the scientific perspectives of the activities. Many of the activities, however, have the potential of being further developed within Nordic research programs.

Activities on **measurement technology** have been a very valuable part of the NKS-B program portfolio. Nordic countries possess expert competence in this field, which is also appreciated on the European level. Nevertheless, radiological measurements constitute an expertise mastered only by a few institutions in each of the Nordic countries. Activities within NKS therefore constitute an opportunity to further develop and maintain this competence as well as to work out common protocols and procedures that will ensure coordinated actions within the Nordic countries in case of an emergency. The activities on field measurements and laboratory-based analyses are highly relevant, and very valuable results have been obtained from both field exercises and laboratory intercomparisons.

The purpose of the **radioecology** activities has been to establish reliable data for prediction of possible dose to humans from different ecosystems, to be used in decision-support systems, and to search for new organisms accumulating radionuclides in various ecosystems. From the published reports on NKS activities in this field, it is not always clear how the results will be utilized in a systematic manner to further strengthen the expertise within these two areas of radioecology.

The **emergency preparedness** activities have been well anchored. In general, all activities have been relevant for emergency preparedness and they fulfill the criteria set up in the NKS-B program. The activities have contributed to maintaining and building up competence and to maintaining and building Nordic networks between scientists in emergency preparedness disciplines. Transverse collaboration between closely related activities seems to have been rather low but might be improved in the further work on integrating the activity results into broader decision-support systems.

All 25 NKS-B activities were evaluated by applying ten criteria that emerged from the NKS Board guidelines:

- Whether the activity falls within the NKS-B framework
- Nordic competence and network building and maintenance
- The scientific and pedagogical merits of the activity
- The application and scientific perspectives of the activity
- At least three Nordic countries involved
- Potential use of results and information
- Activity results of adequate quality
- Activity in accordance with plans and budget
- Cost-effectiveness of total budget
- Relevance for authorities and others

Each of these criteria was graded by a score ranging from A: very good to E: very poor. These scores were weighted to obtain an overall grade for each activity.

Activity reports published in the NKS series were the evaluators' main source of information. The evaluations of the eight activities that had received the largest funding are summarized below.

Summary evaluations of selected NKS-B activities

1. *Intercomparison of laboratory analyses of radionuclides in environmental samples*
   Acronym: Labinco Area of work: Measurement technology Grade: A
   Leader: Risø Report NKS-144 Funding: DKK 350k
   Some laboratories still seem to have some difficulties and some types of measurements are clearly more difficult than others. Nevertheless, it seems that the laboratories are performing better than they have typically done in the previous intercomparisons.This activity would have benefitted from integration with RadChem (see below). Labinco has helped maintain and extend the competence in radioecological data acquisition, analysis and modelling. It gets a very high pedagogical merit through a focus on methodological skills. The results represent scientific knowledge of very high merit, and they are of value for participating laboratories and authorities. All five Nordic countries participated.

2. *Radiochemical analysis in emergency and routine situations*
   Acronym: RadChem Area of work: Measurement technology Grade: B
   Leader: IFE Reports NKS-124, NKS-129 Funding: DKK 415k
   Accurate determination of radionuclides from various sources in the environment is essential for assessment of the potential hazards and suitable countermeasures in case of releases. Reliable radiochemical separation and detection as well as rapid analytical methods are needed. Valuable information was provided by the laboratories on their practice regarding the specified analyses, making it possible to analyze and compare radiochemical separation procedures. A comparison with Labinco (see above) would have been of value. RadChem has helped maintain and extend the competence in radioecological data acquisition, analysis and modelling. The pedagogical merits are very high through a focus on methodological skills. The results may lead to higher quality and standardization of laboratory practices, which is of value also to involved authorities. Four Nordic countries participated.

3. *Nordic collaboration on the use of mass spectrometers for the analysis of radioisotopes*
   Acronym: NorCMass Area of work: Measurement technology Grade: B
   Leader: Risø/Lund Reports NKS-134, NKS-135, NKS-136 Funding: DKK 610k
   The aim of the activity was to stimulate and expand Nordic competence in radioisotope measurement technology and radiochemistry. To achieve this, guidelines have been produced and workshops on mass spectrometric measures have been carried out. A Nordic network has been created, improving, e.g., determination of trans-uranium elements. The activity appears to have had good pedagogical merits.The results are oriented toward practical routine surveillance as well as emergencies. The scientific perspectives are judged to be limited. The results are relevant for laboratories and authorities. Three Nordic countries participated.

4. *Improving radiological assessment of doses to man from terrestrial ecosystems*
   Acronym: EcoDoses Area of work: Radioecology Grade: B
   Leader: NRPA Reports NKS-98, NKS-110, NKS-123 Funding: DKK 1010k
   EcoDoses may be seen as a natural continuation of previous BOK-2 work. The aim of EcoDoses was to improve the radiological assessments of doses to man from terrestrial ecosystems. It has helped maintain and extend the competence in radioecological data acquisition, analysis and modelling. The integration with EU and other international projects was insufficient. Very valuable results for science and authorities were obtained. All five Nordic countries participated.

5. *New indicator organisms for environmental radioactivity*
   Acronym: Indofern Area of work: Radioecology Grade: B-

Leader: STUK Reports NKS-140, NKS-143 Funding: DKK 3030k
The objective was to search for new useful organisms accumulating effectively certain radionuclides in various Nordic ecosystems (terrestrial, fresh water, marine), and compare their value as indicators with those known earlier. The aim was to get more information on nuclides like Sr-90, Pu and Am and the most abundant discharges from nuclear power plants. The activity has helped maintain and extend the competence in radiological data acquisition, analysis and modelling.The integration with EU and other international projects was insufficient. Vast amounts of potentially useful data have been collected. Valuable results for science and authorities were obtained. All five Nordic countries participated.

6. *Decision support handbook for remediation of contaminated inhabited areas*
Acronym: UrbHand Area of work: Emergency preparedness Grade: B-
Leader: Risø Report: Version 1 of handbook Funding: DKK 410k
The handbook contains data for remidiation techniques that can be used in urban environments. Simple schemes can be used for assessing external doses and avertable doses for different remediation strategies. In phase 2 it should be considered if parts of the EMARAD material could be included in the handbook. The activity has contributed to extend the competence in using clean-up data from full-scale experiments in the former Soviet union. The results and information in the handbook are relevant in nuclear and radiological accident situations when urban environments have been contaminated. The handbook could be made more userfriendly. It is relevant for authorities that take part in the decision making process. Four Nordic countries participated.

7. *Nordic network of meteorological services engaged in nuclear emergency preparedness*
Acronym: MetNet Area of work: Emergency preparedness Grade: B-
Leader: DMI Final activity report Funding: DKK 590k
MetNet aims at creating a network of Nordic meteorological services engaged in nuclear preparedness and response through operational real-time calculations of long-range atmospheric dispersion and deposition of radioactive materials released to the atmosphere in nuclear accidents. Exercises demonstrated the importance of a Nordic network for real-time atmospheric transport calculations and that NKS MetNet partners can act as an operational unit in an emergency. Good data can be delivered within a few hours. The scientific merits appear to be limited. The results of the activity are relevant for authorities and others engaged in assessing the consequences of a nuclear accident. All five Nordic countries participated.

8. *Emergency management & radiation monitoring in nuclear and radiological accidents*
Acronym: EMARAD Area of work: Emergency preparedness Grade: A-
Leader: STUK Reports NKS-137, NKS-142 Funding: DKK 1140k
EMARAD consists of two major parts: pre-calculated consequences of accidents at nuclear power plants; and monitoring strategies that are needed in the management of different nuclear and radiological emergencies. The activity has contributed to extend the network between Nordic experts on consequence analysis, radiation monitoring and emergency preparedness. There are several scientific merits of the activity, e.g., the development of programs for the processing of nuclear accident consequence data and aspects related to malicious use of radioactive materials. The pedagogical merit is the website with various data that can be used in all the Nordic countries. The results of the activity are relevant for authorities and others engaged in the assessment of the threats of nuclear facilities to the Nordic countries and the consequences of nuclear or radiological accidents. Of special importance is the emphasis on the systematic approach to defining a proper monitoring strategy. All five Nordic countries participated.

Conclusions and recommendations by the NKS-B evaluators

To improve decision-support systems, critical analyses to identify which data are most needed to strengthen system performance should be made and the data be acquired through focused activity work. The search for new accumulating indicators should be limited to a few species relevant for the Nordic countries and the effort then focused on a systematic long-term monitoring of such species.

Challenges for future NKS work on emergency related activities will be:

- Careful considerations on the balance between research-oriented and more practical routine-oriented activities
- More clear communication of the activity results
- Integration of such results into decision-support systems
- Better integration of NKS activities with relevant EU activities
- Inclusion of university departments in research activities

It might be questioned whether preparation of databases and handbooks is a natural part of NKS research programs. If so, updating is necessary in order not to render them obsolete. It is unclear if this aspect has been considered at the onset of such activities.

As described above, a weighted score of the fulfillment of NKS criteria was calculated for all NKS-B activities. Comparing the cumulative weighted grades between the three NKS-B groups of activities it was found that the groups ranked in the following order:

1. Measurement Technology
2. Emergency Preparedness
3. Radioecology

The weighted grades for all NKS-B activities are better than or equal to B-.

In general, the NKS-B program was judged to be fairly good. However, it is recommended that the future composition of the NKS-B program should be reconsidered. New subprograms like decommissioning of nuclear facilities and radioactive waste treatment – still within the context of radiological protection – might be added or substitute some of the existing subprograms.

In future NKS-B activities a balance between research oriented and more practical / routine oriented activities should be considered carefully. Also more clear communication of the activity results, integration of activity results into decision support systems, better integration of NKS activities with relevant EU activities, and inclusion of university departments in research activities should be further examined.

The scientific seminars and workshops organized within the NKS-B program were very useful instruments to communicate the results of the activities more widely, to build networks between Nordic scientists and attract young scientists, and also to perform courses in different disciplines like internal dosimetry, spectral data processing and sampling strategies. It is highly recommended that this activity should be continued and strengthened in the next framework program. (*Author's comment:* There is no longer such a thing as a fixed framework (cf. next paragraph); it can be maintained for a longer or shorter period, changed gradually or drastically at any time, as decided by the Board.) The seminars might be even more efficient if they were organized transversely between related activities within the program but also between the R and B programs.

The process of evaluating NKS activities needs a careful reevaluation. When the 4-year program structure was left and more continuous programs were introduced, the former evaluation procedure more or less lost its validity. Without a fixed deadline for the final activity reports to be evaluated, the evaluation process becomes rather difficult, especially when tying the outcome of the evaluation process to a fixed date status seminar. It is therefore recommended that the NKS activity reports (final or intermediate) to be evaluated are sent to the evaluators in due time before the status seminar, and that no later-stage activity reports should enter the evaluation process. Alternatively, the evaluation process could be a “rolling” process, i.e., each activity would be evaluated in line with its completion. Such a prolonged evaluation could however be considered more inconvenient for the evaluators.

Continued R&B Work 2006 – 2008

It is far beyond the scope of the present report to reiterate the purpose, contents and results of each and every R&B activity. A selected number of activities are presented below. The information is based on abstracts, summaries etc. of the activities in question, as available in technical and final reports at the NKS website. Another source of information has been reports from various seminars, especially NKS-201 from the joint R&B seminar in Stockholm, Sweden March 2009. The seminar proceedings may, in turn, make reference to one or more technical or final reports. Activities not presented at the joint seminar have been excluded here. Activities carried out in 2002 – 2005 and evaluated in 2006 are presented in the chapter on 2002 – 2005 work, even if the final report appeared in 2006 or later.

NKS-R Summary for 2006 – 2008

Notes on some NKS-R activities

NKS-151 RutheniumReleases: *Ruthenium Behavior in Severe Nuclear Accident Conditions*
During routine nuclear reactor operation, ruthenium will accumulate in the fuel in relatively high concentrations. In a steam atmosphere ruthenium is not volatile and is not likely to be released from the fuel. In a severe accident it is possible that air gets into contact with the reactor core. In an air ingress accident during reactor power operation or during maintenance, ruthenium may form volatile oxides, which may be released into the containment. In order to estimate the gaseous ruthenium species it is of interest to know how they are formed and how they behave. To this end a number of experiments were performed. A significant part of the released ruthenium will be deposited on reactor coolant system piping. However, in the presence of steam and aerosol particles, a substantial amount of the ruthenium may be released in gaseous form into the containment atmosphere. Oxide forms of ruthenium are more volatile than the metallic form. Radiotoxicity is high both in the short and long term.

NKS-160 ExCoolSE: *Ex-Vessel Corium Coolability and Steam Explosion Energetics in Nordic Light Water Reactors*
ExCoolSE, performed under the Melt-Structure-Water Interactions project (MSWI) at KTH in Stockholm, Sweden, placed the focus on assessment of ex-vessel melt risks in Nordic BWR plants with external cavity flooding. While combining both experimental and analytical studies, attention was paid to scaling, simulation and support for plant safety analysis. Covering topics of importance to in-vessel corium coolability, steam explosion energetics and ex-vessel corium coolability, those MSWI phenomena were investigated that had the largest impact and significant uncertainties on the quantification of ex-vessel steam explosions and ex-vessel debris coolability. Substantial advances in process modeling and new insights into related mechanisms were gained from the study of corium pool heat transfer in the BWR lower head; debris bed formation; steam explosion energetics; thermal hydraulics and coolability in bottom-fed and heterogeneous debris beds. An advanced three-dimensional simulation tool was developed and validated for analysis of heat transfer in a BWR lower plenum. An assessment of corium retention and coolability in the reactor pressure vessel lower plenum by means of water supplied through the control rod guide tube cooling system was performed. The analysis results revealed the limit of coolability for the control rod guide tube and uncovered possible vulnerabilities for in-vessel melt retention. Results of experiments and related analyses strongly suggest that porous beds formed in ex-vessel from a fragmented high-temperature debris is far from homogeneous. Both high porosity and heterogeneity are central to the bed's enhanced dryout heat flux and therefore improved coolability. Calculation results of bed thermal hydraulics and dryout heat flux with a two-dimensional thermal-hydraulic code gave the first basis to evaluate the extent by which macro and micro inhomogeneity can enhance the bed coolability. For steam explosion risk in reactors, a revisited study of the material property effect on steam explosion energetics showed that corium high density, high melting point and low conductivity are central to mechanisms in premixing that govern corium low explosivity. Overall, ExCoolSE advanced the knowledge of melt-structure-water interactions, reducing conservatism in quantification of ex-vessel melt risks in Nordic BWRs.

NKS-178 MORE: *Management of Requirements in NPP Modernization Projects*
The overall objective was to improve the means for managing the large amounts of evolving requirements in Nordic NPP modernization projects. The activity has facilitated the industrialization of

the research results from TACO (see above) and practical application of improved approaches and methods for requirements engineering and change management. The main results of MORE are:

- Increased knowledge on handling of requirements during modernization projects.
- Input and recommendations to the implementation of the TACO traceability model in a prototype tool (TRACE) on issues regarding the handling of requirements.
- Continuation of a Nordic network of experts within the area of dependable requirements engineering issues.
- Expansion of this network to also include researchers from Europe – and contacts with Korea and Japan.
- A Workshop on Dependable Software Engineering (WDSE) in Seattle, Washington, USA in 2008.

NKS-179 AutoNewTech: *Levels of Automation and User Control: Evaluation of a Turbine Automation Interface*
The study was performed during the annual operator training at the Studsvik nuclear power plant simulator facility in Nyköping, Sweden. Seven NPP turbine operators from the Oskarshamn 3 plant were interviewed concerning their use of the automatic turbine system. The results show that during manual control the operators experience loss of speed and accuracy in performing actions together with difficulty of dividing attention between performing a task and overall monitoring, as the major problems. The positive aspects of manual operations lie in increased feeling of being in control when performing actions by hand. As the level of automation gets higher, the need for feedback increases which means that information presentation also becomes more important. The presentation of the conditions that manage the automatic sequences are often experienced as difficult to perceive. The use of the semiautomatic step-mode is often preferred.

NKS-194 WERISK: *Extreme Temperatures and Enthalpy in Finland and Sweden in a Changing Climate*
Though risks caused by harsh weather conditions are taken into account in the planning of nuclear power plants, some exceptional weather events or a combination of different events may prevent normal power operation and simultaneously endanger safe shutdown of the plant. Extreme weather events could influence, for example, the external power grid connection, emergency diesel generators (blockage of air intakes), ventilation and cooling of electric and electronics equipment rooms and the seawater intake. Due to the influence of an intensified greenhouse effect the climate is changing rapidly during the coming decades and this change is expected to have an influence also on the occurrence of extreme weather events. WERISK examined extreme temperatures. Enthalpy is a parameter that combines air temperature and air humidity, and it is used in the design of air conditioning systems. Therefore, the WERISK analysis includes the return levels of enthalpy. In frames of extreme value theory the concept of return level is used to convey information about the likelihood of rare events. In this case the probabilities of rare events are expressed in terms of T-year return values. The T-year return value is defined as the threshold that is exceeded once every T years. The time T is referred to as the return period. The influence of climate change on extreme temperatures is analyzed based on regional climate model simulations. The largest increase of the 50-year return level of daily maximum temperature is found in south-western Finland and southern Sweden. By the end of this century the increase can be 3 – 5 degrees Celsius. The largest change in the return levels of daily minimum temperature can be found in north-eastern Finland at the end of this century. This change can even be more than 10 degrees.

NKS-197 WASCO: *Wire System Aging Assessment and Condition Monitoring*
Nuclear facilities rely on electrical wire systems to perform a variety of functions for successful operation. Many of these functions directly support the safe operation of the facility. Therefore, the continued reliability of wire systems, even as they age, is critical. Condition monitoring of installed wire systems is an important part of any aging program, both during the first 40 years of the qualified life and even more in anticipation of the license renewal for a nuclear power plant. Wire testing methods were developed at the Halden reactor project and experiments were performed in collaboration with Norwegian and Spanish companies and a US research institute, comparing several cable condition monitoring techniques. The Halden method is based on frequency domain reflecto-

metry, which resulted in the development of a system called line resonance analysis. It can be used on-line to detect any local or global changes in the cable electrical parameters as a consequence of insulation faults or degradation. On-site tests at Barsebäck and Ringhals NPPs have been performed and analyzed.

(NKS-201) POOL: *Experiments and Modeling of Pressure Suppression Pools*
In a hypothetical loss-of-coolant accident a large amount of vapor is released after a break of a main steam line into the drywell compartment of a boiling water reactor. When the pressure increases in the drywell compartment, air and vapor flow through vent pipes into a wetwell compartment. The vent pipes are submerged in a pressure suppression pool, which changes a large volume of vapor into a small volume of water. In the POOL activity, the thermal hydraulic phenomena and the pressure loads in the drywell and wetwell compartments are studied. Experiments are performed with the pressurized PPOOLEX facility at the Lappeenranta University of Technology, Finland. PPOOLEX consists of down-scaled models of drywell and wetwell compartments. VTT performed computational fluid dynamics and finite element modeling of the experiments. Modeling of thermal stratification experiments of the water pool was done at the Royal Institute of Technology (KTH) in Stockholm, Sweden.

(NKS-201) SafetyGoal: *Probabilistic Safety Goals for Nuclear Power Plants*
SafetyGoal was initiated by NKS and NPSAG to deal with the use of probabilistic safety criteria for nuclear power plants. The activity is related to an OECD/NEA task on probabilistic safety criteria in member countries. The issues discussed include consistency in judgment in application of safety goals, safety goals related to PSA level 2, and safety goals related to other man-made risks in society. Safety goals usually have a dual function, as they define an acceptable safety level at the same time as they have a wider and more general use as decision criteria. Target values for PSA results are in use in most countries with nuclear power. The values are defined either by the regulator or the utility. Since the start in the 1980s, PSA models have expanded considerably, both regarding operating status and classes of initiating events. The level of detail of the analyses has also increased. There is a growing interest in PSA applications. This has lead to an increased interest and need to make judgments concerning the acceptability of risk contributions calculated with PSA.

NKS-202 StratRev: *Stratification Issues in the Primary System: Review of Available Validation Experiments and State-of-the-Art in Modeling Capabilities*
The objective was to review available validation experiments and state-of-the-art in modeling of stratification and mixing in the primary system of light water reactors. Workshop presentations from various utilities showed that stratification issues are not unusual and can cause costly stops in the production. It is desirable to take actions in order to reduce the probability for stratification to occur, and to develop well-validated and accepted tools and procedures for analyzing upcoming stratification events. The ultimate goal is to establish Best Practice Guidelines that can be followed both by utilities and authorities in case of an event including stratification and thermal loads. An extension of the existing Best Practice Guidelines for computational fluid dynamics in nuclear safety applications developed by OECD/NEA is thus suggested as a relevant target for a continuation project.

NKS-204 NROI: *Experimental Study on Iodine Chemistry (EXSI: Containment Experiments with Elemental Iodine)*
The behavior of iodine during a severe accident has been studied in several experimental programs, ranging from large-scale tests to numerous separate effect studies. Oxidation of iodine in gas phase has been one of the greatest remaining uncertainties. In this study the possible formation of iodine oxide aerosols due to radiolytic oxidation of gaseous iodine was experimentally tested and the reaction products were analyzed. The experimental facility at VTT and the measuring technology were sophisticated and unique in the area of nuclear research as well as in the field of aerosol science. The results from the experiment show an extensive particle formation when ozone and gaseous iodine react with each other. The formed particles were collected on filters, while gaseous iodine was trapped in bubblers. The particles were iodine oxides and the size of the particles was approximately 100 nm. The transport of gaseous iodine through the facility decreased when both gaseous iodine and ozone were fed together into the facility.

NKS-208 PODRIS: *Studies on the Effect of Flaw Detection Probability Assumptions on Risk Reduction at Inspection*
The aim of PODRIS was to study the effect of POD (probability of detection) assumptions on failure probability using structural reliability models. The main interest was to investigate whether it is justifiable to use a simplified POD curve, e.g., in risk-informed in-service inspection (RI-ISI) studies. The results indicate that this is the case. Another aim was to compare various structural reliability calculation approaches for a set of cases. Through benchmarking one can identify differences and similarities between modeling approaches, and provide added confidence on models and identify development needs. Comparing the leakage probabilities calculated by different approaches at the end of plant lifetime (60 years) shows that the results are very similar when inspections are not accounted for. However, when inspections are taken into account the predicted order of magnitude differs. Further studies would be needed to investigate the reasons for the differences.

NKS-213 MOSACA: *Safety Culture: Dimensions and Evaluation*
The report presents results from an interview study that examined the characteristics of the safety culture as developed by the Nordic nuclear branch. The study also tested the theoretical model of safety culture developed by the authors. The interview data were collected in Sweden and Finland. Interviewees represented the major actors in the nuclear field (regulators, power companies, expert organizations, waste management organizations). The study gave insight into the nature of safety culture in the nuclear industry. It provided an overview on the variety of factors that people in the industry consider important for safety. The respondents rather coherently saw such psychological states as motivation, mindfulness, sense of control, understanding of hazards and safety and sense of responsibility as important for nuclear safety. Some of the respondents described a certain Nordic orientation toward safety. One characteristic was a sense of personal responsibility for safety. However, there was no clear agreement on the existence of a shared Nordic nuclear safety culture. Sweden and Finland were seen different for example in the way the cooperation between plants and nuclear safety authorities was arranged and research activities organized. There was also perceived differences in the way everyday activities like decision making were carried out in the organizations. There are multiple explanations for the differences. Swedish industry has been driven by the strong supplier. In Finland the regulator’s role in shaping the culture has been more active. Other factors creating differences are, e.g., national culture and company culture and the type of the power plant. Cooperation between Nordic nuclear power organizations was viewed valuable yet challenging from a safety point of view. The report concludes that a good safety culture requires a deep and wide understanding of nuclear safety including the various accident mechanisms of the power plants as well as a willingness to continuously develop one’s competence and understanding. An effective and resilient nuclear safety culture has to foster a constant sense of unease that prevents complacency yet at the same time is has to foster a professional pride and a feeling of accomplishment to maintain work motivation and healthy occupational identity.

