DRAFT

NKS(17)4
2017-05-11

Agenda for the board meeting in Copenhagen 8 June 2017

Place:
The Citadel, Kastellet, Kastellet 54, DK-2100 København Ø

Time: 10:00 to 16:00

1 Opening

2 Practical remarks
- Meeting secretary.
- Information from chairman and host.

3 Approval of the agenda

4 Minutes of the last board meeting (Oslo 18 January 2017)
- See draft minutes NKS(17)1 dated 2017-02-15.
- Review, discussion and decision.

5 Accounts 2016
- See distributed material: Financial Statements 2016, NKS(17)2 and Long-Form Audit Report, both dated 2017-04-10.
- Presentation by the auditor and the secretariat, discussion and decision.

6 Financial status for the current year
- See distributed material: Financial status report and financial programme specification, both dated 2017-05-19.
- Presentation, discussion.

7 News since last board meeting
- Report from the owners' group.
- News from the board members' organisations.
- Administrative news.

8 R-part: status

- See material from Christian Linde: status report May/June 2017.
- Presentation by the programme manager.
- Discussion.

9 B-part: status

- See material from Kasper Andersson: status report May/June 2017.
- Presentation by the programme manager.
- Discussion.

10 NKS article

- Presentation by the programme managers.
- Discussion, decision.

11 NKS R and B seminar 2019

- Presentation by the programme managers.
- Discussion, decision.

12 Information activities

- The website, NewsLetters, NewsFlashes etc.
- NKS and LinkedIn.
- Presentation, discussion.

13 Research activities in 2018

- Call for Proposals.
- Preliminary budget 2018.
- Funding 2018.
- Discussion, decision.

14 NKS in the future

- Introduction by the chairman.
- “Evaluation of the Swedish participation in the Nordic Nuclear Safety Research (NKS) collaboration”, presentation of the SSM report by the authors.
- PC activities.
- The Secretariat.
- Any other issue.
- Presentation, discussion and decision.

15 Other issues

- Any other business.

16 Next meeting

- Next meeting will be in Reykjavik January, 2018.

17 End of meeting

DRAFT
NKS(17)1
2017-02-15

Minutes of the board meeting in Oslo 18 January 2017

Present: Sigurður M. Magnússon (Chair, IRSA), Charlotte Bro (DEMA), Eva Simic (SSM), Linda Kumpula (TEM), Ole Harbitz (NRPA), Annelie Bergman (SSM), Astrid Liland (NRPA), Atle Valseth (IFE), Jens-Peter Lynov (DTU), Karin Andgren (Vattenfall), Mette Øhlenschlæger (SIS), Nici Bergroth (Fennovoima), Petri Kinnunen (VTT), Tarja Ikäheimonen (STUK), Carsten Israelson (DEMA), Christian Linde (SSM), Emma Palm (SSM), Kasper Andersson (DTU) and Finn Physant (meeting secretary, FRIT).
Apologies: Jorma Aurela (TEM)

1 Opening

The Chair opened the meeting and welcomed the participants. Regrets had been received from Jorma Aurela. The Chair expressed many thanks to the hosts Ole Harbitz and Strålevernet. Special welcomes were given to:
-Linda Kumpula, who in this meeting replaced Jorma Aurela,
-Charlotte Bro as owner and board member (replacing Steen Hoe) accompanied by Carsten Israelson,
-Karin Andgren replacing Olga German as board member,
-Petri Kinnunen replacing Timo Vanttola as board member,
-Christian Linde as R-part programme manager replacing Emma Palm.
The Chair thanked Olga German, Steen Hoe and Timo Vanttola for their contributions to NKS.

2 Practical remarks

Practical remarks about the meeting were given by the Chair and the host. Finn Physant was appointed meeting secretary.

3 Approval of the agenda

The agenda was approved.

4 Minutes of last board meeting (Copenhagen, 22 June 2016)

The minutes were approved. Actions A to D noted in the appendix of the minutes of the last board meeting will be noted in parenthesis in these minutes when handled during today's meeting.

5 News since last board meeting

a. Report from the owners' group meeting

There has been no owners' group meeting since the last board meeting. The Chair informed of an informal owners' meeting under meeting item 5 b.

b. News from board members' organisations

The members informed each other about relevant news.

Charlotte Bro informed about recent changes in legislation of relevance for DEMA as nuclear authority. Firstly a new act on the control of peaceful use nuclear material in Greenland has been adopted. According to the new act, DEMA has to control and supervise the use and whereabouts of nuclear material which may be extracted in Greenland. This has to be done in order to fulfill the IAEA safeguards obligations. Secondly, the obligations arising out of the amended Convention on Physical Protection on Nuclear Material and Nuclear Facilities have been included in the Danish Emergency Act, thereby by law establishing what was already a long time practice that DEMA supervise that operators comply with the obligations on physical protection. At certain points the law stipulates higher standards than those required by the convention, for instance category III-material must be protected according the stricter requirements for category II-material, thereby applying the highest international stands.