NKS-223 RiskEval: *Interpretation and Risk Evaluation of Technical Specification Conditions*
RiskEval was financed by NKS and NPSAG. The aim was to publish a guidance for evaluation of technical specification (TS) conditions with PSA. The activity covered PSA quality; how to verify that the PSA model is sufficiently robust and sufficiently complete; general requirements on methods; and acceptance criteria for evaluation of changes in the TS conditions. TS are part of the safety documentation for Finnish and Swedish NPPs. Any changes therefore have to be reported and approved by the national regulatory body. As PSA has developed over the years, it has proved to be a useful tool for evaluating many aspects of TS from a risk point of view, and in that way making the PSAs as well as the decision tools better. This also means that it will be possible to take credit for safety system overcapacity as well as inherent safety features and strength of non-safety classed systems. However, PSA is only one of the tools that shall be used in an evaluation process of TS changes (strengthening / relaxation). PSA is an excellent tool to be used to verify the importance, and thereby possibly relaxation, of the TS requirements. But since PSA is only one tool in the evaluation, it is not sufficient in itself for defining which equipment shall or shall not have TS requirements. Phase 1 of RiskEval studied several risk-informed TS evaluation projects performed internationally. Several seminars with participants from the Finnish and Swedish nuclear community discussed methods and important aspects on risk-informed TS evaluation.

NKS-B Summary for 2006 – 2008

Notes on some NKS-B activities

NKS-173 BIODOS: *Biodosimetry Applications in Emergency Preparedness*
The aim of BIODOS was to establish improved methods for biodosimetry that has specific application in emergency preparedness. Under this activity, the PCC (premature chromosome condensation) assay for biological assessment of radiation exposure was established in the involved laboratories. The range of work covered included assay optimization, analysis optimization, development of scoring criteria for PCC rings, comparison of the method to the classical cytogenic approach, and development of a PCC ring dose response curve. The results include an optimized approach for preparation and evaluation of the PCC assay for fast biological assessment of radiation dose which could be potentially applied in a triage manner in the event of a significant accident involving many persons. BIODOS has further served to build an informal network between the three involved organizations in order to provide capabilities in the event of an emergency and to expand the capacity of the individual laboratories. The work was continued in BIOPEX; see below.

NKS-175 UrbHand: *Decision Support Handbook for Recovery of Contaminated Inhabited Areas*
The handbook provides Nordic decision makers and their expert advisors with required background material for the development of an optimized, operational preparedness for situations where airborne radioactive matter has contaminated a Nordic inhabited area. The focus is on mitigation of long-term problems. The information given in the handbook is comprehensive, and many details require careful consideration well in time before implementation of countermeasures in a specific area. Training sessions are therefore recommended. The handbook describes the current relevant Nordic preparedness (dissemination routes) in detail, and suggests methods for measurement of contamination and prognoses of resultant doses, and data for evaluation of countermeasures and associated waste management options. A number of non-technical aspects of contamination in inhabited areas, and of countermeasures for its mitigation are discussed, and a series of recommendations on the application of all the handbook data in a holistic countermeasure strategy are given. A part of the handbook development has been a dialog with end user representatives in each of the Nordic countries, to focus the work on the specific needs of the users.

NKS-176 SPECIATION: *Speciation Analysis of Radionuclides in the Environment*
SPECIATION focused on further development of speciation methods for radionuclides; and investigation of speciation of radionuclides in the environment. The laboratory work included

- Further development on the speciation of I-129 and I-131in water samples
- Speciation methods for I-129 and I-131 in air
- A dynamic system for fractionation of Pu and Am in soil and sediment
- Investigation on reabsorption of Pu during the fractionation of Pu in soil and sediment
- Speciation of I-129 in North Sea surface water
- Partition of Cs-137 and I-129 in Nordic lake sediments, pore-water and lake water
- Sequential extraction of Pu in soil, sediment and concrete samples
- Pu sorption to Mn and Fe oxides in geological materials
- Investigation of the adsorbed species of lanthanides and actinides on clay surfaces

A seminar on speciation and hot particles was arranged and two articles were submitted for publication in an international journal.

NKS-177 NordRisk: *Nuclear Risk from Atmospheric Dispersion in Northern Europe*
Within NordRisk an NKS atlas was developed, describing risks from hypothetical long-range atmospheric dispersion and deposition of radionuclides from selected nuclear risk sites in the northern hemisphere. A number of case studies of long-term long-range atmospheric transport and deposition of radionuclides has been developed, based on two years of meteorological data. Radionuclide concentrations in air and radionuclide depositions have been evaluated and examples of long-term averages of the dispersion and deposition and of the variability around these mean values are provided.

NKS-180 HOT II: *Overview of Sources of Radioactive Particles of Nordic Relevance*
HOT II shows that that there are many existing and potential sources of radioactive particle contamination of relevance to the Nordic countries. Following their release, radioactive particles represent point sources of short and long term radioecological significance, and the failure to recognize their presence may lead to significant errors in the short and long term impact assessments related to radioactive contamination at a particular site. Thus, there is a need of knowledge with respect to the probability, quantity and expected impact of radioactive particle formation and release in case of specified potential nuclear events (e.g., a reactor accident or an act of terrorism). Furthermore, knowledge with respect to the particle characteristics influencing transport, ecosystem transfer and biological effects is important.

NKS-186 BIOPEX: *Emergency Preparedness Exercise for Biological Dosimetry*
As a continuation of BIODOS (see above), the BIOPEX activity aimed at testing and validating the newly established dose calibration curve for PCC rings, a specific chromosome aberration for use in biodosimetry in large casualty emergency preparedness. The testing of the PCC ring technique was performed by direct comparison to the conventional dicentric assay, both conducted with a triage approach that gives a crude dose estimate through analysis of a relatively small number of cells. The results indicated that both triage assays were capable of discerning non-exposed cases and that in the uniform irradiations, the dose estimates based on data from both assays were fairly consistent with the given dose. However, differences were observed depending on the dose level. At doses about 5 Gy and below, dicentric scoring resulted in more accurate whole-body dose estimates than PCC rings. At very high doses PCC rings appeared to give more accurate dose estimates. With respect to the technical aspects, scoring of the PCC rings is easier and therefore somewhat faster but may be more sensitive to quality aspects. In conclusion, the study demonstrated that the PCC ring assay is suitable for use as a biodosimeter, especially for estimation of very high doses.

NKS-187 GAPRAD: *Filling Knowledge Gaps in Radiation Protection Methodologies for Non-Human Biota*
The background and rationale to GAPRAD relate to a lack of information on naturally occurring radionuclides in terrestrial and aquatic systems that have direct applicability for use in environmental impact assessments. Results from field activities are presented for some Nordic terrestrial, freshwater and brackish water systems. The data mainly concern activity concentrations of Po-210 in environmental media and selected biota allowing concentration ratios to be derived where appropriate. Furthermore, details in relation to Po-210 uptake and biogenetics in humans based on experimental work conducted within GAPRAD are presented.

NKS-188 REMSPEC: *Analysis of Remotely Accrued Complex Gamma Ray Spectra: A Proficiency Test*
REMSPEC was an exercise using synthetic gamma ray spectra to simulate the type of data that may be encountered in the early phase of a nuclear accident. The aim was to provide the participants with an opportunity to exercise without the practical difficulties involved in using live samples. An HPGe spectrum was synthesized containing a range of typical fallout isotopes and distributed, along with calibration information, to the participant laboratories. These were required to submit results within three hours of receipt of the data, with the option of submitting further results within one week. The results provided by the laboratories indicate that they were all able to identify and quantify virtually all the constituents of the spectrum. They also indicated that there remained some problems with aspects such as true coincidence summation and using file formats with which the laboratories might not be familiar.

NKS-192 LUCIA: *Assessing the Impact of Releases of Radionuclides into Sewage Systems in Urban Environments:Simulation, Modeling and Experimental Studies*
LUCIA was established to provide more knowledge and suitable tools for emergency preparedness purposes in urban areas. The design of sewage plants and their wastewater treatment systems is rather similar in the five Nordic countries. One plant from each country was selected for assessing the impact of radionuclide releases from hospitals into the sewage system. Measurements and model predictions of doses to potentially exposed members of the public were carried out. The results from the dose assessments indicate that in case of routine releases annual doses to the three hypothetical groups of

individuals are most likely insignificant. Estimated doses for workers are below 10 µSv/year for the two studied nuclides, Tc-99m and I-131. If uncertainties in the predictions of activity concentrations in sludge are considered, then the probability of obtaining doses above 10 µSv/year may not be insignificant. The models and approaches developed can also be applied in case of accidental releases. A laboratory intercomparison exercise was organized to compare analytical results among the participating laboratories, using the nuclides in question. A simplified process oriented model of the biological treatment was also proposed in order to estimate the concentrations and the retention time of the sludge in different parts of the treatment plant, which in turn can be used as a tool for dose assessments.

NKS-193 REIN: *Long-Term Decline of Radiocesium in Fennoscandian Reindeer*
REIN was established to synthesize the available information on contamination levels and effective half-lives for Cs-137 in reindeer in Finland, Norway and Sweden. Several studies of radiocesium contamination in reindeer have been carried out in the Nordic countries over the last 50 years. However, the current (2009) slow decline in concentrations, which will maintain the consequences of the Chernobyl deposition for Swedish and Norwegian reindeer husbandry for at least another 10 – 20 years, has not previously been observed or predicted. In the Chernobyl affected areas Cs-137 concentrations in reindeer initially declined by effectives half-lives of 3 – 4 years, whereas the current decline appears to be mainly governed by the nuclide’s physical half-life (30 years). The high transfer of nuclides to reindeer, the geographical extension of reindeer herding and the special position of the Sami population in Finland, Norway and Sweden, demonstrate the need for maintaining competence and further developing the common basis for Nordic fallout management and emergency preparedness related to this food chain.

(NKS-201) PardNor: *Parameters for Ingestion Dose Models for Nordic Areas*
PardNor addressed shortcomings in modeling of ingestion doses for Nordic decision support. Nordic preparedness authorities apply in principle either the ARGOS or the RODOS decision support system for consequence prognoses and optimization of countermeasure strategies. In both of these systems the integrated ingestion dose module is identical with the ECOSYS model developed in Germany shortly after the Chernobyl accident. However, a review has revealed that a number of ECOSYS parameters do not reflect the current state-of-the-art knowledge, and do not adequately represent Nordic conditions. Default ECOSYS parameters produce ingestion doses in Nordic areas that can be wrong by orders order of magnitude. In PardNor new data were collected, thus enabling reliable use of ECOSYS scenarios involving contamination of Nordic food production areas. Analyses have been performed for each Nordic country to determine the sensitivity of the ingestion dose end-point in ECOSYS to variation in 9 selected, potentially important parameters (human dietary components and animal fodder components). This parametric sensitivity was found to vary considerably between the Nordic countries, reflecting considerable differences in diet and domestic production, and highlighting the importance of identifying appropriate location-specific parameters. The conditions for deposition and interception to vegetation would over a certain time span be very different in different Nordic areas. Also the influence on ECOSYS dose estimates of resuspension enrichment factors, leaching rates, fixation rates and desorption rates was investigated, identifying new data sets where needed.

Major Seminars, Exercises and Other Events 2006 Onward

Joint R&B activities:

- Mini-seminar on the revision of R&B frameworks, Risø, Denmark May 2007
- Joint summary seminar. Stockholm, Sweden March 2009.
- Mini-seminar on the findings of the latest evaluation. SKI, Stockholm, Sweden Nov. 2006

NKS-R activities:

- Seminar on dependable requirements engineering of computerized systems at NPPs. Halden, Norway Nov. 2006.

NKS-B activities:

- YoungRad seminar for young scientists in the fields of radiophysics, radiochemistry, radioecology, radiation protection and related fields. Helsinki, Finland Dec. 2006.

- BIOPEX: Emergency preparedness exercise 2008 for biological dosimetry.
- FOREST seminar: Toward improved understanding of radionuclide transfer in forests and preparedness to handle contaminated forests. Helsinki, Finland Oct. 2008.
- NordTheat seminar. Asker, Norway Oct. 2008.

Revised R&B Framework Programs for 2008 and Beyond

New frameworks for the NKS-R and NKS-B programs were adopted by the Board in November 2008. Many of the features of the initial R&B framework will be recognized. For examples of possible program contents, activities and other details, see the policy document in Appendix 6. For later updates, please turn to www.nks.org.

NKS-R Framework: Reactor Safety

The research activities within the reactor safety part of the NKS program have changed from time to time depending on subjects of interest. The following section might serve as a guide as to which areas will be prioritized for financing in years to come. Research activities may be of different kinds, such as developing new knowledge; compilation of knowledge in a systematic manner to support practical applications; or pilot projects demonstrating the use of new knowledge or techniques. It could also be seminars or courses to spread knowledge.

NKS funding is limited, roughly only one percent of the total Nordic funding in the area of reactor safety, phase-put and waste treatment.The funding can therefore not be expected to be of vital importance for the development in these areas. In addition to the expected result of a research activity in terms of knowledge, the activity will also be prioritized based on its contribution to the overall NKS criteria, e.g,. a Nordic common view on nuclear safety. Priority will also be based on the importance to the safety of existing reactors. Non-safety operational issues as well as economic issues are given low priority. If a proposed activity supports or duplicates other national or international activities, this will also affect the decision on NKS funding.

The nuclear power industry and regulatory bodies have a number of challenges of particular interest where research activities are essential, and will be prioritized. The areas are safety upgrade of older reactors to something comparable to modern standards; harmonization of reactor safety; power upgrade; aging / life management; phase-out and dismantling of nuclear facilities; waste treatment and final storage.

The following main research areas are judged to be of current interest:

- Reactor physics and thermo-hydraulics
- Modernization, introduction of new techniques and new demands
- Aging of nuclear facilities
- Severe accidents
- Probabilistic methods
- Organization, man and safety culture
- Phase-out and decommissioning of nuclear facilities
- Common seminars for reactor safety and emergency preparedness

The above list of subjects is not complete, and other proposals that can be associated with any of the eight categories above will also be considered in the evaluation process. More specific priorities regarding subjects to be covered can be given in connection with each “Call for Proposals”.

NKS-B Framework: Emergency Preparedness

The aim of the NKS-B program is to strengthen Nordic work concerning

- radiological emergency preparedness
- management of radioactive waste and discharges
- radioecology and environmental assessments

In addition to the threats from potential nuclear accidents, threats related to the possibility of malicious uses of radioactive or nuclear substances are now seen as a major concern. The case of poloniom-210 poisoning and contamination in London in November 2006 is an example of an unexpected situation that demonstrates new challenges related to, e.g., special competence regarding measurement / analytical techniques and radiation protection assessments.

During the last 30 years or so, a lot of experience and knowledge regarding consequences of radioactive discharges, fallout and environmental radioactivity have been gained. The research has to a large extent focused on the behavior of a few important radionuclides. This competence and knowledge must be maintained and further developed to include a wider range of relevant nuclides.

In the past, radiation protection criteria were developed only for humans, and it was assumed that by protecting man, other species would be protected to an acceptable degree. In recent years several problems have been identified with this existing tenet, with the result that systems for protection of flora and fauna, *per se*, are being developed and tested. Several knowledge gaps relating to this have already been identified, especially with regard to radionuclide uptake, transfer and biological response indicators. Furthermore, there is a need to obtain more experience in the practical application of environmental protection frameworks in typical Nordic environments.

Since 2004, uranium prices have increased sharply, leading to a higher interest in uranium prospecting, and also thorium, in some Nordic countries. Mining and milling for uranium and thorium, and also some other metals, give rise to waste rock and tailings with enhanced concentrations of radioactive substances from the natural series.A wide range of monitoring and measurement techniques will be needed for the risk assessments.

The NKS-B program is structured into three basic areas: research, seminars and education. Research work should be focused on maintaining and building up competence. Seminars should aim at building and maintaining both competence and networks. Education should help building competence in the individual countries with the aim of reaching the common goals.

When evaluating proposals for activities they will be judged against how well they comply with the framework as well as against their scientific and pedagogical merits.

The following main research areas are judged to be of current interest:

E	Emergency preparedness (in general as well as specific tools)
W	Waste and discharges
R	Radioecological assessments
M	Measurement strategy, technology and quality assurance

The above list of subjects is not complete, and other proposals that can be associated with any of the four categories above will also be considered in the evaluation process. More specific priorities regarding subjects to be covered can be given in connection with each “Call for Proposals”.

Joint R&B activities

In the near future issues regarding decommissioning of nuclear installations and waste management will demand increased attention. This will include analyses of technical safety aspects, volumes and protection of the environment. Hence, activities in a number of areas will not always be strictly R or B related but may be relevant to both programs. The Board decides whether such an activity will be handled under the R or B program, or if it should be treated in some other way. Possible examples of such activities are

- decommissioning and waste management
- common seminars covering both R and B activities
- information and communication activities targeting media and the general public

Concluding Personal Reflections

Conclusions and Recommendations

- Don't lose the Nordic touch in the name of international cooperation or as a result of making English the working language. The Nordic added value is just that: an added *value*.
- Make sure that the results of NKS activities are properly reported to end users, financiers and participating organizations, and that the results are implemented where relevant and applicable.
- It is time for a new evaluation of the last years of NKS work – very soon.
- Revise the policy document, which is from 2008 (both the Swedish and English versions).
- Cooperation with Estonia, Latvia and Lithuania has proven to be valuable, as is cooperation between the Nordic countries and all Baltic Sea states.
- Conferences, seminars and workshops can be rewarding and cost-effective ways of networking and dissemination of information.
- Exercises are valuable but the larger they get, the more resources they demand. This is especially true for international or Nordic emergency preparedness exercises (like INEX, NORA and ODIN); it is equally true for RESUME type measurement or surveillance exercises. Smaller calibration and intercomparison exercises and meteorological and similar table-top exercises are rewarding and cost-effective.
- Remind all new program managers of the NKS policy not to accept non-EU participation in NKS activities without careful scrutiny, in order to avoid unwanted arrivals in the Schengen area.
- Shift to only one website, all in English, except perhaps old minutes of Owners Group and Board meetings, or the administrative handbook (a translation might not have top priority).
- Keep the Call for Proposals process as timely, simple and fast as possible, for the sake of applicants as well as NKS.
- Always include the full budget as an Appendix to the Board minutes and specify all appropriations in the minutes (full title, acronym, budget and any conditions for each activity). This makes life easier for the auditor, evaluators and other persons in need to know.
- Keep close tabs on the economy – no more "luxury problems" where steadily growing sums of funds are transferred from one year to the next; or the occurrence of opposite situations like the one with the inadvertent overspending of SOS-1 money.
- National in-kind contributions should be included in an overall estimate of the total NKS budget. It is this figure that the administrative costs should be compared to; not just the monetary contributions by the owners and others.
- Old NKS numbered documents, presently available only as print-outs at the Secretariat, should be scanned and fed into the electronic archives for future reference. New such documents should be filed electronically as they appear, together with old and new NKS photographs.
- All documents published on the webpage before board meetings should be saved in the electronic archives, especially financial reports, budgets and material on Calls for Proposals and the program managers' status reports and recommendations. The material might best be kept on the password protected webpage.

Points to Ponder

- Have the conclusions and recommendations of previous evaluations influenced the continued work?
- What happened to the owners' decision to specify contributions etc. in euros? It seems to have been forgotten.
- The current way of handling proposals and applications for NKS funding is on the right track. But since the R&B programs at one time or another get a preliminary budget frame for planning purposes, the program managers are well aware of the financial restrictions for the next year or so. Is it then necessary to have a fixed period during which to submit applications? Or could the Call for Proposals be extended to the entire year, as long as a set of simple instructions on the website

are followed? The applications shall answer some basic questions: Who is supposed to do what why when where how at what cost, who picks up the tab and who benefits from it all? The program managers could have the applications assessed as they are appear and mail the application together the assessment and a suggested decision to the Board for an email discussion and final decision, perhaps in a Silent Procedure. Only the controversial proposals would then have to wait until the next physical Board meeting.

- Consider the very sound and important recommendations given in the last paragraph of the 2006 NKS-B evaluation as regards the evaluation process. Perhaps it should be a standing agenda point for each meeting that the Board should discuss in depth the results of activities that have been finished and a final report published since last meeting? The Board should also decide who should do what in order to communicate the results to end users and other interested parties, and make sure the results are being considered for implementation. Every 4 years or so there should be an evaluation of results, reports, processes, usefulness, practicability, efficiency etc. At that time the Board or Owners Group might also want to scrutinize the NKS structure and administrative support function and rethink the plans for the future.
- Is it perhaps time to do away with the old principle of equal sharing of NKS funds between the R and B parts? Why not let the number of relevant applications and the proposed funding guide the Board's decision? Chances are the distribution will be 50-50 over time anyway. And if not, does that not reflect a reality that should not be ignored?
- What happened to the agreed exchange of information with EU? Is that taken care of by the activities?
- One agenda point at every board meeting is the mutual exchange of information between the organizations. So why (just to give an example) weren't the other Nordic countries informed on the large Swedish exercise that started just before the unfortunate Fukushima event in 2011?
- Have the owners or the board ever considered a change of auditor to prevent personal ties and avoid complacency? There is no obvious reason for a change, but it seems appropriate to at least discuss this matter from time to time, perhaps when evaluating NKS work and activities.
- The Secretariat and R&B program managers could handle a significantly larger volume of research funds at approximately the same administrative cost. Increased contributions to NKS would lower the relative size of the administration.
- There are hidden administrative costs (e.g., the program manegers' and chairman's pay) that perhaps should be considered when discussing overhead costs.

The Great Language Divide: English or Scandinavian? Photo: Torkel Bennerstedt

Areas of Discussion Throughout the Years

- NKS structure and research work: Under constant discussion, in order to make participation and support more attractive for both financiers, researchers and end users.
- Size of "administration" (a concept that has never been defined by the Board): For the first time evaluated in 2006, and under constant scrutiny ever since.
- Cost effectiveness: Undefined popular topic of discussion.
- Number and size of projects / activities: Constant decisions to make them fewer and larger; but often forgetting this when deciding on new or revised programs.

- Joint or separate Owners Group and Board meetings? At present NKS is back where it started, with separate owners' meetings, and a report at the board meetings.
- Size and composition of the Board: No significant changes have been made, in spite of some suggestions from individual owner representatives and the evaluator of NKS' organization.
- Working language: That issue finally seems to be settled once and for all. English it is.
- Scope, objectives and fields of NKS work: From 4-year classics to R&B.
- Waste issues – in or out? There was a time when especially the Finns were totally against all waste projects, since they claimed to have all knowledge and international cooperation they needed. Their interest in sharing this knowledge with their Nordic neighbors was nil. With new owner representatives and a totally new nuclear program, this has changed for the better.
- Should NKS engage in information projects? The answer has varied, but presently it seems to be a firm no, given prior experience and results.
- R or B? At times it may be difficult to decide whether a proposed activity belongs to R or B; see for instance the minutes of the Board meeting on May 6, 2003, regarding nuclear vessels.
- Cooperation with the Baltic states: Many are for it, others more or less indifferent. The present position seems to be that cooperation with the Baltic countries is OK if it is relevant, NKS is in charge and the Baltic participation does not require NKS funding.
- Support to young researchers, PhD and MSc work: For many years this type of support was more of a mantra than an actual fact. Now with the possibility of travel grants and other initiatives on the part of R&B program managers, the situation seems to be improving.

Some Final Business

- Have the NKS results been put to practical use by the financiers and other potential end users? Implementation and feed-back from end users and others tend to be neglected – or at least: the end users have failed to report back to the NKS Board any implementations that have been made. Seemingly, it has been more important to get good grades from the evaluators than positive feed-back from the end users. Why not arrange an NKS Footprints Seminar?
- It could be useful to gather a seminar with former project leaders and program managers lecturing on their experiences of NKS work and what it has meant to their careers and their special field of study. Has it been of value when moving on to EU projects or new positions, nationally or internationally? What can future generations learn from this? (This seminar could be part of the NKS Footprints Seminar suggested above.)
- Just as a reminder, an excerpt from the evaluation of SBA-2 (the information project 98-01): As for NKS information activities in general, the proper authorities and financiers should define what services are required from NKS – any actions should be end-user driven. (I.e., the initiative should not come from the information officers. Any proposed information activity should undergo the same scrutiny as any other activity.) Future plans – if any – should be more concrete than has been the case earlier.
- Only once in all his years as Nordic secretary, the author of this report has come across a case of non-compliance with a board decision. From the minutes of the Board meeting at NRPA on Nov. 21, 2002: "The chairman proposed and distributed a chart to be used by the program managers for presenting plans vs. results in their status reports. The chart was accepted by the Board." In spite of this clear message and several reminders at later meetings, the proper charts were never used. The board not as much as reprimanded the program managers.
- At the board meeting in Helsinki on May 6, 2003 the chairman reported that NKS had received an offer from London International Television to produce a 5-minute documentary / commercial on NKS at a cost of GBP 30,000. The board decided that NKS should not engage in this sort of undertakings.

Signing Off, At Long Last

It’s been a mighty experience, writing this history of NKS. A true trip down Memory Lane. An assorted bouquet of the finest Nordic flowers. Happy smiles at good times and clever quips – NKS is a lot of fun, too, admit it!

With all its errors and shortcomings, my story depicts 15 years of diligence and inspiration on the part of hundreds of people from a handful of small countries on the Arctic rim. Work beyond self. Including, disparate, mind boggling. Thoughts keep crisscrossing my mind. And it all boils down to one word that characterizes the collective NKS effort: dedication.

That’s great. You’re great. Keep on keeping on.

Torkel Bennerstedt
TeknoTelje HB
Torhamn, Sweden

STRONGER LESSONS

Have you learn’d lessons only of those who admired you,
and were tender with you, and stood aside for you?
Have you not learn’d great lessons from those who reject you,
and brace themselves against you?
or who treat you with contempt, or dispute the passage with you?

Walt Whitman: Leaves of Grass (From Annex 1, 1888)

Torhamn Photo: Torkel Bennerstedt

References

Franz Marcus: Half a Century of Nordic Co-operation – An Insider's Recollections (NKS Nov. 1997).

Torkel Bennerstedt: Förprojekt om en eventuell historik 1994 – 2008 (pre-project report on a potential NKS historic review), NKS(09)3.

NKS/AFT(10)3: Contract NKS – TeknoTelje HB regarding the historic review.

NKS(06)3: Program handbook.

NKS(06)4: Administrative handbook.

NKS(08)2 Rev.5: The policy document (in Swedish), formerly called the project / program handbook.

NKS(08)3 Rev.3: The policy document (in English).

Directives for the pre-projects of the 94-97 program.

NKS(94)7: Pre-project report of the 94-97 program.

NKS(97)FR10: Final Summary Report of the Nordic Nuclear Safety Program 1994 – 1997 / Sammanfattning av det nordiska forskningsprogrammet för kärnsäkerhet. (Eds.: Torkel Bennerstedt, Annette Lemmens).

NKS(98)2: Utvärdering av NKS-programmet 1994 – 1997 (Antti Vuorinen) (Evaluation of the NKS program 1994 – 1997).

NKS(98)1: The final report of the program group for the 1998 – 2001 program.

NKS-5: Plans for the NKS Program 1998 – 2001 (including directives and report of the reference and pre-project groups plus the final report of the reference group).

NKS 68: Final Summary Report of the Nordic Nuclear Safety Program 1998 – 2001 / Sammanfattning av det nordiska forskningssamarbetet för kärnsäkerhet (Ed.: Torkel Bennerstedt).

NKS-69: Samordningsfunktionen. Slutrapport for Nordisk Kernesikkerhedsforsknings projekt SEK. (Torkel Bennerstedt, Finn Physant, Annette Lemmens.) November 2002. (Final report of the administrative services project SEK 1998 – 2001.)

NKS-66: Facklig utvärdering av NKS-programmet 1998 – 2001 (Gustaf Löwenhielm, Raimo Mustonen) (Evaluation of the scientific NKS program 1998 – 2001).

NKS-67: Evaluering av organisasjonen – NKS-programmet 1998 – 2001 (Martin Høiby) (Evaluation of the NKS organization 1998 – 2001).

Material on the new R&B program.

NKS(05)4: Reactor Safety Part of the NKS Program. NKS-R Framework.

NKS(05)6 Rev.: Directives for the Evaluation of NKS Work in 2002 – 2005 (see Appendix 1 in NKS-145).

NKS-145: Evaluation of NKS Activities During 2002 – 2005 (Risto Sairanen, Per Persson, Per Hedemann Jensen, Tore Lindmo).

Other relevant NKS numbered documents, e.g., varoius technical and final reports. See also separate Appendices for minutes of Consortial and Board meetings.

Appendices

Appendix 1: Brief Summary of NKS Owners Group Meetings

(Including minutes from the meetings of the NKS Consortium)

The following meetings of the Consortium / Owners Group have been documented.
(DK = Denmark; FI = Finland; IS = Iceland; NO = Norway; SE = Sweden)

Date		**Host and/or Venue**	**NKS Doc. No.**
Nov. 16, 1993		Arlanda / Stockholm, SE	NKS(93)15
Sept. 2, 1994		SKI, Stockholm, SE	NKS(94)15
Feb. 24, 1995		BRS, Bernstorff Slot, Gentofte, DK	NKS(95)4
Jan. 11, 1996		STUK, Helsinki, FI	NKS(97)4
Jan. 30, 1997		SKI, Stockholm, SE	NKS(97)16
Sept. 4, 1997	*	DEMA, Snekkersten, DK	NKS(97)19
Feb. 5, 1998		NRPA, Østerås, NO	NKS(98)5
Sept. 17, 1998		IVO, Helsinki, FI	NKS(99)4
Feb. 10, 1999		DEMA, Bernstorff Slot, Gentofte, DK	NKS(99)13
Sept. 15, 1999		SKI, Stockholm, SE	NKS(99)15
Feb. 9, 2000		NRPA, Østerås, NO	NKS(00)3
May 3, 2000	**	Arlanda / Stockholm, SE	NKS(00)14
Nov. 8, 2000	***	VTT, Innopoli, Otaniemi, FI	NKS(00)19
March 8, 2001	*	SKI, Stockholm, SE	NKS(01)6
May 21, 2001	*	IRSA, Reykjavík, IS	NKS(01)11
May 22, 2001	****	IRSA, Reyklavík, IS	NKS(01)12
Nov. 7, 2001	***	Kongrescenter Roskilde, DK	NKS(01)17
March 20, 2002	*	Hotel Prindsen, Roskilde, DK	NKS(02)5
May 6, 2002		SSI, Stockholm, SE	NKS(02)12
Nov. 20, 2002		NRPA, Østerås, NO	NKS(02)15
May 5, 2003		KTM, Helsinki, FI	NKS(03)5

Legend (applies to the table above as well as the summaries below):

*	Extraordinary Owners Group meeting
**	Extraordinary joint Owners Group and Board meeting
***	Status Seminar followed by a joint Owners Group and Board meeting
****	Joint Owners Group and Board meeting

Starting in May 2005, news from the Owners Group meetings are included in the minutes of the Board meetings. Hence, no separate documentation from the owners are available after that date.

The agenda normally included the following points:

1. Standard items (practical questions for the meeting; news from the participants' organizations; minutes of the last meeting; next meeting)
2. Financial plans, contributions and follow-up
3. Policy questions, structure and administrative matters
4. Overview of the technical and scientific work of the NKS program
5. Additions to or chenges in the technical / scientific work
6. Spring: auditor's report
7. Information and communication issues, dissemination of results
8. Any other business

This Appendix highlights some of the most important issues and decisions of the 1994 – 2003 Owners Group meetings. Items 3, 7 and – to a certain extent – 5 and 8 are normally the only ones that are included here, since the others are normally reported elsewhere in this document. The owners' yearly financial contributions from 1998 and onward are found in a separate appendix together with funding from other sources (Appendix 4). NKS budgets are summarized in Appendix 5. Technical / scientific results are reported under separate headings in the main text.

The complete minutes are available on the NKS website. So are the results of NKS research – in the form of reports, information on seminars etc.

Nov. 16, 1993 Arlanda / Stockholm, SE NKS(93)15

The 1993 meetings are beyond the scope of this report. but since this meeting was important for the work in 1994 and onward, it is nevertheless included.

- Magnus von Bonsdorff participated in the meeting as new chairman of NKS.
- Franz Marcus will act as Nordic secretary the first half of 1994, and support the new Nordic secretary in the second half.
- Torkel Bennerstedt and Thomas Eckered were invited to the meeting and were interviewed as possible candidates for the post. It was decided to negotiate a contract with Torkel Bennerstedt, and plans for his work in 1994 were outlined.

Sept. 2, 1994 SKI, Stockholm, SE NKS(94)15

- The 1994 – 1997 program as presented in NKS(94)7 may start as planned. AFA-1 and EKO-3 need some additional planning.
- NKS has earlier commented reports etc. from the Nordic Council of Ministers in questions regarding nuclear safety. The Nordic secretary is to inform the Council that in the future such requests should be sent to pertinent national authorities, not NKS.
- A contract will be signed with Franz Marcus for continued services in 1995 (25% of a full time).

Feb. 24, 1995 BRS, Bernstorff Slot, Gentofte, DK NKS(95)4

- Since both SKI and SSI help finance NKS work Sweden was allowed two representatives in the Owners Group.
- The owners endorsed the Board's acceptance of the project plans for 1995. The financial support to NKS in 1995 was confirmed, along with the budget. Funding was granted for projects in reactor safety (RAK-1 and RAK-2), radioactive waste (AFA-1), radioecology (EKO-1, EKO-2, EKO-3 and EKO-4), and information (SAM-4).
- Funds were allocated for the historic review to be written by former Nordic secretary Franz Marcus.

Jan. 11, 1996 STUK, Helsinki, FI NKS(97)4

- The national contributions to NKS will be the same as last year. The extra funding provided by NRPA, SKI and SSI in 1995 is not available in 1996. The Swedish funding is handled by SKI but is shared equally by SKI and SSI.
- It was confirmed that Sweden has two representatives in the Owners Group.

Jan. 30, 1997 SKI, Stockholm, SE NKS(97)16

- As recommended by the NKS Board the project plans for 1997 were adopted.
- The budget was accepted once the amount for EKO-3 has been checked.
- The Nordic secretary and the Reference Group leaders may make smaller adjustments between the RAK projects and the EKO projects, respectively.

Sept. 4, 1997 * DEMA, Snekkersten, DK NKS(97)19

- Former STUK Director General Antti Vuorinen was invited to this extraordinary meeting in his capacity of evaluator of the **1994 – 1997** program.

- The owners declared their willingness to finance a continued Nordic cooperation program, granted that the proposed project plans are found to be of relevance for the end users. The economic support in 1998 is expected to be of the same order as in 1997.
- The owners are to participate in future Board meetings. This will facilitate dissemination of information between the two groups and be practical from a number of aspects. (*Author's comment:* Cf. the minutes from Feb. 5, 1998.)
- The Bureau was urged to continue its work in planning for the next 4-year program, and it was decided to appoint a program committee chaired by Sigurður Magnússon. Its work should focus on scientific issues but may also address structural and organizational issues. Directives for the Committee will be written by the Nordic secretary and the SKI representative.
- Future project leaders are to report directly to the Board.
- Still ongoing activities within the **1994 – 1997** frame will not receive additional funding from the owners and is to be reported to the Board in mid 1998.
- A joint seminar for the entire **1994 – 1998** program will be arranged in Stockholm in March 1998.

Feb. 5, 1998 NRPA, Østerås, NO NKS(98)5

The **1994 – 1997** program:

- It was noted that the final reporting from EKO-3 and EKO-4 is delayed.
- The evaluation report, NKS(98)2, is expected by mid March. The owners were informed on the status and the evaluator's recommendations.
- Since the total costs for coordinating NKS work (Nordic secretary, Secretariat, printing and dissemination of reports etc.) may seem conspicuously high, it was decided that this issue should be discussed in the final 1994 – 1997 administrative report. Some of the costs are actually directly attributable to the scientific and technical work. The administrative support from the Secretariat and the Nordic secretary is to be evaluated in about two years.

The **1998 – 2001** program:

- It was expected that unused funds in the order of DKK 1 million will be transferred from 1997 to 1998. The amount is available for new projects, developed through proper pre-projects. If the proposals are not accepted by the owners and the Board, a refund will be made to the owners. (*Author's comment:* Cf. Sept. 15, 1999.)
- Six pre-projects were launched: SOS-1, SOS-2, SOS-3, BOK-1, BOK-2, SBA. The work is to be reported at a seminar in September. The six owners are to name one pre-project leader each. The pre-project work is to be supervised by a special reference group, chaired by Sigurður Magnússon. The SKI and SSI representatives are to write directives for the reference group in cooperation with the Nordic secretary. The reference group was given the mandate to start activities that should not wait until the Board meeting in the fall, or that are well-known and well planned. A total budget of DKK 2.4 million was allocated for the pre-projects and the reference group.
- The scientific reference groups linked to the different 4-year programs were abolished, effective from the start of the coming 4-year program.
- All NKS projects and groups are urged to be more cost effective. The terms of the contracts with the Nordic secretary and the Secretariat will be reviewed halfway into the new 4-year program.
- It was decided that the owners are also members of the Board. Each country may appoint up to three national experts (Sweden four) as members of the Board. (*Author's comment:* Cf. the minutes from Sept. 4, 1997.)

Sept. 17, 1998 IVO, Helsinki, FI NKS(99)4

- The routines regarding the audit of NKS bookkeeping shall be reviewed.
- The owners confirmed a number of issues discussed at the previous Board meeting; the final reports and evaluation report regarding the 1994 – 1997 program; and the start of the new 1998

– 2001 program. An evaluation of the new program will be made halfway into the 4-year period. No organizational changes were made.
- It was decided that the owner representing SSI will outline a new Letter of Intent on future cooperation between the owners of NKS.

Feb. 10, 1999 DEMA, Bernstorff Slot, Gentofte, DK NKS(99)13__

- A new Letter of Intent between the owners has been signed.
- The owners shared the Board's views concerning the **1994 – 1997** program, the policy document, the role of the Bureau and the status of the project work (see Board meeting minutes for details). The SOS-3 budget was confirmed.
- Board members were urged to take active part in implementing and disseminating the results of NKS work. The implementation is to be reported at the midway seminar.

Sept. 15, 1999 SKI, Stockholm, SE NKS(99)15__

- The owners decided to investigate the legal possibilities to transfer unused NKS funds from one program period to the next and from one year to the next. A report is to be compiled by the Secretariat. (*Author's comment:* Cf. March 7 – 8, 2001.)
- It was further decided to adjust the economic and administrative routines (to the extent possible, national laws and regulations taken into account) in accordance with the suggestions and recommendations made in the audit report for 1998. The Nordic secretary is to report the results of the investigations to the owners during the fall and suggest changes.
- The owners agree that discussions on the next NKS research period (be it 3, 1+3, 1+4 years or whatever) should start in 2001.
- The possibility to use unspent funds to support young scientists will be be explored at a later stage.

Feb. 9, 2000 NRPA, Østerås, NO NKS(00)3___

- The views of the Board regarding the **ongoing program** were confirmed. (*Author's comment:* See the corresponding Board meeting minutes.)
- National processes will be initiated to identify relevant uses of the financial balance from last year and planning for the **next 4-year program**. The project leaders will receive an invitation from the Nordic secretary to participate in the process. The outline of the next program is to be discussed at an extraordinary Board meeting at Arlanda in May 2000.
- The owners should contact present and potential national (external) financiers of NKS (*tilläggsfinansiärer*) to discuss their financial support and participation in NKS work.

May 3, 2000 ** Arlanda / Stockholm, SE NKS(00)14__

This was an extraordinary joint Owners Group and Board meeting; see Appendix 2 on Board meetings for details.

Nov. 8, 2000 * VTT, Innopoli, Otaniemi, FI NKS(00)19__**

A status seminar was followed by a joint Owners Group and Board meeting; see Appendix 2 on Board meetings for details.

March 7 – 8, 2001 * SKI, Stockholm, SE NKS(01)6___

This was an extraordinary meeting.

The **1998 – 2001** program: The SOS, BOK and SBA annual reports were accepted.

The **next program**:
❖ Documents NKS(01)2 and NKS(01)4 served as input in the discussions regarding the new NKS structure and future program. The following principles were laid down:

- The work will be divided into **two areas**: the **NKS-R** program (**reactor safety** including waste and development issues); and the **NKS-B** program (**emergency preparedness** including radioecology and emergency preparedness related information/communication; B stands for *Beredskap*, which is Scandinavian for emergency preparedness).
- A program manager will be appointed for each program.
- NKS funds are to be divided about equally between R and B.
- Each program will consist of 5 – 10 large ongoing activities. New activities will be added as old ones are completed.
- The rigid 4-year programs are thus replaced by a flexible system of activities of varying duration, scope and participants.
- A certain degree of competition will be introduced; how this is to be achieved is yet to be defined.
- All activities and budgets will be decided by the Board. New activities may be initiated by external groups, the program managers or the Board itself. The procedure for submitting applications and evaluating proposals is yet to be determined.

❖ The Norwegian and Swedish owners accepted to outline the scientific profile of the R&B programs, and the Bureau was asked to draft a document to be used when recruiting the program managers. The Bureau was also instructed to produce a graphical presentation of the new organization and NKS structure.

Other matters:

- The size of the Board was discussed. No changes were suggested.
- The future relations between NKS, the Nordic Directors Group and NEP are to be discussed at a later stage.
- An estimate of the administrative costs of NKS as part of the overall budget is to be made. A reasonable figure would be in the order of 15%.
- Helge Smidt Olsen was elected **new chairman** of NKS by a unanimous vote. He will take over after Magnus von Bonsdorff starting Jan. 1, 2002.

May 21, 2001 * IRSA, Reykjavík, IS NKS(01)11

This was an extraordinary meeting.

- The owners were of the opinion that the Board should normally decide in questions regarding new activities, and that only activities recommended by the program manager should be considered.
- The owners went on to unanimously appoint Timo Okkonen program manager of NKS-R and Sigurður Emil Pálsson of NKS-B.

May 22, 2001 ** IRSA, Reykjavík, IS NKS(01)12**

This was a joint Owners Group and Board meeting; see the minutes of that meeting in Appendix 2.

Nov. 7, 2001 * Kongrescenter Roskilde, DK NKS(01)17**

A Status Seminar was followed by this joint Owners Group and Board meeting. Please refer to Appendix 2 for the minutes of the meeting.

March 20, 2002 * Hotel Prindsen, Roskilde, DK NKS(02)5

This was an extraordinary meeting.

- The proposed new Owners Group Letter of Intent (“contract”) was accepted with some minor changes and was signed the next day.
- It was decided that from now on all contributions to NKS should be specified in **euros**, not in DKK or the various national currencies.

- The Secretariat is to present a list of all administrative written or oral agreements now governing practical NKS work.

May 6, 2002 SSI, Stockholm, SE NKS(02)12

- As requested by the Nordic Directors Group and suggested in the organizational and administrative evaluation of the 1998 – 2001 program, the long-term structure and goals of NKS are to be discussed during the rest of the year. The work will be initiated and coordinated by the SSI representative.
- It was decided that future Owners Group meetings should once again be separated from the Board meetings.
- The Bureau suggested administrative changes saving some DKK 0.6 million per year. In addition to this, Board members' travel cost refunds were discussed. The owners were not aware of the generous terms for refunds and decided that owners and Board members are to be refunded on rare occasions only.
- The Nordic secretary presented a list of written and oral agreements as requested.

Nov. 20, 2002 NRPA, Østerås, NO NKS(02)15

- The Nordic secretary pointed out that the new NKS structure has led to a situation where nobody has a full grasp of the total scientific and administrative work. This was of little concern to the owners, who stressed the central role of the Board, both individually and as a group, and the key position of the program managers in networking, producing and disseminating results.
- The number of working hours and travels put in by the Nordic secretary have decreased as stipulated in his new contract with SKI.
- The owners noted with some concern the accumulation of unused funds, mostly due to delayed invoicing from the participating organizations, and stated that measures need to be taken to remedy this.
- The strategy discussion initiated at the last meeting had not resulted in any reactions from any of the owners. The Swedish owners are to produce a short background material to be used by the Board in its deliberations. Meanwhile, NKS work will proceed up to and including in 2004.
- The final version of the **1998 – 2001 scientific evaluation** will be handed over to the Board for discussions and implementation, as appropriate.
- It was decided that the NKS chairman is welcome to participate in future owners' meetings.

May 5, 2003 KTM, Helsinki, FI NKS(03)5

- The final reports from the **1997 – 2001** program will be available on a CD-ROM, together with all older technical reports, final reports, evaluations etc. The owners expressed their thanks to the Secretariat for this comprehensive coverage of NKS and NKA work.
- The **present program**: Since Timo Okkonen has left his position with STUK, Petra Lundström of Fortum was appointed new NKS-R program manager. Sigurður Emil Pálsson continues as program manager of NKS-B.
- The Swedish draft strategy paper needs more work before a Board discussion can take place.