Charlotte Bro also informed that due to cut backs DEMA is not able in 2017 to provide funding for NKS at the same level as in 2016 – and that further reduction for 2018 could be expected. Charlotte Bro stressed the importance of keeping administrative costs down and that these costs, as a %, for NKS are much higher than in DEMA and they need to be reduced. Furthermore Charlotte Bro informed that DEMA believes that the EU rules for public procurement should apply to the contract for the NKS Secretariat and that the salary for the PC´s were very high, 510 000 DKK for a half time position. Charlotte Bro suggested that it should be considered if the PC activity could be undertaken with 25% rather than 50% of a full position.

It was however pointed out by other board members that a large part of the tasks undertaken by the PC's and also the secretariat's role in the considerable outreach can not be characterised as administration, but in fact work of a scientific nature.

Eva Simic informed the board about an evaluation carried out by the consultant firm Oxford Research on behalf of SSM on the added value of NKS in Swedish perspective. An evaluation report with conclusions and recommendations is close to finalisation. Eva Simic will distribute this report to the board members.

Eva Simic also informed about SSM's new government mission regarding the national competence, and Eva Simic also informed about SSM's research conference in November 22-23.

The Chair informed of an informal owners meeting in the evening of 17 January 2017 between Iceland, Denmark and Norway. Sweden and Finland were not able to attend. The aim of the meeting was to address the concerns raised by Denmark regarding the administrative costs, expressed in a letter to the other owners from DEMA, see also the report by the DEMA board member, above. The administrative costs have been discussed from time to time in the NKS board and among the owners. Now it is about 10 years since a

major reorganization of NKS took place and it may be feasible to take a look at NKS structure and activities including the administration in order to explore opportunities for enhancing efficiency and reducing costs. The way forward regarding these issues (i.e. establishing working groups with well-defined tasks) will be addressed at the next board meeting in June following a thorough discussion of the evaluation report by Oxford Research on the added value of NKS in Swedish perspective. The preparations for the June board meeting will be in consultations with the owners and there may be need for one or more owners meeting.

c. Administrative news

Finn Physant informed the board that the policy document ”This is NKS” had been updated by exchanging ”2015” with ”2016” concerning the size of the annual contributions to NKS. A new folder will be published in 2017 and the ”Handbook for NKS applicants and activity leaders” as of April 2016 is still valid.

Annelie Bergman suggested that the 2017 folder only should be produced in an electronic version. The board agreed to this.

6 Financial status

Finn Physant presented the distributed material: Financial status report and financial programme specification, both dated 16 December 2016. At this date the reserve was estimated to approximately 0,92 MDKK, which is according to the recommendation given by the auditor. – The board took note of the financial situation.

Charlotte Bro asked if a reserve of approximately 1 MDKK really was needed. The Chair informed that this was in line with a recommendation from NKS’ auditor a few years back when severe currency fluctuations gave rise to concern regarding NKS’ financial well being and suggested that Charlotte Bro address this question to the auditor at the next board meeting.

7 Agreements

The following four agreements were prepared for the board’s decision:

-R-part programme manager 2017 with Strålsäkerhetsmyndigheten

-B-part programme manager 2017 with DTU Nutech

-secretariat until 30 June 2018 with FRIT and

-auditing for the accounts of 2016 with Dansk Revision.

All these agreements were approved with the following comments:

In the programme manager contracts the last half sentence ”or agreed with the programme manager in advance” will be erased.

The secretariat contract will be prolonged to 31 July 2018 enabling the board to decide the possible renewal of this contract during the January 2018 board meeting 6 months before the termination of this agreement the latest.

8 R-part: status and new activities

Emma Palm made a presentation of the status of the ongoing R-part activities. Overall the work in NKS-R is progressing well. Since the last board meeting in January, 15 final reports have been published on the NKS website. All activities started in 2015 (and earlier) are completed. All contracts for 2016 activities have been agreed and signed, overall the work in NKS-R is progressing according to plan. Travel assistance has been granted to one young scientist. Several seminars and publications has resulted from the NKS-R activities.