Appendix 2: Brief Summary of NKS Board Meetings

The following Board meetings were held and documented in the period 1994 – 2008:
(DK = Denmark; FI = Finland; IS = Iceland; NO = Norway; SE = Sweden)

Date	Host and/or Venue	NKS Doc. No.
Feb. 8, 1994	Bolkesjø, NO	NKS/RE(94)1
June 7, 1994	Vantaa, Helsinki, FI	NKS/RE(94)2
Sept. 2, 1994	SKI, Stockholm, SE	NKS/RE(94)3
Feb. 24, 1995	DEMA, Bernstorff Slot, Gentofte, DK	NKS/RE(95)1
Sept. 20, 1995	IFE, Halden, NO	NKS/RE(95)2
Jan. 11, 1996	STUK, Helsinki, FI	NKS/RE(96)1
Aug. 27, 1996	IRSA, Reykjavík, IS	NKS/RE(96)2
Jan. 30, 1997	SKI, Stockholm, SE	NKS/RE(97)1
Sept. 4, 1997	DEMA, Snekkersten, DK	NKS/RE(97)2
Feb. 05, 1998	NRPA, Østerås, NO	NKS/RE(98)1
Sept. 17, 1998	IVO, Vantaa, FI	NKS/RE(98)2
Feb. 10, 1999	DEMA, Bernstorff Slot, Gentofte, DK	NKS(99)9
Sept. 15, 1999	SKI, Stockholm, SE	NKS(99)17
Feb. 9, 2000	NRPA, Østerås, NO	NKS(00)5
May 3, 2000 *	Arlanda, SE	NKS(00)14
Nov. 8, 2000 **	VTT, Innopoli, Otaniemi, FI	NKS(00)19
May 22, 2001 ***	IRSA, Reykjavík, IS	NKS(01)12
Nov. 7, 2001 ***	Kongrescenter Roskilde, DK	NKS(01)17
March 19, 2002 ****	Hotel Prindsen, Roskilde, DK	NKS(02)4
May 7, 2002	SSI, Stockholm, SE	NKS(02)11
Nov. 21, 2002	NRPA, Østerås, NO	NKS(02)16
May 6, 2003	KTM, Helsinki, FI	NKS(03)4
Nov. 13, 2003	IRSA, Grand Hotel Reykjavík, IS	NKS(03)7
May 5, 2004	SIS, Herlev, DK	NKS(04)5
Nov. 9, 2004	SKI, Stockholm, SE	NKS(04)10
May. 12, 2005 ‡	Hotel Olavsgaard, Lillestrøm, NO	NKS(05)3
Nov. 17, 2005	IRSA, Grand Hotel Reykjavík, IS	NKS(05)8
May 11, 2006	Dipoli, Otaniemi, FI	NKS(06)5
Nov. 10, 2006	SSI, Stockholm, SE	NKS(06)9
May 11, 2007	Risø, Roskilde, DK	NKS(07)6
Nov. 16, 2007	NRPA, Østerås, NO	NKS(07)11
May 7, 2008	DEMA, Kastellet, Copenhagen, DK	NKS(08)5
Nov. 19, 2008	IRSA, The Culture House, Reykjavík, IS	NKS(08)8

Legend (applies to the table above as well as the summaries below):

*	Extraordinary joint Owners Group and Board meeting
**	Status Seminar followed by a joint Owners Group and Board meeting
***	Joint Owners Group and Board meeting
****	Extraordinary Board meeting
‡	From this meeting on, an oral report from the Owners Group meeting is given to the Board and included in the minutes of the Board meeting. The Owners Group meetings are to take place the day before the Board meeting. (At an Owners Group meeting on Sept. 4, 1997, it was decided that the owners will participate in future Board meetings. This will facilitate dissemination of information between the owners and the Board and be practical from a number of aspects. The Owners Group meetings could however be held at any date, irrespective of the date of the Board meetings.)

The agenda has varied slightly over the years, depending on the present structure of NKS work. Normally the agenda has included the following points:

1 Standard items (practical questions for the meeting; news from the participants' organizations; minutes of the last meeting; next meeting)
2 Economic status report
3 Policy questions, structure and administrative matters
4 Reports from project leaders / program managers;
5 Fall: Call for Proposals; decision on new projects / activities and next year's budget
6 Spring: auditor's report
7 Information and communication issues, dissemination of results
8 Any other business

This Appendix highlights some of the most important issues and decisions of the 1994 – 2008 Board meetings. Only items not reported elsewhere in this document are presented here.

The complete minutes are available on the NKS website. So are the results of NKS research – in the form of reports, information on seminars etc.

Feb. 8, 1994 Bolkesjø, NO NKS/RE(94)1

Organizational matters:

- New chairman of the Board: Magnus von Bonsdorff.
- New secretary of the Board: Helge Smidt Olsen.
- New Nordic secretary: Start of a 12-month transition period from Franz Marcus to Torkel Bennerstedt.
- NKS funding by the Nordic Council of Ministers ceased in 1989. The ties between NKS and the Council should be cut not for this reason alone but for several others as well: scientific, political and practical. E.g., NKS can no longer assist with expert opinions on various (sometimes politically raised) nuclear issues as has happened in the past.

The **1990 – 1993** period: The final reports of the projects of BER, KAN, RAD, SIK and SAM are all delayed. So is the annual report for 1993. The evaluation of the old program should be reported no later than June 1994.

The **1994 – 1997** period:

- The pre-project work regarding preparations for the next 4-year period is underway (phase 1: planning has been reported). Pre-project leaders and participants were appointed.
- The role and mandate of the reference groups were discussed. The Board confirmed that the objective is to prioritize and lead the scientific work of the various projects and report to the Board.
- A special working group called the Bureau was formed. Participants: the chairman of the Board, the secretary of the Board and the Nordic secretary.
- The secretarial functions will remain with Risø for the time being.

June 7, 1994 Vantaa, Helsinki, FI NKS/RE(94)2

Several of the final reports for the **1990 – 1993** program are delayed. NKS lacks means to put pressure on the project leaders. Two of the evaluation reports are still missing. The ones that have been finished contain some constructive criticism, which will be passed on to the new project leaders,

The administrative routines are to be reviewed and a new version of the administrative handbook published. This is done to emphasize that final reports are an integrated part of the total project work and thus must be prioritized from the start.

Decisions regarding the **1994 – 1997** program:

- Motivation and priorities regarding some projects must be clarified.
- The results should be presented in a form that makes them directly applicable, e.g., handbooks and directives.
- Specified parts of the projects can be started now. Later instructions from the Board are to be followed.
- Chairpersons and members of the reference groups were appointed, together with the project leaders of the new RAK, AFA and EKO projects.
- Appointed project leaders:
  RAK-1: Kjell Andersson, Karinta-Konsult, Sweden
  RAK-2: Ilona Lindholm, VTT Energy, Finland
  AFA-1: Karin Brodén, Studsvik RadWaste, Sweden
  EKO-1: Sigurður Emil Pálsson, IRSA, Iceland
  EKO-2: Tone D Bergan, IFE, Norway
  EKO-3: Jens Hovgaard, DEMA, Denmark → Anneli Salo, Consultant, Finland
  EKO-4: Eldri Naadland Holo, NRPA, Norway
- The overall program might be too large to handle, given budget and personnel constraints. This will be discussed at the next meeting.

Sept. 2, 1994 SKI, Stockholm, SE NKS/RE(94)3

- The **1990 – 1993** evaluation report will be published shortly and sent to relevant organizations. The evaluators have applied various structures and methods in their work and focused on different aspects. Thus, the results are somewhat disparate. One of the chapters gives recommendations for the future organization of NKS work. It is suggested that a midway evaluation of the projects is performed after about two years. Furthermore, it is suggested that a certain portion of the budget for every project be withheld until the final report has been delivered.
- The **1994 – 1997** program: The Board expressed its satisfaction with the RAK-1, RAK-2, EKO-1 and EKO-4 plans. Further information was requested for AFA-1, EKO-2 and EKO-3. NKS will write contracts with the respective project leader's organization, stating the terms of the work. The responsibility for the projects rests with the organizations, not the project leaders personally. The mandate of the reference groups is to follow the work, not to lead or steer it. In order to make NKS work more flexible, detailed budgets for 1996 and 1997 will not be decided until the first two years' results have been evaluated.
- The earlier Board decision to avoid NKS involvement in questions raised by the Nordic Council of Ministers in what could be felt to be political or sensitive matters was confirmed.

Feb. 24, 1995 DEMA, Bernstorff Slot, Gentofte, DK NKS/RE(95)1

- The evaluation report for the **1990 – 1993** period has been printed and distributed. 4 of 16 of the final project reports for the period are still missing.
- Re the **1994 – 1997** program: The project plans for AFA-1, EKO-2 and EKO-3 were approved. Thus, the entire program had been accepted. Work has already begun in most projects and subprojects.
- It was decided that the annual report for one year and the plans for next year are combined in one report.
- It was decided to write a policy document for NKS work, including a set of project criteria that have to be fulfilled. The Board's winter meeting will be held in mid-January, starting next year. The contracts with the project leaders' organizations are all in place.
- Franz Marcus presented a plan for a book on the history of Nordic nuclear cooperation. The idea was accepted in principle, but the economic issue remains unsolved.

Sept. 20, 1995 IFE, Halden, NO NKS/RE(95)2

There are still three final reports missing from the **1990 – 1993** period. A folder introducing NKS and its work will be published in Scandinavian languages and English.

The **1994 – 1997** program:

- All projects follow the adapted time schedule. A detailed division of EKO-4 into subprojects and tasks was accepted. A new project, EKO-5, suggested and financed by the Swedish Rescue Services Agency, SRV, was approved.
- RAK-1 has produced a paper on possible future cooperation with EU. The Board recommended other project leaders to follow suit and decided to develop informal contacts with EU (DG-XI and DG-XII). The Nordic secretary was requested to contact EU in order to facilitate future discussions on possible modes of exchange of information. At a later stage, the NKS chairman could head a small NKS delegation to Brussels for joint discussions.
- EKO-1 communicates with its participants via a WWW Home Page. This pilot project will be followed closely by the Board and might serve as an inspiration to all projects and – indeed – NKS itself.

Other matters:

- The Nordic Directors Group reportedly expressed their satisfaction with NKS work at its last meeting.
- From now on, a summary final report will be published as soon as the final reports have been approved by the Board. The summaries (in Scandinavian languages and English) are identical with the summaries published in the full reports. (*Author's comment:* Cf. Jan. 30, 1997.) The target group consists of any and all persons and organizations interested in the results of NKS work. The distribution of the full final reports will be limited to the inner NKS circle.
- NKS will not finance cooperation projects with countries in eastern Europe. (*Author's comment*: Cf. Aug. 27, 1996.)
- The work with a policy document and the Nordic history is now underway.

Jan. 11, 1996 STUK, Helsinki, FI NKS/RE(96)1

- Criteria for midway and post-program evaluations of NKS projects were approved.
- The **1990 – 1993** period: Three final reports are still missing.
- The **1994 – 1997** period: The Board had ordered a critical review of the ongoing projects, which was now reported. Some delays had occurred and the great number of subprojects was questioned. So was the value of some of the subprojects. Adjustments of subproject plans were made as needed. In most cases cost-effectiveness, compliance with budgets and plans and achieved results were in line with the Board's expectations. Consequently, the plans for continued work in 1996 were approved.
- The heads of the information department of relevant authorities had submitted an application for an information project. It was accepted in part by the Board and added to the EKO program. There was a general attitude that information issues should be closer integrated with the projects in the next NKS four-year program.
- The Board confirmed a decision at an earlier meeting to publish the annual reports and the plans for next year as *one* report.
- Franz Marcus' Nordic history will be published by the Nordic Council of Ministers in their report series. (*Author's comment:* Due to the strained relations to the Nordic Council, the book was finally published by NKS.)

Aug. 27, 1996 IRSA, Reykjavík, IS NKS/RE(96)2

- There are still three final reports missing from the **1990 – 1993** period.
- Re the ongoing program, **1994 – 1997**: The critical review presented at the last Board meeting turned out to be helpful. Most projects (including their subprojects) are progressing as planned, and work with the final reports has been initiated. Both the reference groups and the Board play an important role in quality control of the reports. The draft policy document presented by the Bureau is to be revised and a new draft to be presented at the next Board meeting, together with draft evaluation directives. The chairman will contact DG-XII in order to pave the way for a visit by a small NKS delegation, and the Nordic secretary is to propose a policy for EU-

NKS contacts. The object is to inform about NKS and discuss a possible contact forum for the coming 4-year NKS period.

- Re the **next 4-year program**: The Board, reference groups and project leaders are to suggest new projects and areas of interest. The Bureau was asked to compile the proposals and suggest a procedure for the upcoming planning process.
- The Board stated that NKS should seriously consider a wider cooperation with eastern Europe. Nothing was said about scope, timeframe or costs. (*Author's comment*: Cf. Sept. 20, 1995 above.)

Jan. 30, 1997 SKI, Stockholm, SE NKS/RE(97)1

The **1994 – 1997** program:

- NKS work is by and large progressing according to plans.
- Parts of the information project (SAM-4) were questioned and additional guidelines given for the final report.
- The recriticality work of RAK-2.1 will be continued as an EU project in 1997 – 1998.
- The annual project reports for 1996 were approved.
- The Nordic secretary presented revised guidelines for the final reports. All Summaries are to be compiled in a new type of report (Summary Final Report, in English and one Scandinavian language) together with a brief introduction by the Nordic secretary. (*Author's comment:* Partly a restatement – see Sept. 20, 1995.)
- It was pointed out that all NKS activities shall be performed in such a fashion that they cannot be misinterpreted as regulations or recommendations issued by national authorities. (*Author's comment:* Cf. Feb. 5, 1998, third bullet point.)
- The draft evaluation criteria presented by the Bureau were discussed and a few changes made.
- It was decided to ask professor Antti Vuorinen, former head of STUK, to perform the evaluation, and his first reaction was "not disinterested".
- It was decided to arrange an NKS seminar to report on the present program and discuss the new program.

The next NKS program (**1998 – 2001**):

- The Bureau introduced two drafts, one with directives for the planning and one on the collection of proposals.
- Each owner will arrange a national meeting with all interested parties to formulate a national proposal for discussions with the reference groups and the Bureau.
- The Nordic secretary was asked to invite all NKS participants to propose new projects or areas of work, compile the proposals and distribute them to the owners and the Board.
- The Board will then decide on the new NKS program.

Other matters:

- The Bureau was given mandate to finish the work with the new policy document.
- It was reported that the Nordic Directors Group at their last meeting expressed a positive attitude toward NKS and its work.
- The NKS chairman, Nordic secretary and Franz Marcus will meet with EU representatives shortly to discuss modes of exchange of information and coordination.

Sept. 4, 1997 DEMA, Snekkersten, DK NKS/RE(97)2

The **1990 – 1993** program: The final report from the BER-6 project (Reclamation of contaminated urban and rural environments following a severe nuclear accident (Per Strand et al.) is now ready after a historically long delay.

The **1994 – 1997** program:

- A few minor delays are expected in the RAK projects.

- AFA work proceeds as planned.
- EKO-5, initiated by SRV, is finished after less than two years, including the final report.
- Some delays are reported for a couple of the EKO- projects; likewise for SAM-4, which started later than the rest of the projects.
- During 1997, the Nordic secretary and the Secretariat have focused their attention on the final reports and seminars of the various projects; planning for the evaluation of the present program; planning for the next NKS program; and new media and modes of communication.
- At least six summing-up seminars are planned; one of which is a joint seminar for all NKS projects.
- The final reports will be distributed as a CD/ROM and (for those requesting it) in print.
- Antti Vuorinen, who had accepted the task of evaluator of the present program, reported on his work.

The **1998 – 2001** program:

- The work done by the Bureau in defining the framework of the new program is to be continued.
- The owners were urged to nominate a program committee to work out the details of the new program in cooperation with the Bureau.
- The chairman and Nordic secretary were given renewed mandate for the upcoming period.
- There will be no reference groups next period.

The Nordic history by Franz Marcus will undergo a language check before publication; apart from that, it is almost finished.

Feb. 5, 1998 NRPA, Østerås, NO NKS/RE(98)1

The **1994 – 1997** program:

- Most final reports are finished and several of the final project seminars have been held. Invitations for the joint final seminar have been distributed.
- Antti Vuorinen presented his draft evaluation report. He will recommend that NKS funds fewer but larger projects and focuses on training of young scientists and competence building.
- The Board stressed that the role of NKS is to give recommendations to authorities and the industry; NKS has no mandate to issue rules or standards. (*Author's comment:* Cf. Jan. 30, 1997, sixth bullet point.)
- A meeting with EU will be arranged in the spring.

The **1998 – 2001** program:

- The draft structure presented by Sigurður Magnússon (two major programs, SOS and BOK, with a number of flexible activities that may run for one or more years) was received positively by the Board.
- The Nordic secretary was asked to draft directives for the pre-project work.
- A number of pre-project leaders and other participants will work out the details of the program.
- A special reference group for the pre-projects will be appointed by the owners. The group was given the mandate to initiate certain project activities.
- The pre-project work is to be reported at a seminar before the next Board meeting.

Other matters:

- Franz Marcus' Nordic history is ready to be printed.
- The graphic profile of NKS was approved.
- There is a growing interest in the NKS website; the number of hits is steadily increasing.
- A short report from the last meeting of the Nordic Directors Group was given and the Nordic secretary was invited to future meetings as an observer.

Sept. 17, 1998 IVO, Vantaa, FI NKS/RE(98)2

The **1994 – 1997** program:

- Final reports on EKO-2, EKO-4 and SAM are still missing. Thanks were conveyed to those project leaders who had finished their reports.
- The Nordic secretary presented a summary of the full evaluation report by prof. Vuorinen. The conclusions and recommendations of the evaluation were discussed. Some of them have already been implemented in the new program, others will follow as the program evolves.

Contacts with EC:

- Information was given on the joint NKS-EC seminar. NKS cannot expect EC funding, but a communication channel has been established to try to avoid NKS overlaps of EC projects.
- New project leaders will be instructed to keep abreast with EC projects and developments.
- EC does not find the existence of regional cooperation programs controversial.

The **1998 – 2001** program:

- After some minor changes, the project plans for SOS-1 and SOS-2 were approved as presented. The costs for SOS-3 have to be better motivated; other than that, the plans were accepted.
- Certain subprojects were shifted around between BOK-1, BOK-2 and SBA; and SBA was divided into two projects.
- The following project leaders were appointed:

SOS-1:	Kjell Andersson, Karinta-Konsult, Sweden
SOS-2:	Kaisa Simola, VTT Automation, Finland
SOS-3:	Karin Brodén, Studsvik, Sweden
BOK-1:	Bent Lauritzen, Risø, Denmark
BOK-2:	Sigurður Emil Pálsson, IRSA, Iceland
SBA-1:	Inger Margrethe Eikelmann, NRPA, Norway
SBA-2:	Vibeke Hein, BRS, Denmark

- The Nordic secretary heads the Secretariat at FRIT. The secretarial services of the SEK program (formerly SAM) are expected to continue much as before.
- The Board pointed out that focus must be on research rather than investigations and compilation of facts, in order to warrant continued funding from the owners' research funds.
- The Board stressed the importance of coordination between the various projects, specifically including careful planning of seminars, dates and venues.

Feb. 10, 1999 DEMA, Bernstorff Slot, Gentofte, DK NKS(99)9

The **1994 – 1997** program: The EKO-2 and EKO-4 final reports are still missing, together with a number of reports from RAK-1 and EKO-5 subprojects.

The **1998 – 2001** Program:

- The Board expressed concern regarding the slow start of some of the projects. This was not the project leaders' fault, it was pointed out, but rather a consequence of the preparation phase (program group and pre-projects).
- The ongoing work was approved, and a contact person in the Board was appointed for each of the project leaders.
- The document "This is NKS" presented by the Nordic secretary was approved.
- The Board decided not to formally invite EU to the upcoming midway seminar, but that Nordic EU delegates could receive an informal invitation.
- The Board expects project leaders to establish contact with EU experts as needed and plans to follow up on the contacts of yesteryear.

It was noted that SEK and FRIT will leave Risø and move to CAT across the road. It was confirmed that FRIT/SEK is responsible for the NKS archives and reference library.

The **next NKS program**: It was decided that the Bureau shall prepare a document before the next Board meeting, outlining some ideas for the planning procedure and program structure.

Sept. 15, 1999 SKI, Stockholm, SE NKS(99)17

The **1994 – 1997** program: The EKO-2 and EKO-4 final reports are still missing. The Board expressed its dissatisfaction with the unacceptable and lengthy delays.

The **1998 – 2001** program:

- The chairman thanked for the fine presentations given at the status seminar the day before. The Board agreed that this is an effective form for updating the Board and triggering discussions. NKS work, by and large, proceeds according to plans.
- Actions were taken to adjust some details, and further information on certain subproject issues were requested. SBA-2 has been inactive for the past six months due to lack of project participants. Anders Jörle was appointed new project leader of SBA-2.
- A midway seminar with tentative evaluation of the achievements so far in this period will be held in the fall of 2000. The Bureau will draft directives for the seminar and evaluation.
- It was decided to send the the final reports for the 1994 – 1997 program and the plans for 1998 – 2001 to EU.
- The new organizational chart of NKS, presented by the Bureau, was accepted.
- SEK was urged to check with the auditor whether it is legally possible to transfer funds from one 4-year program to the next. (*Author's comment:* Cf. Feb. 9, 2000, last bullet point; and Nov. 8, 2000, fifth bullet point.)

Feb. 9, 2000 NRPA, Østerås, NO NKS(00)5

The **1994 – 1997** program: The EKO-4 final report has been published. The EKO-2 report is still missing.

The **1998 – 2001** program:

- All annual project reports were approved. The objectives of SOS-1 and its target groups need to be more clearly identified. SOS-2 is running well but appears to be too ambitious and needs to be limited in scope. SOS-3, BOK-2 and SBA-1 work was approved. BOK-1 work is on schedule, except for one subproject. Revised plans for the SBA-2 information project were presented, discussed and approved. The project leader was urged to keep in contact with the SBA-1 and SOS-1 projects.
- A midway seminar with tentative evaluations of current results will be arranged in Helsinki on Nov. 7 – 8, 2000. The evaluations will be performed by the project leaders' contact persons in the Board.
- Funds are available for additional project work and may be applied for.
- The Board understands that NKS funds will be transferred from one year to the next and from one program period to the next. (*Author's comment:* Cf. Sept. 15, 1999, last bullet point; and Nov. 8, 2000, fifth bullet point.)

May 3, 2000 * Arlanda, SE NKS(00)14

The **1998 – 2001** program:

- Since the BOK-1.6 subproject reports no action or results it will be cancelled after another month unless there are definite signs of viability and improvement.
- A number of proposals for new subprojects and activities were accepted, and the project plans and budgets were changed accordingly. The Nordic secretary was granted a budget for promoting Nordic – Baltic cooperation, as needed.
- The status seminar (with evaluation and a study to a Triga reactor) in November was discussed. The Bureau will revise the draft agenda.
- The presented directives for the evaluation of the current program are to be revised by the Bureau but can be used tentatively in the ongoing planning process. The Nordic secretary is to coordinate the work to name national candidates for the evaluation group. The Bureau is to propose a budget for the entire evaluation process.

The **next NKS program**: Names of suggested planning group participants shall be sent to the Secretariat.

Nov. 8, 2000 ** VTT, Innopoli, Otaniemi, FI NKS(00)19

The **1998 – 2001** program:

- As suggested by the project leader of SBA-2 the information project will be discontinued.
- The midway evaluations presented at the status seminar the day before will be taken into account when planning for the next NKS program. The project leaders are to assure that the Board's views as manifested in the discussion following the seminar are considered in the continued work.
- The Board is positive to a proposed joint NSFS – NKS seminar. The Bureau was granted a small budget for this purpose.
- A transition seminar for final reporting of the present program and plans for the next will be held in Denmark in 2002.
- The Board is aware that there will be unused funds at the end of the 4-year period. The amount in question will be transferred to the next program period. The owners will decide how the funds are to be used. (*Author's comment:* Cf. Sept. 15, 1999, last bullet point; and Feb. 9, 2000, last bullet point.)
- The Board confirmed its decisions in May regarding new subprojects and budgets, and added a number of new subprojects and budget items.
- Directives for the final reporting 1998 – 2001 as suggested by the Bureau were accepted.
- Evaluators of the present scientific program: Raimo Mustonen, STUK, and Gustaf Löwenhielm, SKI. The directives proposed by the Bureau were adopted with minor changes.
- Evaluator of NKS organization and administration: Martin Høiby, NRPA. The directives proposed by the Bureau were adopted with minor changes.

The **next NKS program**: A memo from the Bureau outlining a new scientific program structure and a slimmer and more flexible *modus operandi* met with the Board's immediate approval and will be discussed further. The Bureau suggested that two major areas of work be identified: Emergency preparedness including radioecology; and Reactor safety including decommissioning and waste. A revised memo will be discussed at the next Board meeting. An extra Owners Group meeting will be held shortly to discuss the new program; the chairman and the Nordic secretary will be invited to participate.

As Helge Smidt Olsen leaves the NKS Board, the owners appointed Sigurður Magnússon as new secretary of the Board.

May 22, 2001 * IRSA, Reykjavík, IS NKS(01)12**

The **1998 – 2001** program:

- The agenda of the seminar the day before the Board meeting included presentations and discussions of project status, final reporting, and the scientific and organizational / administrative evaluations. The discussions were continued at the Board meeting. The Board expressed its satisfaction with the presented drafts of the final reports.
- The apparent overspending of SOS-1 funds has to be investigated and necessary action taken. The Nordic secretary is to report back to the Board in two weeks.
- The Board redirected funds from the inactive information project (SBA-2) and a BOK-2 subproject.
- The Nordic secretary reported on the great number of seminars that have been held or are being planned and a couple of large international exercises (Baltic Nuclear and Barents Rescue) with NKS participation. An international seminar in Oslo on ethics and environmental issues is planned for October; NRPA was urged to make sure that the Board's intentions regarding contents and lecturers are observed.
- The chairman summed up the evaluation reports. The conclusions and recommendations will feed back into the discussions on the coming program.

The **next NKS program**:

- The revision of the Bureau document on the new NKS structure and program is to be continued.
- The Board was informed that the owners had appointed the two program managers: Timo Okkonen, STUK (NKS-R) and Sigurður Emil Pálsson, IRSA (NKS-B).
- The presented guidelines for the reactor safety (NKS-R) and emergency preparedness (NKS-B) programs will be handed over to the program managers. NKS-R work will prioritize, e.g., thermohydraulics and human factors. The importance of involving the nuclear industry was stressed. In NKS-B the close link between emergency preparedness and radioecology will be stressed.
- A planning group of ten persons (the owners, the program managers, the chairman and the Nordic secretary) will work out a proposal of initial activities and present it to the Board.

Nov. 7, 2001 * Kongrescenter Roskilde, DK NKS(01)17**

This was Magnus von Bonsdorff's last meeting as chairman of NKS. He will be succeeded by Helge Smidt Olsen.

The **1998 – 2001** program:

- SOS-1 finances: The Nordic secretary reported on the actions taken during the summer and fall. The Bureau had ordered an investigation by the auditor, and the results were now discussed by the Board. This problem would not have occurred had the project leader been more diligent in following up the expenditures; and the Nordic secretary was too late in realizing the seriousness of the situation. The information from the Secretariat to the project leader had been correct, but it was understandable that he could miss the warning signals, given the format for presenting the figures. The figures were there for everyone to see, also the Board, but nobody reacted in the early phases of the development; and the Nordic secretary did not sound the alarm as early as could be expected. However, the internal system of checks and follow-up worked, although a bit late. The secretarial routines and formats for presenting economic reports will be revised. SOS-1 was granted additional funding, and the project leader will reduce his fee so the total cost will match the given budget.
- The Nordic secretary was instructed to – in cooperation with the Secretariat – make the written economic reports to the Board and the project leaders more transparent.
- The Board was reluctant toward future seminars on ethical/philosophical issues and environmental radiation protection, and consensus seminars in general.
- The final reports should focus on Nordic added value of the efforts; achievements and practical results; and the participants' in-kind support should be estimated.
- The administrative evaluation has been completed. The scientific evaluation awaits the final reports of the projects.

The **next NKS program**:

- The R&B frameworks as presented at the previous status seminar were accepted after a few modifications.
- There are distinct differences between R and B as regards end user value and implementation (authorities and industries).
- The Bureau will review the central organization and administrative routines to better fit the needs of the new NKS structure.
- The Board members were encouraged to suggest guidelines and priorities regarding future activities and fields of work.
- The program managers are to work out detailed program proposals in cooperation with the Nordic secretary, to be discussed at the next (extra) Board meeting.
- The document "This is NKS" is to be revised by the Bureau in accordance with the recommendations in the administrative evaluation report.
- It was decided that organizations from Baltic Sea countries can participate in NKS activities at their own expense if it benefits NKS and its goals.

March 19, 2002 ** Roskilde, DK NKS(02)4**

This was Helge Smidt Olsen's first meeting as chairman of NKS. Olli Vilkamo will for some time fill in for Timo Haapalehto.

The new **R&B program**:

- The R&B program managers can be called on to participate in (parts of) the Board meetings; they are also free to participate if they wish.
- The program managers' outlines of the structural framework and initial activities were well received. The Board stressed the importance of transparent assessments of proposed activities in accordance with NKS criteria and demanded total control of the financial situation. The Swedish owners pointed out that proposed activities should be cleared with relevant end users and co-financiers. Nine R and eight B activities were approved by the Board.
- A new draft Owners' Letter of Intent was discussed and will be completed at the next Owners Group meeting.
- The Nordic secretary informed on the seminar "NKS today and tomorrow".

The **1998 – 2001** program:

- The Nordic secretary delivered a short status report on the final work within the 1998 – 2001 program.
- The Finnish owner reported on the somewhat delayed scientific evaluation.

May 7, 2002 SSI, Stockholm, SE NKS(02)11

The R&B program:

- Report from the last meeting of the Nordic Directors Group: The group is satisfied with the new program structure and initial activities and stressed the importance of efficiency and cost effectiveness. There is a need for a thorough discussion among the owners as to legal aspects and the long-term strategy of NKS.
- To clarify the roles of the owners and the Board, respectively, a separation of Owners Group meetings and Board meetings is called for.
- The owners agree to a great degree with the administrative evaluation and its conclusions; the owners are however divided on the issue of the size of the Board. Discussions on the long-term NKS strategy have been launched.
- The Bureau suggested annual cost cuts of some DKK600k which met with the Board's approval.
- The chairman pointed out that well over 80% of available financial resources are spent on R&B work. Hence, the potential for savings in absolute numbers and increase in cost effectiveness should be greater in scientific activities than in administration. The Board was therefore urged to assess all new R&B proposals from this point of view.
- The program managers shall ensure that all activities are embraced by the potential end users and that the expected results are realistic.
- The program managers delivered status reports and the Board accepted a number of new activities.
- It was decided that on certain conditions MS and PhD courses and work can be supported by NKS.
- The draft program and administrative handbooks were discussed; revised versions are to be distributed shortly.
- The Nordic secretary presented a list of written contracts and oral agreements regulating NKS work.
- The total NKS budget for 2002 as presented by the Bureau was accepted.
- Only about 60% of the budget for the seminar "NKS today and tomorrow" had to be used.

The **1998 – 2001** program:

- The SBA-1 and BOK-2 final reports are still missing.

- The scientific evaluation will be finished shortly.

Nov. 21, 2002 NRPA, Østerås, NO NKS(02)16

The R&B program:
- All future R&B contracts must specify a deadline for scientific work and final reporting.
- Activities approved at one Board meeting have to be contracted by the time of the following meeting in order not to risk cancellation.
- The Owners declared that measures should be taken to avoid an accumulation of unused funds.
- The Owners have decided to prolong the present program into 2004.
- The chairman is invited to participate in future Owners Group meetings. (The Nordic secretary acts as secretary at these meetings.)
- The Swedish owners agreed to produce a memo to be used in the continued strategy discussions.
- In their status reports to the Board, program managers shall include information on participants, end users and an estimate of the quality of the expected results.
- The chairman proposed and distributed a chart to be used by the program managers for presenting plans vs. results in their status reports. The chart was accepted by the Board.
- The Board approved seven new R activities and seven new B activities plus a small Baltic travel fund for the B program.
- The presented program handbook and administrative handbook need additional revision.

The **1998 – 2001** program:
- The Board expressed its satisfaction with the beta version of the CD-ROM containing the final reports, technical reports and other NKS material.
- The SBA-1 final report has not yet been finished.
- The scientific evaluation report is ready and will be discussed at the next Board meting.

May 6, 2003 KTM, Helsinki, FI NKS(03)4

The R&B program:
- The program manager of NKS-R, Timo Okkonen, was replaced by Petra Lundström, Fortum, since TimO had left his position with STUK.
- The strategy discussion continued – and will do so. The owners and members of the Board were urged to send their input to the Swedish owners who will produce a new memo.
- The NKS-B status report was well received. Additional funds were allocated for the NucVes (nuclear vessels) activity. After an intense debate on whether this actually is a B activity and not rather an R activity it was decided to keep it under the B umbrella.
- The Board was interested in the Nordic Nuclear Network suggested by the NKS-R program manager.
- Due to the present financial situation no new activities were added to the R or B programs. Work to find new co-financiers is in progress.
- The program handbook and administrative handbook were approved.
- It was decided that final reports shall still be printed but that the project managers can choose whether technical reports should be printed or published electronically.

The **1998 – 2001** program:
- The Secretariat demonstrated a master CD containing the final reports. Older reports and other relevant material will be added.
- The scientific evaluation was presented and discussed in depth. The mostly positive report concludes that the objectives were fulfilled and recommends that NKS work continues for a new period. The evaluators supported the new structure and administrative changes adopted by the Board. The chairman thanked the evaluators for their valuable contributions.

Nov. 13, 2003 IRSA, Grand Hotel Reykjavík, IS NKS(03)7

The R&B program:

- 10 new R activities and 11 new B activities were approved. Conditions for continued work / funding of some of the ongoing R&B activities were given.
- The Nordic secretary informed on the preparations for a joint NKS-BKAB seminar on Quality in Radiation Protection Work at Nuclear Installations.
- At its last meeting the Nordic Directors Group concluded that for the foreseeable future the Directors Meetings and NKS will continue to be two separate arenas with no formal links.

Planning for the future:

- The Swedish owners presented a memo on efficiency and organization in the next couple of years.
- The Board agreed on the goals but differed somewhat in ways to get there.
- It was decided to let the program managers report whether they are able to take on additional tasks under the present contracts with NKS.
- The Swedish owners and the Nordic secretary will discuss his function in order to optimize his efforts and use of resources.
- The Bureau was asked to send a questionnaire to the program managers and all of their activity leaders in order to poll the general opinion on the new program structure, organization and administrative support.

May 5, 2004 SIS, Herlev, DK NKS(04)5

- The Board approved the additional work and funding of ongoing activities requested by the program managers, together with the suggested relocation of funds within the R&B programs.
- The Board wished to stress that if there is a request for relocating unused funds to another activity, this is to be considered as a new new application and will be treated as such.
- The Nordic secretary informed on the participants' very enthusiastic evaluation of the second joint NKS-BKAB seminar on Quality in Radiation Protection Work at Nuclear Installations. A third seminar of this kind, however, requires an external initiative by a co-sponsor and end user.
- The Bureau reported that the activity leaders were satisfied with the new R&B structure and the services offered by the Nordic secretary and the Secretariat, and that the program managers saw no possibility to take on more administrative duties under the present contract.
- The Secretariat was requested to draft a policy for dissemination of information.

Nov. 9, 2004 SKI, Stockholm, SE NKS(04)10

- The proposed funding of 9 R activities was approved, together with a revised framework for the R program as a whole. The Board expressed some concern regarding the fact that there are activities with as little as one or two participating organizations. Measures should be taken to avoid this to the extent possible, in order not to lose the Nordic dimension.
- The proposed funding of 11 B activities was approved. The Board pointed out that the process of assessing new proposals should be made more transparent.
- Re the new program handbook: The Consortial partners should from now on be referred to as the Owners. The Owners are also the main financiers of NKS. It is the Board that decides in budgetary matters, after proposals from the Bureau. With this, the handbook was accepted.
- The Nordic secretary presented the new routines for dissemination of information. Changes have been made in the program and administrative handbooks. The NKS webpage is updated continuously, and electronic newsletters and newsflashes will be distributed as need be; at least twice a year.

May 12, 2005 ‡ Hotel Olavsgaard, Lillestrøm, NO NKS(05)3

- Report from the previous Owners Group meeting: The owners are very satisfied with the new structure. A replacement for the present program manager for NKS-R will have to be found

soon since Petra Lundström has been promoted to a top position within her present organization. The contract with the NKS-B manager will be prolonged. Although the owners are satisfied with the Bureau and its work, administrative routines and costs will continue to be scrutinized. Discussions and a new decision on the administrative way ahead can be expected at the November meeting.
- The presented R&B status reports and their respective applications for additional funding were approved. The Board expressed its satisfaction with the work.
- The need for an evaluation of NKS work since the start of the R&B programs will be discussed in November. The Bureau was asked to produce a memo until then.
- An NKS status seminar in Finland May 2006 was discussed and a work group (the Bureau and a Finnish Board member) was appointed.
- The improved NKS website and newsletters were discussed.

Nov. 17, 2005 IRSA, Grand Hotel Reykjavík, IS NKS(05)8

News from the previous **Owners Group meeting**:
- Nici Bergroth fills in as program manager for the rest of the year. It was later decided that Jesper Kierkegaard will take over in 2006.
- Measures will be taken to save money and simplify the administration. Effective June 2006, the post of Nordic secretary will be replaced by a time-limited coordinating function. The Bureau will be dissolved and the post as secretary of the Board discontinued. NKS owners, board members, chairman, secretariat and program managers are expected to take over most of the work earlier done by the Nordic secretary, the secretary of the Board and the Bureau. The role of the coordinator will be defined over time and is expected to decrease.
- Finland and Sweden will check whether some large R activities could be carried out bilaterally, thus opening for NKS activities concerning decommissioning and waste, which could be of a more general Nordic interest. Also, a review of the R program should consider the interests of the co-financiers.
- Sigurður Magnússon takes over as chairman of NKS after the next Board meeting.

The R&B program:
- The proposed funding of 9 R and 10 B activities was approved. The Board declared its satisfaction with the progress of the R&B program.
- The Bureau presented its proposed directives for the evaluation of work and results in 2002 – 2005. It was accepted after some changes. SEK will not be evaluated this time since the owners had already done that since the May meeting. The R&B evaluators were appointed: Risto Sairanen and Per Persson (NKS-R); Per Hedemann Jensen and Tore Lindmo (NKS-B).
- The program and budget for the 2006 NKS status seminar presented by the Bureau was positively received by the Board. The work group will continue its preparations.
- The Board is satisfied with the NKS website and the number of hits registered.
- SEK will have to review the VAT routines, especially the favorable agreement with SKI which will be ended shortly due to new regulations.

May 11, 2006 Dipoli, Otaniemi, FI NKS(06)5

News from the previous **Owners Group meeting**:
- A new program manager for NKS-B is expected to take over in 2008.
- The NKS framework program needs to be reviewed in the light of the past years' experience, conclusions of he evaluation (once it is finished) and the presentations and discussions at the status seminar.

The R&B program:
- The Board approved funding of one R and four B activities and expressed its satisfaction with the progress of work in relation to adopted work plans. It was stressed that the major portion of the funding of the NKS-B Young Scientists Seminar should be used for travel grants rather than for seminar preparations.

- The Board was pleased with the status seminar in despite of the unexpectedly low attendance (some 60 participants).
- A new NKS pamphlet was distributed at the status seminar, and a beta version of a coming DVD containing all NKS reports and other material since the start was available for testing; it will be ready for distribution shortly.
- The evaluation report shall be finished no later than September 2006. The NKS coordinator arranges a meeting in the summer with the involved persons to speed up the process.
- The Call for Proposals procedure and the assessment of proposed activities will be reviewed by the program managers and the new chairman. Their work has to be completed before the next CfP.
- Two work groups were appointed to review the R&B frameworks. Their reports are to be presented at the November meeting and any changes adopted at that meeting should be implemented in May next year.
- New versions of the program and administrative handbooks were presented by the coordinator. The program handbook may be used tentatively until a revised version is to be discussed by the Board.
- Sigurður Magnússon now took over as chairman and thanked Helge Smidt Olsen for his many years of dedicated work for NKS.

Nov. 10, 2006 SSI, Stockholm, SE NKS(06)9

- The new chairman, Sigurður Magnússon, noted that the structural and administrative changes seem to work well. But it is still too early to discuss and evaluate the new regime.
- The Board thanked the four evaluators for their fine work, both as regards the scientific results and the constructive conclusions and recommendations for future activities. The section on dividing NKS funds between R and B, the five countries and participating organizations was thought provoking. NKS results are of high standard, especially considering available resources. The evaluation will be published as NKS report No. NKS-145. The implementation of suggested changes will be discussed together with the review of the R&B frameworks.
- The coordinator presented the Secretariat's report on the status seminar in Otaniemi, Finland.
- The ongoing review of the R&B frameworks was reported and will continue at the next meeting. The revision of the Call for Proposals procedure was presented. End users shall be identified in all applications and given an opportunity to comment on the usefulness of the activity in question. In the case of NKS-B the Nordic NEP group will be considered as a potential end user.
- Since Jesper Kierkegaard moves on to a new job, Patrick Isaksson was appointed new NKS-R program manager.
- The Board approved funding of nine R and eight B activities.
- The chairman was given the mandate to use up to DKK100k between Board meetings for urgent matters.
- The program and administrative handbooks cannot be updated until the revision of the R&B frameworks is finished.
- The coordinator reported that a new folder is under production; electronic newsletters are sent out as scheduled; and the much delayed DVD will be distributed shortly. The website will undergo a complete overhaul.

May 11, 2007 Risø, Roskilde, DK NKS(07)6

- The coordinator and the NKS-B program manager will be replaced during 2008.
- Work on the new R&B frameworks will continue in the summer. As a part of this work, prioritized areas for this year's Call for Proposals are to be identified.
- An information policy shall be outlined by the chairman, the coordinator and the Secretariat. It is to be integrated with the program handbook and the framework to form an NKS policy document and shall be presented at the next Board meeting. The administrative handbook will undergo a revision once the policy document has been approved.

- According to status reports given by the program managers R&B work is proceeding according to plans, apart from some minor delays.
- NKS-B: It is essential that REIN is concluded as soon as possible. A reservation for additional funding of one activity was made, pending a Board approval via email.
- NKS-R: The program manager had received an extraordinary proposal for a new activity. A reservation for funding of that activity was made, pending a Board approval via email.
- NSFS: The chairman had received an application from NSFS regarding financial support of the 2010 IRPA conference hosted by NSFS in Helsinki. Again, a reservation for funding of that activity was made, pending a Board approval via email. The cost, DKK200k, is to be shared equally by R and B.

Nov. 16, 2007 NRPA, Esterase, NO NKS(07)11

News from the previous **Owners Group meeting**:

- Justin Gwynn will succeed Sigurður Emil Pálsson as program manager of NKS-B. The transition will be made smoothly over a period of six months starting in 2008.
- The two Swedish owners SKI and SSI will merge to form a new authority, SSM, from July 1, 2008. It is not known at this point exactly how this will affect NKS relations; most likely the changes will not be drastic.
- As the role of Nordic secretary / coordinator is gradually abolished the NKS chairman and – to a certain extent – the Secretariat and the program managers will take over his duties. The work to increase efficiency and cut costs will continue.

The R&B program:

- The program managers presented the R&B status reports and their proposals for funding.
- As the number of R proposals was much larger than usual and the quality of the applications high, it was decided to allocate extra funding. A total of 12 activities received financial support.
- Since the number of B applications did not reach the expected level, more than half of the available funding was withheld, pending a new CfP before the meeting in May 2008. A travel grant for young scientists was set up, replacing the YoungRad activity. A total of 5 activities received financial support.
- The policy document was discussed and changes made. E.g., it was decided to stress that non Nordic participants to NKS seminars have to be cleared with the program manager to avoid situations where non EU residents look for a loop hole to enter the Schengen zone legally. A corrected version of the policy document will be sent by email for further comments and final approval. The Swedish version reflects the official policy of NKS whereas the abridged English version serves as a guideline for an international audience.
- The chairman expressed his and the Board's gratitude to Sigurður Emil Pálsson for his excellent and ambitious work through many years as project leader and program manager.

May 7, 2008 DEMA, Kastellet, Copenhagen, DK NKS(08)5

- No Owners Group meeting was held.
- The Board saw no reason to revise the R&B frameworks at this point.
- The new policy document was approved.
- The Board recommends that applications for NKS funding under the CfP procedure be written in English.
- The NKS-B program manager presented a status report and an assessment of the extra CfP. Five proposals met with the Board's approval. The program manager again suggested a young researchers' travel fund (*Author's comment:* This was already decided at the last meeting, budget and all), and the Board defined "young" in this context to be under 35 years of age.
- The NKS-R program manager noted that no formal applications for funds had been received but suggested additional funding of two activities, which was approved.
- The Board decided that NKS does not support seminars outside the Nordic countries, with rare exceptions for the Baltic states when motivated.

- This was the Nordic secretary's / coordinator's last appearance at an NKS Board meeting.

Nov. 19, 2008 IRSA, The Culture House, Reykjavík, IS NKS(08)8

News from the previous **Owners Group meeting**:

- Two new members representing the Danish and Finnish owner, respectively, were welcomed: Michael Boesgaard Brøndel (DEMA) and Anne Väätäinen (KTM).
- A new Letter of Intent between the owners must be written since the formation of the new Swedish authority, SSM.
- The chairman will ask Torkel Bennerstedt to write the history of NKS for the years 1997 – 2004. (*Author's comment:* This was later corrected to 1994 – 2008.)

The R&B program:

- 9 of 18 NKS-R applications were honored; for NKS-B the figures were 7 out of 12. A new CfP for NKS-B activities will be announced during the spring since considerable funding is still available.
- A joint R&B seminar will be arranged in Stockholm March 2009.
- The assessment of applications from the CfP procedure were discussed at some length. The chairman suggested that Board members should do the assessments to ensure balanced priorities and secure national interests.
- The English version of the policy document was approved after a few changes. The administrative handbook was presented without any comments from the Board; the chairman was given the mandate to approve future versions.
- The Board was positive to publishing NKS accounting and audit reports on the website. From now on material to be discussed at Board meetings will be available for download on the website.
- Special thanks ware directed to Torkel Bennerstedt who left his position as Nordic secretary / coordinator at the previous Board meeting after many years of dedicated work.

Appendix 3: Overview of NKS Programs and Evaluations

Program Overview 1977 - present

Number	Years	Main Programs
First	1977-1980	QA, AO, KRU, RA, MY
Second	1981-1985	SÄK, KVA, LIT, AVF, REK
Third	1985-1989	AKT, KAV, RAS, MAT, INF
Fourth	1990-1993	BER, KAN, RAD, SIK
Fifth	1994-1997	RAK, AFA, EKO, SAM
Sixth	1998-2001	SOS, BOK, SBA
R&B	2002 →	R (Reactor safety), B (Emergency preparedness)

See Appendix 11 for an explanation of the acronyms.