Christian Linde presented the evaluation results and funding recommendations for CfP 2017. NKS-R received 14 proposals this year (6 continued, 2 renewed and 6 new proposals), with a total funding request of 6948 kDKK. Two funding alternatives were presented based on the evaluations with a total budget equal to 3100 kDKK. The first alternative suggested full funding for six proposals and the second alternative suggested funding for seven proposals with a reduction of the requested amounts by ca 13 %. After some discussions, the board favored the second funding alternative and agreed to fund the following seven activities in 2017 (all amounts in kDKK):

SPARC	524
NORDEC	524
COPSAR	493
FIREBAN	393
SC_AIM	279
HYBRID	493
WRANC	393

The total budget for these seven activities is 3100 kDKK.
Petri Kinnunen commented the application of the HYBRID project. In the project application it had been marked that VTT would invest 122 kDKK in the project, but is not applying any NKS money for itself. This is a false budgeting as VTT is not investing direct funding for this project. VTT will do similar work in the Finnish nuclear safety research programme SAFIR2018 and most likely the Finnish contribution in HYBRID is meant to be exchange of knowledge between these projects, but direct transfer of money from VTT it will not be.
Christian Linde presented a recent publication issue encountered by VTT. They had submitted a manuscript to a peer-review journal for publication of results from the ATR activity, which was funded by NKS in 2015. The manuscript was not accepted for publication since the ATR final report (NKS-372) was already available on the NKS website. The coordination group realised this case highlights a potential conflict between the ideal of openness of NKS and the opportunity for scientists to publish their results in peer-review journals. To solve this particular issue, the coordination group decided to remove the NKS-report from the website and to have VTT resubmitting a revised report with a link to the open access article where the results are published. VTT and NSK will split the cost of 1900 USD. Special attention should be made before publishing NKS-reports on the website to avoid similar cases in the future. Action: the program managers shall ask the activity leader when the final report is submitted if they intend to publish, if so the NKS report will be put on the NKS website after the publication is finished.

9 B-part: status and new activities

Kasper Andersson presented a status report for ongoing activities. In an overall view the activities are progressing well. There are no delayed activities started before 2016. The activities from 2016 are being carried out on schedule, but in a few cases with acceptable delays. Young scientist travel assistance has been granted to 2 scientists. Both NKS-B seminars planned in 2016 have been carried out: GAMMASPEC and NORDUM.
Kasper Andersson presented the evaluation results and funding recommendation for CfP 2017 – a total of 16 (of these 3 are continued) proposals were received. After some discussion the board agreed to fund the following activities in 2017 (all amounts in kDKK):

EPHSOGAM	381
AUTOMORC	452
GAMMASPEC	381
NORDIC ICP	272
CAMNAR	363
NEXUS	390
AVESOME	435
RADSHIELD	426

The total budget for these 8 activities is 3100 kDKK.

10 Budget for 2017

Finn Physant presented the distributed budget proposal of 9 January 2017. Three revisions to this proposal were made. The contribution from DEMA was corrected to 375,000 DKK. The contribution from IFE was corrected to 110,000 NOK. The common expense budget was reduced to 200,000 DKK. - The budget approved by the board is attached to these minutes in appendix A.

11 NKS article

Christian Linde presented a draft plan for an article on the impact of NKS on Nordic collaboration within nuclear reactor safety and emergency preparedness, which was suggested earlier at the last board meeting in June 2016. A main objective of the article was described aiming at highlighting the value of NKS activities and collaborations to the Nordic and the international communities, e.g. by scientific and technical excellence, developing competence, end-user relevance and building networks. A discussion with the board followed suggesting to find e.g. a French journal for publication and to focus on the results of NKS sponsored activities and the outcome of collaborations (action A).

12 NKS R and B seminar 2019

Kasper Andersson presented to the board the coordination group's first draft of a seminar outline. The targeted audience is broad, including authorities/regulators, operators/industries, technical consultants, universities/academia, young and senior scientists and media. The location is to be a Nordic capitol (for the board to decide). It is to take place over 1½ days in January 2019. Lessons learned from previous seminars include: less technical detail in presentations, more focus, more breaks, more discussion time, and more female speakers. The coordination group presented a wish for a seminar program work group consisting of the 2 PM's, Finn Physant, and Astrid Liland, Karin Andgren, Kaisu Leino and Gisli Jonsson. Astrid Liland and Karin Andgren were positive for participation and Kaisu Leino and Gisli Jonsson will be invited. This group is balanced wrt. R/B, Nordic countries and gender, and is very experienced wrt. NKS work. Some ideas for the seminar structure were presented, which may serve as an input for the initial discussions in the program group. NKS PC's could give presentations at the seminar of the journal publication, that would be finalized then. It was agreed to again have alternating R and B presentation groups, and that also this seminar should if possible have 3-4 high ranking key speakers to increase sales value (action A). It was discussed if there should be a seminar fee for participants, but it was pointed out that this would be against fundamental principles of

NKS. - The board was supportive of the seminar outline and the coordination group will develop the seminar plan further for the next board meeting.