List of all evaluations since the first 4-year program

Program	Report Id.	Author(s)	Comments
1977 – 1980	NORD	Erik Jansson	QA(Quality Assurance)
		Lars Högberg	QA
		Jan Olof Snihs	AO (Waste Management)
		Curt Bergman	AO
		Leif Moberg	AO
		Veikko Palva	KRU (Control Room Design)
		Niels Busch	RA (Radioecology)
		Frits Heikel Vinther	RA
		Jon Olav Berg	MY (Authority Related Projects)
1981 – 1985	NORD87:7	Ami Rastas	SÄK (Reactor Safety)
		Bjarne Regnell	SÄK
		Mats Danielsson	KVA (Quality Assurance)
		Kåre Netland	LIT (Human Reliability)
		Bengt Edwall	AVF (Radioactive Waste)
		Uffe Korsbech	REK (Radioecology)
		Lennart Hammar	General overview
		Pekka Silvennoinen	General overview
1985 – 1989	NORD90	Heikki Kalli	AKT (Releases, Dispersion, Impact)
		Heikki Raumolin	KAV (Nuclear Waste Management)
		Jørgen Firing	RAS (Risk Analysis & Safety Philosophy)
		Christer Jansson	MAT (Materials Research)
		Arne Jensen	INF (Advanced Information Technology)
1990 – 1993	NKS(94)17	Göran Steen	BER (Emergency Preparedness)
		Leiv Berteig	KAN (Waste Management)
		Olli Paakkola	RAD (Radioecology)
		Povl L Ølgaard	SIK (Reactor Safety)

1994 – 1997	NKS(98)2	Antti Vuorinen	Entire program (RAK, AFA, EKO, SAM)
1998 – 2001	NKS-66	Gustaf Löwenhielm	SOS (Safety and Radiation Protection) SBA (Safety Threats in Nordic Surroundings)
1998 – 2001	NKS-66	Raimo Mustonen	BOK (Emergency Preparedness and Consequences) SBA (Safety Threats in Nordic Surroundings)
1998 – 2001	NKS-67	Martin Høiby	SEK (Secretariat and NKS organization)
R&B 02-06	NKS-145	Risto Sairanen	NKS-R (Reactor Safety)
		Per Persson	NKS-R
		Per Hedemann Jensen	NKS-B (Emergency Preparedness)
		Tore Lindmo	NKS-B

Summaries of the evaluations of the 1994-97 program and onward are given under the respective NKS program in the main text.

Appendix 4: Economic Contributions to NKS in kDKK

Year	TOTAL	DEMA	KTM	IRSA	NRPA	SKI&SSI	Others
1994	7420	860	2015	150	970	3425	0
1995	9875	970	2290	150	1348	3563	1554
1996	9515	970	2305	150	970	3425	1695
1997	9129	970	2302	150	970	3425	1312
1998	8512	970	2264	150	600	3425	1103
1999	8890	970	2255	150	970	3425	1120
2000	8347	900	2252	150	970	3425	650
2001	7727	900	1632	150	970	3425	650
2002	7551	484	2232	149	893	3273	520
2003	7391	260	2228	149	966	3268	520
2004	7466	261	2234	149	968	3276	578
2005	7458	260	2231	149	967	3272	579
2006	7817	336	2313	157	1007	3394	610
2007	7869	358	2312	161	1025	3393	620
2008	8598	773	2386	168	1059	3504	708

Total for the fifth 4-year program	1994 – 1997:	DKK 35,939k
Total for the sixth 4-year program	1998 – 2001:	DKK 33,476k
Total for the first 4 R&B years	2002 – 2005:	DKK 29,866k
Total for the next 3 R&B years	2006 – 2008:	DKK 24,284k
GRAND TOTAL for the NKS program	1994 – 2008:	DKK 123,565k

Appendix 5: NKS Budgets in kDKK

N.B.: Budgets as decided by the Board – not actual spending

Budgets for the fifth 4-year program 1994 – 1997 (kDKK)

Project	1994	1995	1996	1997	In all
RAK-1	700	1150	1250	1150	4250
RAK-2	800	1150	1150	1140	4240
AFA-1	500	1050	1060	1050	3660
EKO-1	1000	1200	1210	1110	4520
EKO-2	1000	1300	1530	1355	5185
EKO-3	500	1100	1040	1100	3740
EKO-4	500	1000	1135	830	3465
EKO-5 *	---	247	605	207	1059
SAM **	2450	2215	1860	3285 ***	9810
TOTAL	**7450**	**10412**	**10840**	**11227**	**39929**

*) Proposed 1995 and financed by SRV; carried out by FOA for NKS
**) Including the SAM-4 information project
***) Raised costs in 1997 due to final reporting, evaluation and planning for the next 4-year program

Budgets for the sixth 4-year program 1998 – 2001 (kDKK)

Project	1998	1999	2000	2001	In all	Notes
SOS-1	570	700	700	1487	3457	
SOS-2	1050	1400	1450	1462	5362	#1
SOS-3	570	700	700	650	2620	
BOK-1	1130	1100	2681	2755	7666	#2
BOK-2	1130	1850	2000	2094	7074	#3
SBA-1	400	150	590	830	1970	#4
SBA-2	120	120	245	0	485	#5
SEK	1700	1600	1800	2700	7800	#6
TOTAL	**6670**	**7620**	**10166**	**11978**	**36434**	

N.B.:	Late start for the 4-year program due to a long pre-project period
Note #1:	2001: Including funds according to an earlier decision
Note #2:	Additional funding for participation in the Barents Rescue international exercise and two more activities
Note #3:	Additional funding of five separately approved activities
Note #4:	Additional funding of three separately approved activities
Note #5:	Projected cancelled
Note #6:	Raised costs in 2001 compared to earlier years due to final reporting and evaluation of the present program and planning for the next program

Budgets for the R&B program 2002 – 2005 (kDKK)

Project	2002	2003	2004	2005	In all
R Activities	2360	2250	2320	2400	9330
R Program manager	400	400	400	400	1600
R Expenses	75	175	100	100	450
B Activities	2590	1760	2200	2200	8750
B Program manager	400	400	400	400	1600
B Expenses	100	200	100	100	500
SEK: Coord., adm.	2005	1685	1505	1480	6675
TOTAL	7930	6870	7025	7080	28905

Budgets for the R&B program 2006 – 2008 (kDKK)

Project	2006	2007	2008	In all
R Activities	2400	2500	3430	8330
R Program manager	400	400	400	1200
R Expenses	100	100	200	400
B Activities	2600	2500	2520	7620
B Program manager	400	400	400	1200
B Expenses	100	100	200	400
Special Support	715	270	200	1185
SEK: Coord., adm.	1115	975	1270	3360
TOTAL	7830	7245	8620	23695

Total for the fifth 4-year program	1994 – 1997:	DKK 39,929k
Total for the sixth 4-year program	1998 – 2001:	DKK 36,434k
Total for the first 4 R&B years	2002 – 2005:	DKK 28,905k
Total for the next 3 R&B years	2006 – 2008:	DKK 23,695k
GRAND TOTAL for the NKS programs	1994 – 2008:	DKK 128,963k

Appendix 6: NKS Policy, Framework and Procedures

This document was adopted by the NKS Board at its meeting in Reykjavík, Iceland, on Nov. 19, 2008. (*Author's comment:* Maybe the time is ripe to give this document a good overhaul.)

Introduction

This is the official policy document of NKS, Nordic Nuclear Safety Research. NKS is a platform for Nordic cooperation and competence in nuclear safety and radiation protection including emergency preparedness and protection of the environment. The work is financed and supported by Nordic authorities, companies and other organizations. Information on NKS activities is disseminated through seminars, reports, electronic newsletters and the NKS website, www.nks.org. The results are used by financiers and other participating organizations in their decision making processes and information efforts. All results are available free of charge to anyone interested in NKS activities.

In addition to this policy document, practical NKS work is governed by an administrative handbook in Danish, also available at www.nks.org. Reviews and updates of the policy document and the handbook will be brought to the Board for approval; smaller changes will be decided by the chairman.

Divided into three main chapters, this document gives background information on NKS and its structure; a presentation of the current scientific framework program; and guidelines for practical work and how to join it. The target group is first and foremost active NKS participants; but it is hoped that any organization or individual wishing to learn what NKS stands for and how work is conducted will find the document useful.

This document sets out to answer questions like:
- What is NKS all about?
- How is NKS and its work organized?
- Who pays?
- What are the main areas of work?
- Do I have to live in one of the Nordic countries to participate?
- How do I join?
- What is a Call for Proposals?
- Can I suggest new activities?
- What criteria must proposals meet?
- How do I get NKS funding?
- How is the quality of the work evaluated?
- How are NKS results communicated?

If, after reading this document, any of your questions remain unanswered, please contact the appropriate Program Manager or the Secretariat at nks@nks.org.

This is NKS

Scope and Objectives

NKS (Nordic Nuclear Safety Research) is a platform for Nordic cooperation and competence in nuclear safety and radiation protection including emergency preparedness and protection of the environment. The work centers around nuclear power related issues and is divided into two main areas:

- Reactor Safety (NKS-R)
- Emergency Preparedness (NKS-B)

In addition, some activities will be identified as being cross-disciplinary, i.e., belonging to both NKS-R and NKS-B.

Normally, the NKS program does not include safeguards; transport of nuclear or radioactive materials; general radiation protection; or external threats.

The hallmark of NKS is a spirit of sharing – all results are available free of charge, not only to NKS participants but worldwide. When quoting NKS material or work supported by NKS, a reference to the source shall be made.

The Nordic Perspective

NKS is an informal forum, serving as an umbrella for Nordic initiatives and interests. Its purpose is to carry out joint activities producing seminars, exercises, scientific articles, technical reports and other types of reference material. Special efforts are made to engage young scientists. The work is financed and supported by Nordic authorities, research institutions, power companies, contractors and other organizations. The results are used by participating organizations in their decision making processes and information efforts. To ensure that the Nordic perspective prevails, all major activities should include representatives from at least three Nordic countries.

The region in question is the five Nordic countries, i.e., Denmark (including the Faroe Islands and Greenland), Finland, Iceland, Norway and Sweden. With a total population of some 25 million people, and a common cultural and historic heritage, the Nordic countries have cooperated in the field of nuclear safety for approximately half a century. Informal networks for exchange of information have developed throughout the years, strengthening the region's potential for fast, coordinated and adequate response to nuclear threats, incidents and accidents. NKS has served well as a platform for such activities.

Major Nordic Nuclear Installations

The Nordic interest in cooperation and pooling of resources via NKS is due to the large number of nuclear installations and activities in the region. There are four nuclear power reactors in operation in Finland, and one (Olkiluoto 3) is under construction. Sweden has 12 nuclear power reactors. Of these, 10 will continue operation and two have been permanently shut down (Barsebäck 1 and 2). The Barsebäck reactors are being decommissioned. There are research reactors in Denmark, Finland, Norway and Sweden. The three Danish reactors have been closed and decommissioning work has started. The reactors in Finland and Norway are still in operation. The two Swedish research reactors have been shut down and face decommissioning. In Sweden there is also a nuclear fuel production plant in operation. All five Nordic countries have interim storages for radioactive waste. Finland, Norway and Sweden have final repositories in operation for low and medium level waste. In Finland and Sweden work is in progress to allow construction of final repositories for spent fuel. Apart from nuclear installations in the Nordic countries, there are commercial, research and naval nuclear reactors and other nuclear installations in surrounding eastern and western countries.

Financial Support

Normally, only activities of interest to financing organizations and other end users are carried out. The results should be practical and directly applicable. The owners and main financiers are:

- Danish Emergency Management Agency
- Finnish Ministry of Employment and the Economy
- Icelandic Radiation Protection Institute
- Norwegian Radiation Protection Authority
- Swedish Radiation Safety Authority

Additional financial support is obtained from these organizations:

- Fennovoima Oy in Finland
- Fortum Power and Heat Oy in Finland
- TVO in Finland
- IFE in Norway

- Forsmarks Kraftgrupp AB in Sweden
- Nuclear Training and Safety Center AB (KSU) in Sweden
- OKG Aktiebolag in Sweden
- Ringhals AB in Sweden

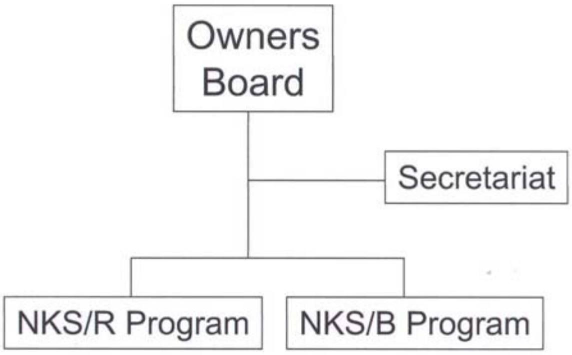
In 2007 the contributions of the owners together with support from the additional financiers above totalled some 7.9 million Danish crowns (1.1 million euros). To this should be added in-kind contributions by participating organizations, e.g., work hours, travel expenses and laboratory resources. These contributions are expected to be worth approximately as much as the actual NKS budget, and the program is highly dependent on them. Hence, all activity proposals are expected to offer at least a 50/50 in-kind contribution by the applicants.

All decisions on budgetary matters are made by the Board, usually for a period of one year at a time. NKS only supports the work of Nordic organizations, although international participation is sometimes accepted granted that external funding is provided by the foreign organizations, fully covering their costs. Non-Nordic cooperation is welcomed whenever relevant to the overall objectives of NKS and in line with the current program and policy; it will however not be supported financially by NKS.

Organization

The owners and main financiers of NKS are four central authorities and one ministry in the Nordic countries. Together with a number of experts appointed by the owners they constitute the NKS Board. Decisions on financing, program activities, NKS policy etc. are made by the owners and the Board. All major activities are handled by the two program managers, one responsible for reactor safety (NKS-R), one for emergency preparedness (NKS-B). The Board will decide on a case-by-case basis where cross-disciplinary activities belong. A secretariat handles administrative duties such as economy, electronic media, publishing of reports etc.

Organization of NKS:



Presently, the following organizations form the NKS Board:

Denmark	Danish Emergency Management Agency (DEMA)
	Danish Radiation Protection Authority (SIS)
Finland	Ministry of Employment and the Economy (TEM)
	Finnish Radiation and Nuclear Safety Authority (STUK)
	Fortum Nuclear Services Ltd
	Technical Research Center of Finland (VTT)
Iceland	Icelandic Radiation Protection Institute
Norway	Norwegian Radiation Protection Authority (NRPA; two persons)
	Institute for Energy Technology (IFE)
Sweden	Swedish Radiation Safety Authority (two persons)
	Vattenfall AB

Fortum Nuclear Services LTD. and Vattenfall AB represent the nuclear industries in the countries.

Overall Framework Program

Program Areas

Nuclear safety and emergency preparedness have been major Nordic priorities for many years. Two of the greatest challenges are the complexity of the systems and the need integrate knowledge from many different areas (reactor technology, nuclear physics, measurement techniques, environmental sciences, radiobiology, information and communication technology to mention a few). Continuous development and improvement is necessary: new knowledge must be gathered and tools created and kept operational. Optimized use of national resources and the potential need for cooperation and assistance between neighboring countries is of the essence; so is communication with media and individual members of the public. Common Nordic views and approaches are important in order to maintain public confidence in authorities and other actors in the nuclear field.

Therefore, in 2007 the NKS Board adopted a dynamic scientific framework program, divided into two main areas, each led by a program manager:
- NKS-R: Reactor Safety
- NKS-B: Emergency Preparedness

Some activities will be identified as **cross-disciplinary**, i.e., belonging to both NKS-R and NKS-B. The main part of the research program is constituted by NKS-R and NKS-B activities, whereas cross-disciplinary activities are expected to be more sporadic. Financial support is to be given fairly evenly to NKS-R and NKS-B in a long-time perspective.

Activities

The work is divided into activities of varying size and duration and may consist of **studies** (research, investigations, exercises etc.) or **dissemination of information** (conferences, seminars, workshops, courses, websites, scientific papers, technical reports etc.), or (usually) a combination of both. The aim is to maintain and build up **competence** and to develop close informal **networks**. In order to make seminars more valuable, participants should also take part in the preparations and follow-up work, e.g., writing the final report. Care should be taken to use other related Nordic, European and other international seminars for exchange of information and networking, where appropriate.

In many cases the issues at hand generate considerable public interest. Activities on information strategies, management and technologies in relation to NKS-R and NKS-B will therefore be included in the program, when appropriate.

The contents, time frames and budget of the program and its many activities are decided by the Board, in accordance with the NKS-R and NKS-B frameworks outlined below. The criteria summarized in a later section are applied when evaluating the proposals. The program is flexible since the results of ongoing work is evaluated at the biannual Board meetings in May and November. Changes in work plans are made when called for. Activities may be expanded, reduced, or aborted; new activities may be added. The program is constantly renewed through an annual (sometimes biannual) procedure of **Call for Proposals**, which is open to all relevant Nordic organizations and results in an expansion of the program. When an activity has been finished and the final report accepted by the Board, the results will be disseminated and can be implemented by the end users.

Young Scientists

In order to maintain a high level of competence in the longer perspective, it is important to ensure that enough young people choose to specialize in nuclear safety, radiation protection and related studies. In most Nordic countries, the number of experts is limited. The university sector plays an important role and must be stimulated to offer courses and relevant thesis projects, and to carry out research projects. Competence can be strengthened by NKS through education in different ways, e.g., by organizing and supporting joint Nordic M.Sc. and Ph.D. courses. It is also beneficial if NKS work is relevant for individual students and their NKS participation can aid in their studies. Other forms of educational activities can also be considered, e.g.,

- Workshops of various types, with invited lecturers, preferably producing proceedings in a refereed publication
- Training programs and exchange visits between research organizations

NKS-R Framework: Reactor Safety

R1 Priorities and Challenges

The research activities within the reactor safety part of the NKS program have changed from time to time depending on subjects of interest. This chapter gives a guidance as to which areas will be prioritized for financing in years to come. Research activities may be of different kinds, such as developing new knowledge; compilation of knowledge in a systematic manner aiming to support applications; or a pilot project demonstrating the use of new knowledge or techniques. It could also be seminars or courses to spread knowledge.

NKS funding is limited, roughly only one percent of the total Nordic funding in the area of reactor safety, phase-out and waste treatment. The funding can therefore not be expected to be of vital importance for the development in these areas. In addition to the expected result of a research activity in terms of knowledge, it will also be prioritized based on its contribution to the overall NKS criteria, e.g., a Nordic common view on nuclear safety. Priority will also be based on the importance to the safety of existing reactors. Non-safety operational issues as well as economical issues are given low priority. If a proposed activity supports or duplicates other national or international activities, this will also effect the NKS decision on funding.

The nuclear power industry and regulatory bodies have a number of challenges of particular interest where research activities are essential and will be prioritized. The areas are safety upgrade of older reactors comparable to modern standard; harmonization of reactor safety; power upgrade; aging/life management; phase-out and dismantling of nuclear facilities; waste treatment and final storage.

R2 Main Research Areas and Program Contents

The following main areas are judged to be of current interest and examples are given for each area.

Abbreviations used:

BWR	Boiling Water Reactor
CFD	Computational Fluid Dynamics
HR	Human Reliability
NDT	Non-Destructive Testing
PSA	Probabilistic Safety Analyses
RI-ISI	Risk-Informed In-Service Inspection

Reactor Physics and Thermo-Hydraulics

Examples:

- Core instability/oscillations in BWR high burn-out fuel
- Reactor physics and dynamics
- Thermo hydraulic and CFD calculations
- Integration of different models

Modernization, Introduction of New Techniques and New Demands

Examples:

- Digital control rooms; new demands
- Power up-grades

Aging of Nuclear Facilities

Examples:

- Thermal and mechanical fatigue
- Radiation induced defects on reactor vessels

- Aging of concrete containments
- NDT technology and validation of methods
- RI-ISI, strategies and application of methods
- Aging managing program and aging mechanisms
- Aging properties of new materials

Severe Accidents
Examples:
- Chemical behavior of iodine and halogens during severe accidents
- Core – concrete interaction

Probabilistic Methods
Examples:
- Application of PSA in safety assessments
- Clear presentation of PSA results
- Assessment of uncertainties
- Assessment of defense in depth using PSA
- Nordic harmonization of demand on PSA for different applications
- Reference library for rules and guides
- Harmonization of definitions in PSA

Organization, Man and Safety Culture
Examples:
- Models and methods for safety review
- Safety culture significance in occurred events
- Actions taken as a result of event analyses
- Benchmarking between nuclear industry and other industries with high potential risks
- Safety assessment of organizational changes
- Safety culture and assessment of organizations
- Safety aspects on using subcontractors in nuclear power plants
- Introduction of new techniques and new working procedures
- Application of HR methods in nuclear power plants

Phase-Out and Decommissioning of Nuclear Facilities
Examples:
- Phase-out and decommissioning of research reactors
- Stakeholder involvement in the Nordic countries
- Regulatory demands by Nordic authorities on decommissioning projects
- Experience from decommissioning projects

Common Seminars for Reactor Safety and Emergency Preparedness
Examples:
- PSA, severe accidents and emergency preparedness
- Phase-out and demolition of nuclear facilities including release of protection of area
- Environmental Impact Assessments

The list of subjects given above is not complete, and other proposals that can be associated with any of the eight categories above will also be considered in the evaluation process. More specific priorities regarding subjects to be covered can be given in connection with each “Call for Proposals”.

NKS-B Framework: Emergency Preparedness

B1 Aim and Challenges

The aim of the NKS-B program is to strengthen Nordic work concerning
- radiological emergency preparedness
- management of radioactive waste and discharges

- radioecology and environmental assessments

In addition to the threats from potential nuclear accidents, threats related to the possibility of malicious uses of radioactive or nuclear substances is now seen as a major concern. The case of polonium-210 poisoning and contamination in London in November 2006 is an example of an unexpected situation that demonstrates new challenges related to, e.g., special competence regarding measurement/analytical techniques and radiation protection assessments.

During the last 30 years or so, a lot of experience and knowledge regarding consequences of radioactive discharges, fallout and environmental radioactivity have been gained. The research has to a large extent focused on the behavior of a few important radionuclides. This competence and knowledge must be maintained and further developed to include a wider range of relevant radionuclides.

In the past, radiation protection criteria were developed only for humans, and it was assumed that by protecting man, other species would be protected to an acceptable degree. In recent years several problems have been identified with this existing tenet, with the result that systems for protection of flora and fauna, *per se*, are being developed and tested. Several knowledge gaps relating to this have already been identified, especially with regard to radionuclide uptake, transfer and biological response indicators. Furthermore, there is a need to obtain more experience in the practical application of environmental protection frameworks in typical Nordic environments.

Since 2004, uranium prices have increased sharply, leading to a higher interest in uranium prospecting, and also thorium, in several Nordic countries. Mining and milling for uranium and thorium, and also some other metals, give rise to waste rock and tailings with enhanced concentrations of radioactive substances from the natural series. A wide range of monitoring and measurement techniques will be needed for the risk assessments.

The program is structured into three basic fields: Research activities, investigations, exercises etc.; Seminars; and Education. Work performed within the first of these fields should be focused on maintaining and building up competence. Seminars should aim at building and maintaining both competence and networks. Education should help building competence in the individual countries with the aim of reaching the common goals.

When evaluating proposals for activities they will be judged against how well they seem to fulfil the aims of the respective fields, as well as against their scientific and pedagogical merits.

B2 Main Research Areas and Program Contents

E **Emergency Preparedness** (in general, as well as specific tools)

Examples of activities:

- Recent nuclear and radioecological emergencies and incidents causing public interest: lessons learned and implications for emergency preparedness
- Potential malicious uses of radioactive substances: security and emergency response
- Exercises and harmonization of activities
- Dose assessments and biodosimetry
- Countermeasures: effectiveness and practicability
- Information and communication: further development of systems and methods
- Decision support systems: integration of existing knowledge

W **Waste and Discharges**

Examples of activities:

- Waste and discharges from decommissioning activities
- Cost assessments of decontamination measures and remediation
- NORM waste from mining and milling (NORM: Naturally Occurring Radioactive Material)
- Interventions and clean-up operations
- Disposal of radioactive sources

R **Radioecological Assessments**

Examples of activities:

- Transport and ecological transfer of radionuclides in terrestrial environments
- Radioactivity in natural produce and foodstuffs produced in contaminated areas: temporal trends and seasonal effects
- Dose assessments from artificial and natural radionuclides
- Radiation effects in biota: studies of reference ecosystems and reference species for Nordic environments
- Case studies at locations with elevated concentrations of radionuclides
- Marine environments of special importance
- Syntheses of earlier radioecological studies of Nordic interest

M **Measurement Strategy, Technology and Quality Assurance**

Examples of activities:

- Implementation of international standards and regulations in Nordic countries (e.g., foodstuffs, bulk materials)
- Sampling/measurement strategies for contaminated material, - areas, - foodstuffs
- Systems for mobile measurements
- Validation of methods for sampling and preconcentration of radionuclides
- Radionuclide analytical techniques and intercomparisons

The list of subjects given above is not complete, and other proposals that can be associated with any of the four categories above will also be considered in the evaluation process. More specific priorities regarding subjects to be covered can be given in connection with each “Call for Proposals”.

Cross-Disciplinary Activities

In the next couple of years, issues regarding decommissioning of nuclear installations and waste management will demand increased attention. This will include analyses of technical safety aspects, volumes and properties of radioactive waste, radioactive releases and protection of the environment. Hence, activities in a number of fields will not always be strictly R or B related but may be relevant to both programs. The Board decides whether such an activity will be handled under the R or B program, or if it should be treated in some other way.

Some examples of possible areas for cross.disciplinary activities:

- Decommissioning and waste management
- Common seminars covering both R and B activities
- Information and communication activities targeting media and the general public

Guidelines

From Proposal to Final Report

Call for Proposals

During an annual (occasionally biannual) procedure of Call for Proposals the R and B program managers invite the Nordic nuclear community to submit activity proposals and apply for NKS funding. Usually this takes place in the fall, with a possible extra opportunity in the spring. Relevant information on the procedure (time schedule; deadline for applications; information to be supplied; criteria to be met; evaluation of the proposals; formalities including forms to be used; etc.) is made available well in advance on the webpage and distributed to the subscribers of the electronic newsletter. The applicants are expected to demonstrate that at least half of the necessary funding of the activity in question will be supplied by the participating organizations, usually in the form of in-kind contributions.

All applications received before the deadline are evaluated by a group of specialists, chaired by the program manager in question. The proposals are evaluated for compliance with the NKS criteria below. The evaluation results are compiled by the program manager together with any recommendations, and a report is sent to the Board members. At its next meeting, the Board decides what activities are accepted, the size of the NKS funding supplied, and any special conditions to be met. The program manager and the various activity leaders then sign individual contracts regarding each activity. This should be done before the subsequent Board meeting, when progress will be scrutinized and continued work approved or aborted. It is the responsibility of the NKS program manager to ensure that the time schedule and budget of the individual activities are kept, together with any conditions specified in the contract, and to report the status of the activity to the Board at its meetings, until the activity is finally finished and the results are accepted by the Board. The results may then be officially published and handed over to the financiers, participating organizations and end users for information and implementation. All activities should be formally evaluated once they are finished.

Proposals turned down by the Board should be listed for future reference and the activity leaders informed on the Board's decision as soon as possible after the Board meeting. In some cases the Board may indicate that a refused proposal should or could asbe completed and submitted at a later occasion for renewed assessment.

Silent Procedure

On special occasions the Board may decide to go ahead with an activity even though it has not followed the normal Call for Proposals procedure. The Board will then decide on any special conditions for that particular activity. E.g., in urgent cases the chairman may initiate a Silent Procedure where an activity proposal and pertaining information is distributed electronically to the Board members, together with a suggested decision on the further handling of the proposal. Members who agree with the suggested action need not answer; those opposed must submit their comments before a specified date. If no objections are received, the suggested action is taken.

Criteria for NKS Activities

The entire NKS program as well as the various activities shall fulfil the following criteria:

- Demonstrated compatibility with the current framework program
- A clear Nordic added value, including
    - creating and maintaining Nordic networks
    - dissemination and increase of Nordic competence in the nuclear field
- Current interest in and high international standard of the technical/scientific work
- Comprehensive and transparent activities, open to the widest possible range of participants, including young scientists
- Active participation and/or declared interest in the expected results of organizations in at least three Nordic countries in all major activities (occasionally, two countries may be acceptable)
- Distinct and measurable goals
- Relevance to financiers and end users
- The practical results shall be presented
    - at conferences, seminars, workshops etc
    - in technical reports and scientific articles in refereed journals
    - as recommendations, manuals, handbooks, checklists
    - in electronic form such as DVDs, CD-ROMs, websites
    - in the form of educational and information material

NKS work is dependent on in-kind contributions worth on the average at least as much as the NKS funding. These contributions may be work hours, travel expenses, laboratory resources etc. and should be clearly specified in all proposals submitted under the Call for Proposals procedure.

NKS aims at an approximately even overall distribution of funding between the R and B programs as well as between participating Nordic countries and organizations within the various activities. Gender neutrality and participation of young scientists shall be encouraged. When possible and relevant, M.Sc.

and Ph.D. support should be included in ongoing or proposed activities and NKS activities coordinated with international projects. Measures should be taken to ensure cost-efficiency, save resources and protect the environment, e.g., by substituting travels and business meetings with electronic contacts and virtual meetings.

Quality Assurance

The quality of the work performed and the activities at large is constantly being surveilled and assured through

- evaluation of applications received during the Call for Proposals
- participation of end users throughout the entire process: planning, execution, deliverables, reporting, implementation, and evaluation
- reporting and discussions at Board meetings
- publication of results in reports and refereed journals
- dissemination and discussions of NKS results in Nordic and international fora (conferences, seminars, topical meetings, workshops etc.)
- regular evaluations of the entire technical/scientific program and the administrative support structure

International Cooperation

There is no formalized NKS cooperation with other international organizations. Participation in international projects is to follow decisions and conditions given by the Board. NKS should strive to create and maintain relevant international contacts and keep the internaional audience informed on its progress.Whenever feasible and desirable, NKS activities should be coordinated with similar Nordic and international activities in order to increase efficiency and improve exchange of results and experience. When needed, NKS can be used as a platform for international coordination and promotion of Nordic views. Non-Nordic cooperation in NKS activities must be approved by the relevant program manager beforehand and will not be supported financially by NKS.

Communication and Dissemination of Information

NKS communication activities (including information and dissemination of results) shall be planned, systematic and in compliance with directives laid down by the Board. The target groups shall be informed about the possibilities offered by NKS as regards cooperation, funding, and exchange of knowledge. The communication efforts shall help establish a picture of NKS as a competent and active organization – nationally, regionally and internationally. The results of NKS work shall be presented openly and free of charge so as to render them useful and easy to implement. When quoted, due credit should be given to the proper NKS sources and a link to the NKS website www.nks.org given.

The major channels for distributing NKS information are:

- the NKS website
- electronic newsletters and newsflashes
- electronic and (occasionally) printed reports and pamphlets
- conferences, seminars, workshops and international cooperation projects
- scientific articles in refereed journals
- internal NKS correspondence and communication

NKS newsletters are normally published biannually, prior to the regular NKS Board meetings in May and November. The newsletters come without attachments of any kind, and the object is to give links to material on the NKS website for more information on new reports, invitations to seminars and similar events. The material referred to can be downloaded free of charge. In addition to the biannual newsletters, brief newsflashes will be distributed as soon as new reports have appeared or when new information is available on upcoming seminars etc. Anyone wishing a free subscription to the newsletters and newsflashes should contact the Secretariat at nks@nks.org.

Appendix 7: NKS-R Activities and Funding

N.B.: (CONDITIONAL) in the table below indicates that some condition has to be met before the funding is made available; e.g., additional information on the scope, objective or work plan of the activity; or as regards the total financial situation of NKS. (The corresponding amount is noted in parenthesis.)

When approved	Code / Name	Description / Full title	Amount (kDKK)
March '02	**NKS-R**	**Initial activities as specified below**	**2000**
	R01	PREPOOL	
	R02	Contextual assessment of maintenance culture safety and efficiency in Finland and Sweden	
	R04	Safety management: Existing case studies from a non-nuclear context as references for an investigation of assessments of nuclear safety management	
	R05	3D transient methodology for the safety analysis of BWRs	
	R07	Barriers, Control and Management – An analysis of concepts with applications in nuclear plant safety	
	R14	PREMELT	
	R15	Independent review of CCF models used in calculations for high-redundant systems in NPPs of the Nordic countries	
	R16	Traceability and communication of requirements in digital I&C systems development	
	R17	Framework for a systematic approach and documentation for risk-informed decision making; pre-project	
May '02	**NKS-R**	**Additional activities or funding as specified below**	**260 + 100**
	R12	Ruthenium behavior in severe accident condition	160
	R22	VALDOR 2003: The third symposium addressing transparency in risk assessment and decision-making	100
	---	Planning for an automation seminar	100
Nov '02	**NKS-R**	**Additional activities or funding as specified below**	**2250**
	R01	DeliPool (PrePool)	400
	R02	Maintenance Culture	560
	R04	Safety Management	320
	R05	3D Transient Methodology	100
	R07	Barriers, Control and Management	300
	R12	Ruthenium Releases	270
	R16	Digital Requirements	300
May '03	**NKS-R**	**Additional activities or funding as specified below** The financial situation did not allow further expenditures	**0**
Nov '03	**NKS-R**	**Additional activities or funding as specified below**	**2320**
	R_2002_01	DeliPool	400
	R_2002_02	MainCuluture	350
	R_2002_04	SafetyManagement	200
	R_2002_07	BarriersControlManagement	200
	R_2002_12	RutheniumReleases	120
	R_2002_16	DigitalRequirements	300
	R_2002_27	DecommSeminar	100
	R_2002_32	ShutDownSequences	250

	R_2002_35	NOTNet	300
	R_2002_38	ImprovementPrgSeminar	100
May ‘04	**NKS-R**	**Additional activities or funding as specified below**	**490**
		Modified CoolSE / KTH	400
		Modified Knowledge Management Seminar / IFE	90
Nov ‘04	**NKS-R**	**Additional activities or funding as specified below**	**2400**
		DeliPool	400
		MainCulture	350
		RutheniumReleases	350
		TACO	150
		ExCoolSE	400
		CorrosionFatigue	200
		CableAging	200
		MORE	150
		CostCalculation	200
May ‘05	**NKS-R**	**Additional activities or funding as specified below**	**400**
		Safety Management	100
		The Validity of Safety Goals	300
Nov ‘05	**NKS-R**	**Additional activities or funding as specified below**	**2200**
		DeliPool	400
		RutheniumReleases	300
		ExcoolSE	100
		CorrosionFatigue	200
		CableAging	200
		MORE	200
		CostCalculation	250
		AutoNewTech	350
		OrRe	200
May ‘06	**NKS-R**	**Additional activities or funding as specified below**	**200**
		ExCoolSE part 2	200
Nov ‘06	**NKS-R**	**Additional activities or funding as specified below**	**2500**
		LingAn	250
		Ruthenium behavior	450
		AutoNewTech	300
		SafetyGoals	200
		OrRe	350
		MORE	300
		POOL	300
		RiskEval	150
		CostCalc	200
May ‘07	**NKS-R**	**Additional activities or funding as specified below** (CONDITIONAL)	**(145)**
		Development of education in nuclear power technology for the NKS countries	(45)
		NSFS: Third All European IRPA Congress on Radiation Protection	(100)
Nov ‘07	**NKS-R**	**Additional activities or funding as specified below**	**3255**
		WASCO	280
		PODRIS	250
		POOL	450

		MOSACA	300
		SafetyGoal	300
		RiskEval	200
		NROI	400
		MORE	175
		IACIP	250
		AutoStrat	200
		Werisk	300
		StratRev	150
May ‘08	**NKS-R**	**Additional activities or funding as specified below**	**175**
		POOL	100
		PODRIS	75
Nov ‘08	**NKS-R**	**Additional activities or funding as specified below**	**3520**
		WASCO	300
		INCOSE	300
		POOL	600
		MOSACA	500
		Safety Goal	375
		NOMAGE4	375
		NROI	500
		HRA-Guide	270
		IACIP	300

Appendix 8: NKS-B Activities and Funding

N.B.: (CONDITIONAL) in the table below indicates that some condition has to be met before the funding is made available; e.g., additional information on the scope, objective or work plan of the activity; or as regards the total financial situation of NKS. (The corresponding amount is noted in parenthesis.)

When approved	Code / Name	Description / Full title	Amount (kDKK)
March '02	**NKS-B**	**Initial activities as specified below**	**2000**
	B02	Urban contamination seminar	
	B04	Additional funding of a PhD course in radioecology	
	B11	Emergency management & radiation monitoring in nuclear and radiological accidents	
	B12	New indicator organisms for environmental radioactivity	
	B22	Improving regional impact assessments	
	B23	Communication technology and emergency preparedness	
	B24	Nordic-EU collaboration on design and evaluation of the RESUME 2002 exercise	
	B25	Nuclear threats in the vicinity of the Nordic countries: A base of knowledge	
May '02	**NKS-B**	**Additional activities or funding as specified below**	**500 (+530)**
	B12	New indicator organisms for environmental radioactivity	150
	B26	Impact assessment of accidents with nuclear powered vessels – Analysis of release mechanisms and source term composition (CONDITIONAL)	(340)
	B27	Improving radiological assessments of doses to man from terrestrial ecosystems; pre-project	200
	B28	Coordination and modernization of methods for AGS and CGS measurements of multi-nuclide contamination	85
	B29	Course in advanced methods for processing AGS and CGS data and similar sets of spectral data	65
	B30	Nordic network of meteorological services engaged in nuclear emergency preparedness (CONDITIONAL)	(190)
Nov '02	**NKS-B**	**Additional activities or funding as specified below**	**1760 + 50**
	B11	EMARAD	360
	B12	INDOFERN	800
	B26	Impact assessment of accidents with nuclear powered vessels (This is 100 of the 340 mentioned under May '02)	100
	B30	Nordic network of meteorological services (CONDITIONS from May '02 met)	190
	B32	Nordic cooperation on the use of MS	150
	B33	Area specific stripping for CGS and AGS	60
	B34	Seminar: Radioecology and measurement techniques	100
	---	Baltic travel fund	50
May '03	**NKS-B**	**Additional activities or funding as specified below**	**240**
	B26	Impact assessment of accidents with nuclear powered vessels (This is 240 of the 340 mentioned under May '02) The financial situation did not allow further expenditures	240

Nov ‘03	**NKS-B**	**Additional activities or funding as specified below**	**2200**
		Cskinetik	130
		EMARAD	280
		IRADES	50
		MetNet	200
		UrbHand	205
		LABINCO	100
		NorCMass	260
		RadChem	200
		EcoDoses	310
		INDOFERN	380
		REIN	85
May ‘04	**NKS-R**	**Additional activities or funding as specified below**	**480**
		INDOFERN / STUK	300
		Modified ASSb / DTU	180
Nov ‘04	**NKS-B**	**Additional activities or funding as specified below**	**2200**
		EMARAD	100
		IRADES	50
		NordRisk	160
		UrbHand	205
		LABINCO	250
		NorCMASS	200
		RADCHEM	215
		SAMPSTRAT	95
		EcoDoses	350
		FOREST	225
		INDOFERN	350
May ‘05	**NKS-B**	**Additional activities or funding as specified below**	**550 +50**
		INDOFERN	350
		MetNet	200
		Seminars	50
Nov ‘05	**NKS-B**	**Additional activities or funding as specified below**	**2200**
		MetNet	200
		NordRisk	180
		UrbHand	205
		Lucia	400
		BioDos	300
		UGS	225
		HOT	180
		EcoDose	280
		FOREST	200
		YoungRad	30
May ‘06	**NKS-B**	**Additional activities or funding as specified below**	**409**
		Urban Gamma Spectrometry Processing	49
		Nuclear risks from atmospheric dispersion in Northern Europe	80
		Assessing the impact of releases of radionuclides into the sewage systems in urban environment – simulation, modeling and experimental studies	80
		Seminar for young scientists in the fields of radio-chemistry, radioecology and radiation protection	200
Nov ‘06	**NKS-B**	**Additional activities or funding as specified below**	**2500**

		ParDNor	520
		BioDos	350
		NordThreat	200
		NordRisk	230
		Speciation	320
		Hot	230
		Lucia	500
		GAPRAD	150
May '07	**NKS-B**	**Additional activities or funding as specified below** (CONDITIONAL)	**(200)**
		UrbHand	(100)
		NSFS: Third All European IRPA Congress on Radiation Protection	(100)
Nov '07	**NKS-B**	**Additional activities or funding as specified below**	**1200 (+1300)**
		BioPEx	300
		ParDNor	340
		GammaRate	100
		GapRad	260
		Young researchers' travel fund; replaces YoungRad	200
		(Reservations for a spring Call for Proposals)	(1300)
May '08	**NKS-B**	**Additional activities or funding as specified below**	**1320**
		REMSPEC	300
		DepEstimate	250
		FOREST-2	130
		SPECIATION	320
		Hairpol	320
Nov '08	**NKS-B**	**Additional activities or funding as specified below**	**1800**
		PARDNOR	370
		GammaSem	260
		NORDSS	100
		GammaRate	100
		BIONCA	280
		HOTRATE	230
		Method MS	460

Appendix 9: Author's Remarks

About the Author

Professional record:

1970	Graduated as MSEE (Master of Science / Electrical Engineering) after 3.5 years of studies at KTH (Royal Institute of Technology), Stockholm, Sweden.
1970 – 1972	Research engineer at the Microwave Institute at KTH.
1973 – 1975	Full time studies in radiation physics and social anthropology at Stockholm University.
1973 – 1975	Part time positions at Karolinska Hospital, Stockholm and the Radiophysics Department at Stockholm University as assisting hospital physicist.
1976 – 1989	SSI employee (Swedish Radiation Protection Institute, Stockholm, Sweden). Some highlights: • Employed as Senior Radiation Protection Officer and head of the Industrial Uses Section. • The position involved engagement in NKA work on transport of radioactive material, sub-group on radioactive consignments by mail, together with Nordic colleagues under the leadership of Franz Marcus. This was my first contact with him. • Became director of SweRad, SSI's division for marketing services world-wide. Arranged, among other things, two international courses on practical radiation protection in nuclear power production.
1989	Started the consultancy firm TeknoTelje HB. My major clients have been NKS, SKI, SIP, SSI, SIUS and Vattenfall. As a consultant to NKS I engaged in a number of projects prior to the work as Nordic secretary. Most relevant reports: • T Bennerstedt: Radioaktivt sjukhusavfall. Regler, praxis och spårbarhet (SSI Report 91-09 in Swedish on national handling procedures concerning radioactive waste from hospitals, research institutions and industries). This was done as a part of the KAN-1.3 project. • T Bennerstedt et al: Monitoring Artificial Radioactivity in the Nordic Countries, TemaNord 1995:559. This was done as a part of the BER-2 project. • Nordic exercises NORA in Jan. 1993 and ODIN in Nov. 1993: coordination, planning, execution and follow-up (official evaluator: Anneli Salo). Final report: T Bennerstedt et al: Nordic Nuclear Emergency Exercises, TemaNord 1995:606. This was done as a part of the BER-5 project.
1994 – 2008	Hired (through TeknoTelje HB) as the Nordic secretary (later to become coordinator) of NKS.

And the rest, as they say, is history. Enjoy!

The Post Marcus Era

When Franz Marcus decided to step down as Nordic secretary the search for his successor started. At a dinner following an Owners Group meeting in early 1993 many questions were raised. What direction was NKS to take? What did the owners look for in the next Nordic secretary? Were there any obvious candidates? The owners began sketching the profile of the person they wanted and discussed what criteria to use.

After the dinner Sigurður M Magnússon called me. He told me about the search for a new Nordic secretary and that in his view I had the profile that was of interest for the post. He went on to ask whether I was interested in the post. I gasped and was totally stunned at first. Then I exclaimed, Yes!

One thing led to the other, and before long I and another candidate were invited to the Arlanda Owners' meeting on Nov. 16, 1993 for an interview. I came well prepared with a stack of viewgraphs and a bunch of ideas. I presented my visions and tentative plans for the job. The atmosphere was relaxed and friendly, and this was of great help to a nervous guy facing his greatest challenge in life so far.

Shortly after the interview Sigurður M Magnússon gave me another unofficial call to tell me "the results of the Arlanda jury": a unanimous vote to offer me the job. I later received an official confirmation of this. The formal negotiations and setting up of a contract were handled by SKI and my firm, TeknoTelje HB , as decided by the Owners Group. It was not too hard to reach an agreement, so I soon found myself hired for 75% of a full time. This percentage was adjusted after a few years, to suit the needs of NKS..

My actual work began in 1994. The Owners had planned for a smooth transition from Franz Marcus to me during a generous period of one year. Franz was the acting Nordic secretary for the first six months, with me as a happy and eager apprentice at his side. One of my first decisions was to interview him on as much as possible of his many tasks. To that order I prepared a long list of questions, and we sat down to work our way through the document. It took quite some time; in fact, we did not quite make it the first time, so we continued next time, and next, and… The work was far more demanding than I had ever imagined.

I soon found out that there were very few written job instructions, recommendations or advice that were detailed enough to be of practical help. It was all in his head; probably for a reason. As I got deeper and deeper involved and the day approached when I was to officially take the reins as Nordic secretary on July 1, 1994 I decided to formalize the work as much as reasonably warranted, given my experience as a serious but forgetful bureaucrat. When asked about any contracts and agreements NKS had reached with organizations and persons, I got a fairly good oral overview. At least that was what I thought. From time to time there popped up new agreements, never in writing, just closed by a confirming handshake. So I decided to note all agreements and anything similar to an NKS policy, first for my personal use but later for discussions with the Board.

After half a year of on-the-job training followed the fantastic feeling of being in charge. Wisely enough the Owners had decided to let Franz act as my mentor for another six months. He also remained active in areas related to his earlier position. Franz wrote his Recollections (see the reference list) and updated a document on EU/Euratom related organizations he had prepared for SKI a few years earlier. Franz, with his vast network, also assisted in setting up and carrying out NKS meetings with EU and the Nordic Council of Ministers. Through a clever arrangement between BRS, Risø and NKS he was hired to evaluate the Danish assistance programs for emergency planning and preparedness in some former USSR states.

My first major appearance as Nordic secretary was together with Franz at a reactor safety conference in Saltsjöbaden, Sweden 1994. This was noted by ENS in an article in their official publication, written by me, presenting NKS to a new audience.

Tasks and Responsibilities of the Nordic Secretary

The Nordic secretary (also referred to as executive secretary) was appointed by the owners. The post as Nordic secretary was discontinued in 2008. Below follows a list of the most important tasks of the Nordic secretary. The tasks varied somewhat over the years as the programs and support structure of NKS changed.

- Participated on a regular basis in the most important NKS meetings: the owners group; Board; reference groups; Bureau; coordination group; Secretariat.
- Reported to the owners and the Board.
- Served as the official head of the Secretariat.
- For a number of years: prepared Owners Group meeting (agendas, invitations, minutes etc.).

- Prepared Board meetings (agendas, invitations, practical arrangements in cooperation with the host organization, follow-up); served as secretary of these meetings once the post as secretary of the Board was abolished.
- Made budget proposals to be discussed by the Bureau and the Board.
- Compiled directives for pre-project work and evaluators.
- Proposed contracts with project leaders / program managers and evaluators.
- Outlined and compiled other official NKS documents to be presented to the Board, including the program handbook / policy document.
- Planned, prepared and supervised larger (mostly joint NKS) seminars, conferences etc., usually together with the Secretariat and/or responsible project leaders.
- Edited semi-annual and annual reports, plans for next year, final report of SAM/SEK at the end of the 4-year period, summary final reports for the whole program.
- Helped develop the administrative handbook in close cooperation with the secretariat.
- Was responsible for overall coordination of the NKS program and held individual meetings with project leaders.
- Participated in a number of larger activities (workshops, exercises etc.) within projects.
- Handled formal contacts and cooperation with with EU and NSFS. (Project leaders / program managers were responsible for any practical work in this connection.)
- Did follow-up of project work, economy etc.
- Assisted in structuring and writing of some final reports and checked the final reports of the projects.
- Led and assisted in website development in close cooperation with the Secretariat.
- Helped compile a template for final reports / NKS technical reports.
- Was at the disposal of the owners, the Board and to a certain extent the project leaders for *ad hoc* tasks.

Additional Info on This Report

I was contracted to perform a pilot study on a possible historic review and delivered a report on the subject, NKS(09)3, entitled "Förprojekt om en eventuell NKS-historik 1994 – 2008" (in Swedish). It specified scope and objectives, timeframe, costs, administrative aspects etc., and a general outline of the historic review was suggested. Based on the pilot study and a Board decision in May 2009, a contract was signed by NKS / Sigurður M Magnússon and TeknoTelje HB / Torkel Bennerstedt (contract no. NKS/AFT(10)3) concerning such a review.

It was agreed that the objective of my report was to give a personal impression of NKS, its work, results and development during my 15 years as Nordic secretary and coordinator. Thus, the scope was quite wide.

It might strike the reader odd that the author's wife Lena Bennerstedt has contributed a number of photographs to this report, and thus obviously participated in some of the travels. She always did this at her own expense, at no extra cost to NKS. There were times when she volunteered as an assistant to the NKS Secretariat, without pay. Occasionally she was hired to perform a special task (mostly in her capacity of consultant in information matters); this was then cleared in advance through the proper NKS channels, following the appropriate routines.

Two Nordic Profiles

When writing the history of Nordic cooperation in nuclear safety research in the years 1994 – 2008 it is impossible not to mention two outstanding Nordic profiles. It so happens that they both are from Iceland.

The first person that comes to my mind is Sigurður M Magnússon, director of IRSA (the Icelandic Radiation Safety Authority). He has represented Iceland in the Owners Group since the formation of NKS, and served as secretary of the NKS Board and member of the Bureau for six years. He took over as NKS chairman in 2006, a position that he still holds at the time of writing this in the spring of 2011. He has formed an international network, the like of which I have never heard. Sigurður has been the mastermind behind just about every major change in NKS format and procedure throughout the years. With great enthusiasm and diplomatic skill he has inspired the development of a slimmer, smarter, more efficient and end user oriented NKS. One of his many contributions is his constant readiness to let his staff participate in NKS activities.

In my view, the person who has contributed the most to the scientific work of NKS is the other Nordic profile, Sigurður Emil Pálsson of IRSA. With never-ending enthusiasm and ever-growing expertise and experience he was instrumental in shaping and developing NKS work in radioecology and emergency preparedness. He started as project leader of EKO-1in 1994 – 1997, continued as project leader of BOK-2 in 1998 – 2001, and became the first program manager of NKS-B in 2002, where he served until 2008. His foresight and skills have helped NKS sharpen its tools in modern communication and use of information technology. One of his many ambitions has been to encourage and support young scientists in all Nordic countries and – when appropriate – the Baltic region. This has broadened the perspective of NKS and participants alike, and valuable international networks have been formed.

Both Sigurður and Sigurður Emil have helped create an added Nordic value that will last for years.

Appendix 10: List of Some Important NKS Documents

Only NKS numbered documents are included. The original documents are, for the most part, in a Scandinavian language. These documents are no longer available at the website, just as a print-out at the Secretariat.

Budgets, agendas and minutes of Owners Group and Board meetings are excluded from the list below. The budgets are presented elsewhere in these Appendices. The minutes are listed in the report and summarized in the Appendices. The full documents are available (in Scandinavian languages) on the NKS website.

Abbreviations (in alphabetical order) used in this Appendix:

Auditor	Ernst & Young
Bureau	Chairman + secretary of the Board + Nordic secretary
NS	Nordic secretary
Prg.	Program
Prg. Man.	Program Manager(s)
Proj. leader	Project leader(s)
Ref. group	Reference group(s)
SEK	The NKS Secretariat

Year	NKS No.	Title of Document	Author(s)
1993	NKS(93)8 Rev.	Plan for NKS 1994 – 1997	Prg. group
	NKS(93)11	Igangsætning af forprojektarbejde (Start-up of the pre-project work)	NS
1994	NKS(94)3	Financial statements and audit report for 1993	SEK, Auditor
	NKS(94)5	Fase 1 af igangsætningen af programmet 1994 – 1997 (Start-up phase of the 1994 – 1997 program)	NS
	NKS(94)7 Rev.	Pre-project reports: plans for 1994 – 1997	Prg. group
	NKS(94)8	Pre-projects and continued work	NS/Bureau
	NKS(94)9 Rev.	Plan for SAM, the coordination function of NKS	NS/Bureau
	NKS(94)10 Rev.23	Status for the 1990 – 1993 final reports	NS/Bureau
	NKS(94)11	Tasks, mandate and organization of NKS	NS/Bureau
	NKS(94)13	Draft contract for project leaders	NS
	NKS(94)16	Administrative handbook (update)	SEK
	NKS(94)17	Evaluation of the 1990 – 1993 program	NS (ed.)
1995	NKS(95)1	Annual report for 1994	Ref. groups
	NKS(95)2	Time schedule and budget for 1995	NS/Bureau

	NKS(95)3	Financial statements and audit report for 1994	SEK, Auditor
	NKS(95)6 Rev.	Draft NKS policy	NS/Bureau
	NKS(95)8	Criteria for the half-time evaluation of the 1994 – 1997 program	NS/Bureau
1996	NKS(96)1	Annual report for 1995 and plans for 1996/97	Ref. groups
	NKS(96)2	Summary report for 1995	NS, SEK
	NKS(96)3	Administrative handbook (update)	SEK
	NKS(96)4	Participant list: names, addresses etc. (update)	SEK
	NKS(96)5	Financial statements and audit report for 1995	SEK, Auditor
	NKS(96)6	Semiannual reports	Proj. leaders
	NKS(96)7	Status for the final reports from the previous period	NS/Bureau
	NKS(96)8	Draft NKS policy (update)	NS/Bureau
	NKS(96)9	The next 4-year program, 1998 – 2001	NS/Bureau
	NKS(96)10 Rev.	This is NKS (update)	NS/Bureau
1997	NKS(97)1	Annual report for 1996 – Plans for 1997 (incl. the coordination function and the SAM-4 info project)	NS (ed.)
	NKS(97)1	Annual report for 1996 – Plans for 1997	Proj. leaders
	NKS(97)2	Summary report for 1996	NS, SEK
	NKS(97)3 Rev.	Proposed outline of final reports	NS/Bureau
	NKS(97)5 Rev.	Criteria for evaluating the 1994 – 1997 program	NS/Bureau
	NKS(97)6 Rev.	Some project ideas for the next 4-year program	NS/Bureau
	NKS(97)7	Directives for planning for the next 4-year program	NS/Bureau
	NKS(97)8	Project handbook	NS/Bureau
	NKS(97)9	Participant list: names, addresses etc. (update)	SEK
	NKS(97)10 Rev.	This is NKS (update)	NS/Bureau
	NKS(97)12	Project status for the 1994 – 1997 program	NS/Bureau
	NKS(97)13 Rev.	Recommendations and advice for authors of final reports	NS/Bureau
	NKS(97)14	Financial statements and audit report for 1996	SEK, Auditor

	NKS(97)15	Proposed project structure for 1998 – 2001	Bureau
	NKS(97)17	Directives for the program group	Bureau
	NKS(97)18	Final report of the BER-6 project	Proj. leader
	NKS(97)20	List of organizations to be consulted about next program	Owners
1998	NKS(98)1	Proposed new research program	Prg. group
	NKS(98)2	Evaluation of the 1994 – 1997 program	A. Vuorinen
	NKS(98)3 Rev. 2	Directives for the reference group for the 1994-97 prg.	NS/Bureau
	NKS(98)4 Rev. 2	Directives for the pre-projects 1998	NS/Bureau
	NKS(98)6 Rev. 3	Members of the pre-project working groups	NS/Bureau
	NKS(98)7	Financial statements and audit report for 1997	SEK, Auditor
	NKS(98)8	Minutes of a ref. group – pre-project leaders meeting	Ref.grp. chair
	NKS(98)9	Organization, program handbook etc.	SEK, Bureau
	NKS(98)10	Economic résumé of the 1994 – 1997 program	SEK
	NKS(98)11	NKS-5: Proposals for the 1998 – 2001 program	NS (ed.)
	NKS(98)12	Summary of prof. Vuorinen's evaluation of the 1994 – 1997 program	NS
1999	NKS(99)1	Seminar and status report	NS/Bureau
	NKS(99)6	This is NKS (update)	NS/Bureau
	NKS(99)7	Participant list: names, addresses etc. (update)	SEK
	NKS(99)8	Financial statements and audit report for 1998	SEK, Auditor
	NKS(99)11	Economic status report	SEK
	NKS(99)12	External funding in the last 3 years	SEK
	NKS(99)16	Status document Sept. 1999	NS, SEK
2000	NKS(00)1	Directives for the midway valuation of the 98-01 prg.	NS/Bureau
	NKS(00)2	Economic status report for 1999	SEK
	NKS(00)4	Program status report Feb. 2000	SEK (ed.)
	NKS(00)6	Agenda for status seminar with evaluation	NS/Bureau
	NKS(00)8	Financial statements and audit report for 1999	SEK, Auditor
	NKS(00)9	Directives for the final evaluation of the 1998 – 2001 program: organization, administration	NS/Bureau

	NKS(00)10	List of new project proposals for the 98-01 program	NS (ed.)
	NKS(00)11	Format and contents of final reports 1998 – 2001	NS/Bureau
	NKS(00)12	Additional directives for final reports 1998 – 2001	NS/Bureau
	NKS(00)13	Directives for the final evaluation of the 1998 – 2001 program: scientific contents and results	NS/Bureau
	NKS(00)15	Directives for midway evaluation reports	NS/Bureau
	NKS(00)16	Participant list: names, addresses etc. (update)	SEK
	NKS(00)17	Program handbook (update)	NS/Bureau
	NKS(00)20	Status report and midway evaluation Nov. 2000	NS (ed.)
2001	NKS(01)2 Rev. 3	Proposal for a new NKS organization and program structure: R&B	Bureau
	NKS(01)3	Economic status report	SEK
	NKS(01)4	Interviews with owners regarding the new program	Bureau
	NKS(01)5	Announcement: Preferred program manager profiles	NS
	NKS(01)7	Financial statements and audit report for 2000	SEK, Auditor
	NKS(01)9	Directives for the main research areas R&B	NS/Bureau
	NKS(01)10	Agenda for the Reykjavík status seminar	NS/Bureau
	NKS(01)13	Program status report May 2001	NS (ed.)
	NKS(01)14	Program status report in Roskilde	SEK (ed.)
	NKS(01)16	Economic status report	SEK
	NKS(01)18	Program status report November 2001	SEK (ed.)
2002	NKS(02)1	This is NKS (update; to be included in the program handbook henceforth)	NS/Bureau
	NKS(02)3	Economic status report	SEK
	NKS(02)6 Rev. 4	Program handbook (update; incl. This is NKS)	NS/Bureau
	NKS(02)7 Rev. 4	Administrative handbook (update)	SEK
	NKS(02)8	Financial statements and audit report for 2001	SEK, Auditor
2003	NKS(03)1	Financial statements and audit report for 2002	SEK, Auditor
2004	NKS(04)1	Financial statements and audit report for 2003	SEK, Auditor
	NKS(04)3	Evaluation of the second Nordic seminar in Malmö on Quality in Radiation Protection Work	NS

	NKS(04)4	Questionnaire: Activity leaders' opinions on the new NKS structure and organization (R&B)	NS/Bureau
	NKS(04)6	Program handbook (update)	NS/Bureau
	NKS(04)7	Administrative handbook (update)	SEK
	NKS(04)9	NKS-R framework program (update)	Prg. Man.
2005	NKS(05)1	Financial statements and audit report for 2004	SEK, Auditor
	NKS(05)4	NKS-R framework program (update)	Prg. Man.
	NKS(05)6 Rev.	Directives for evaluation of NKS work in 2002 – 2005	NS, Bureau
2006	NKS(06)1	Financial statements and audit report for 2005	SEK, Auditor
	NKS(06)3	Program handbook (update)	NS/Bureau
	NKS(06)4	Administrative handbook (update)	SEK
	NKS(06)8	Final report on the status seminar in Otaniemi May 2006	Ed.: NS
2007	NKS(07)1	Financial statements and audit report for 2006	SEK, Auditor
	NKS(07)3 Rev.	Program handbook (update; henceforth published as part of the policy document; see NKS(07)7 below)	NS/Bureau
	NKS(07)4 Rev.	Administrative handbook (update)	SEK
	NKS(07)5 Rev.	NKS-R and NKS-B frameworks (updates; henceforth published as a part of the policy document; see NKS(07)7 below)	Prg. Man.
	NKS(07)7	Policy document (in Swedish)	NS/Bureau
	NKS(07)10	Brief presentation / policy of the NKS program: framework, guidelines and procedures (English version of the policy document NKS(07)7)	NS
2008	NKS(08)1	Financial statements and audit report for 2007	SEK, Auditor
	NKS(08)2 Rev. 5	Policy document (update; in Swedish)	NS/Bureau
	NKS(08)3 Rev. 3	Policy Framework and Procedures (update of NKS(07)10)	NS
	NKS(08)6	Administrative handbook (update)	SEK
2009	NKS(09)1	Financial statements and audit report for 2008	SEK, Auditor
	NKS(09)3	Pre-project: Proposal of a history of NKS 1994 – 2008	NS

Appendix 11: Acronyms and Abbreviations Used in This Report

ABB	Asea Brown Boveri, Ltd.
AFA	NKS program on radioactive waste 1994 – 1997
AGS	Airborne Gamma Spectrometry
AKT	NKS program on radioactive releases, dispersion and environmental impact 1985 – 1989
ALARP	As Low As Reasonably Practicable
AO	NKS program on waste management 1977 – 1980
ARGOS	Accident Reporting and Guiding Operational System (Denmark)
AutoNewTech	NKS-R activity
AVF	NKS program on radioactive waste 1981 – 1985
BER	NKS program on emergency preparedness 1990 – 1993
BIODOS	NKS-B activity
BIOPEX	NKS-B activity
BKAB	Barsebäck Kraft AB (Swedish NPP; now under decommissioning)
BOK	NKS program on emergency preparedness and environmental consequences 1998-2001
BWR	Boiling Water Reactor
CAMS	Computerized Accident Management System
CAT	Center for Advanced Technology, Denmark
CEC	Commission of the European Communities
CCF	Common Cause Failure
CFD	Computational Fluid Dynamics
CfP	Call for Proposals (NKS procedure)
CGS	Carborne Gamma Spectrometry
DD	Danish Decommissioning, Risø
DELI	Development and Validation (one of two main NKS-R themes; the other being MANGAN)
DEMA	Danish Emergency Management Agency
DG XI	Directorate General #11 of EU/EC
DG XII	Directorate General #12 of EU/EC
DKK	Danish *kroner* (currency)
DTU	Danish Technical University
EC	European Commission
ECOSYS	German model for ingestion dose calculation, used in RODOS and ARGOS
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EKO	NKS program on emergency preparedness and radioecology 1994 – 1997
EMARAD	NKS-B activity
ENS	European Nuclear Society
ESREL	An annual European safety and reliability conference
ETEX	European Tracer Experiment
EU	European Union
ExCoolSE	NKS-R activity
EXSI	Experimental Study on Iodine Chemistry
FKAB	Forsmarks Kraftgrupp AB, Sweden
FRIT	Danish host organization for the NKS Secretariat, SEK
GAPRAD	NKS-B activity
GBP	British pound (currency)
HIM	Swedish acronym for KTM; now TEM
HOT II	NKS-B activity
HPGe	High Purity Germanium (Detector)
HPME	High Pressure Melt Ejection
I&C	Instrumentation and Control
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICRP	International Commission on Radiological Protection

IFE	Institute for Energy Technology, Norway
INF	NKS program on advanced information technology 1985 – 1989
IRPA	International Radiation Protection Association
IRSA	Icelandic Radiation Safety Authority
ISA	Integrated Sequence Analysis
IUR	International Union of Radioecologists
IVO	Imatran Voima Oy, Finland; now: Fortum
KAN	NKS program on nuclear waste management and decommissioning 1990 – 1993
KAV	NKS program on nuclear waste management 1985 – 1989
KRU	NKS program on control room design 1977 – 1980
KTH	Royal Institute of Technology, Stockholm, Sweden
KTM	Finnish Ministry of Trade and Industry; now TEM
KVA	NKS program on quality assurance 1981 – 1985
LIT	NKS program on human reliability 1981 – 1985
LOCA	Loss of Coolant Accident
LUCIA	NKS-B activity
LUT	Lappeenranta University of Technology, Finland
LWR	Light Water Reactor
MANGAN	Management and Organization (one of two main NKS-R themes; the other being DELI)
MAT	NKS program on materials research 1985 – 1989
MFM	Multilevel Flow Modeling
MGS	Mobile Gamma Spectrometry
MOI	Method of Images
MORE	NKS-R activity
MOSACA	NKS-R activity
MS	Mass Spectrometry
MSc	Master of Science
MSWI	Melt-Structure-Water Interaction
MY	NKS program of authority related projects 1977 – 1980
NEA	Nuclear Energy Agency (under OECD)
NEP	Nuclear Emergency Preparedness (a work group for relevant Nordic authorities)
NKA	Nordic Liaison Committee for Atomic Energy
NKS	Nordic Nuclear Safety Research
NLH	Agricultural University of Norway
NorCMass	NKS-B activity
NordRisk	NKS-B activity
NPP	Nuclear Power Plant
NPSAG	Nordic PSA Group
NRC	US Nuclear Regulatory Commission
NROI	NKS-R activity
NRPA	Norwegian Radiation Protection Authority
NRPB	National Radiological Protection Board (now under the Health Protection Agency)
NSFS	Nordic Society for Radiation Protection
NTNU	Norwegian University of Science and Technology
OECD	Organization for Economic Cooperation and Development
OIL	Operational Intervention Levels
OKG	Oskarshamn KraftGrupp AB, Sweden (Oskarshamn nuclear power plant)
PardNor	NKS-B activity
PCC	Premature Chromosome Condensation
PhD	Doctor of Philosophy
POD	Probability of Detection
PODRIS	NKS-R activity
POOL	NKS-R activity
PPOOLEX	Experimental facility at LUT, Finland
PSA	Probabilistic Safety Analysis
PWR	Pressurized Water Reactor
QA	Quality Assurance; also an NKS program on quality assurance 1977 – 1980

R&B	Rhythm & Blues; here: Reactor Safety and Emergency Preparedness
R&D	Research and Development
RA	NKS program on radioecology 1977 – 1980
RAD	NKS program on radioecology 1990 – 1993
RAK	NKS program on reactor safety 1994 – 1997
RAS	NKS program on risk analysis and safety philosophy 1985 – 1989
REIN	NKS-B activity
REK	NKS program on radioecology 1981 – 1985
REMSPEC	NKS-B activity
RESUME	Rapid Environmental Surveying Using Mobile Equipment (NKS exercises 1995, 2002)
RI-ISI	Risk Informed In-Service Inspection
RISCOM-II	EU project on Risk Communication
RiskEval	NKS-R activity
Risø	Risø DTU National Laboratory, Denmark
RODOS	Real-Time On-Line Decision Support System for Nuclear Emergencies (EU)
RPV	Reactor Pressure Vessel
Ruthenium-Releases	NKS-R activity
SafetyGoal	NKS-R activity
SÄK	NKS program on reactor safety 1981 – 1985
SAM	NKS program for administrative control and information 1994 – 1997
SARA	EU project 1997-98, involving, e.g., a continuation of RAK.2.1
SBA	NKS program for safety and emergency preparedness related activities 1998 – 2001
SEA	Strategic Environmental Assessment
SEK	The NKS Secretariat
SIK	NKS program on reactor safety 1990 – 1993
SIP	Swedish International Project (division of SKI)
SIS	Danish Radiation Protection Authority
SIUS	SSI's International Development Cooperation Program
SKI	Swedish Nuclear Power Inspectorate (now part of SSM)
SOS	NKS program for nuclear safety and radiation protection 1998 – 2001
SPECIATION	NKS-B activity
SRV	Swedish Rescue Services Agency
SSI	Swedish Radiation Protection Authority (now part of SSM)
SSM	Swedish Radiation Safety Authority (formerly SKI and SSI)
StratRev	NKS-R activity
STUK	Finnish Radiation and Nuclear Safety Authority
TACO	NKS-R activity
TEM	Finnish Ministry of Employment and the Economy (formerly KTM/HIM)
TRACE	Traceability of Requirements for Analyzable Computerized Environments (NKS-R/MORE tool)
TS	Technical Specifications
TVO	Teollisuuden Voima Oy (Industrial Power Ltd.), Finland
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UrbHand	NKS-B activity
VALDOR	VALues in Decisions On Risk (NKS supported international conference)
VAT	Value Added Tax (a European sales tax)
VTT	Technical Research Center of Finland
WASCO	NKS-R activity
WASH-1400	A reactor safety study produced in 1975 for NRC; "the Rasmussen Report"
WDSE	Workshop on Dependable Software Engineering
WERISK	NKS-R activity
WWW	World Wide Web