13 Information activities

Finn Physant informed the board about the status of the website, NewsLetters etc. User statistics of the present generation of website software have now been obtained for more than 4 years and were presented. This presentation included a graphical presentation (action C). 3 NewsFlashes and one NewsLetter have been distributed since the last board meeting including news on the last board meeting, CfP 2017, seminars, reports, young scientist travels etc. There is now a list of more than 500 e-mail adresses, to which the electronic letters are sent. A new and updated version of the pamphlet ”Nordic Nuclear Safety Research” will be published in 2017 (only in an electronic version).

14 NKS and LinkedIn

Christian Linde presented a plan for the entry of NKS on LinkedIn as a way to extend the networking opportunities for NKS. LinkedIn can be seen as an additional channel for spreading news from newsletters and newsflashes. An NKS LinkedIn site could also serve as a hub for networking among the LinkedIn users that choose to become ”followers of NKS”, which could be of particular interest for young scientists. NKS news posted on LinkedIn could also be easily forwarded through the networks of the followers, thereby offering an opportunity for the news to be spread beyond the current list of subscribers. The LinkedIn site would also include a short presentation of NKS and a link to the NKS internet website (action D). The board supported the initiative and approved the plans. Status report will follow at the next board meeting.

15 Other issues

No other issues.

16 Next meeting

Next meeting will be in Copenhagen 8 June 2017. The owners were asked to reserve 7 June for a possible owners´group meeting in Copenhagen.

17 End of meeting

Many thanks for a good meeting were expressed by the chairman – especially to the organizers at Strålevernet. Many thanks were given to Emma Palm for her valuable contributions to NKS as R-part programme manager.

Sigurður M. Magnússon
Chairman

Finn Physant
Meeting secretary

Appendices:
A: Budget decision for 2017
B: Actions from the board meeting

NKS budget decision for 2017 - 18 January 2017

Budgets	Budget for 2017	Budget for 2017	Budget for 2016
	EUR	DKK	DKK
R-part			
Activities	416.981	3.100.000	3.500.000
Fee PC	68.600	510.000	541.667
Travels PC	6.725	50.000	50.000
Coordination/Young scientists' travel	6.725	50.000	100.000
R total	**499.032**	**3.710.000**	**4.191.667**
B-part			
Activities	416.981	3.100.000	3.500.000
Fee PC	68.600	510.000	500.000
Travels PC	6.725	50.000	50.000
Coordination/Young scientists' travel	6.725	50.000	100.000
B total	**499.032**	**3.710.000**	**4.150.000**
Seminar 2016			
Seminar 2016	0	0	100.000
Seminar 2016 total	**0**	**0**	**100.000**
Common			
Common various according to specification	26.902	200.000	250.000
Common total	**26.902**	**200.000**	**250.000**
Others			
Fee Secretariat	90.794	675.000	660.000
Fee Chairman incl. travels	64.565	480.000	470.000
Travels Secretariat	1.345	10.000	10.000
Others total	**156.704**	**1.165.000**	**1.140.000**
TOTAL	**1.181.669**	**8.785.000**	**9.831.667**
Expected incomes according to app. 1	**1.101.647**	**8.190.085**	**8.661.382**
Surplus	**-80.022**	**-594.915**	**-1.170.285**

Any deficits to be covered by the reserve available for the board, which according to the financial status report of 16 December 2016 is ca.:	916.610,00
Proposed budget for 2017	-594.914,63
Present reserve and surplus	321.695,37
Funding reserved for use in 2016, but not used, will amount to ca.:	330.000,00
Gain/Loss due to the development in exchange rates 2016-2017 ca.:	-95.000,00
Old reservations from before 2014, not used, amount to:	238.045,00
Total reserve end of January 2017: ca. DKK:	**794.740,37**
Total reserve end of January 2017: ca. EUR:	**106.900,40**

Specification of ”Common" for 2017

	2017	2017	2016
	EUR	DKK	DKK
Common			
Reports, materials etc.	3.531	26.250	26.250
Postage, fees	1.009	7.500	7.500
Equipment	673	5.000	15.000
Internet	9.416	70.000	90.000
Auditing, consulting	8.239	61.250	61.250
Information material	2.690	20.000	30.000
Various expenses	1.345	10.000	20.000
Common total	**26.902**	**200.000**	**250.000**

Appendix 1 for budget decision for 2017

Pledge for funding in 2017 - Incomes

	Proposal for 2017	Proposal for 2017	Actual for 2016
	EUR	DKK	DKK
SSM	476.335	3.541.265	3.695.510
TEM	350.000	2.602.040	2.537.250
BRS	50.441	375.000	428.348
GR	24.000	178.426	179.100
NRPA	88.045	654.560	989.528
Total EUR / DKK	**988.821**	**7.351.291**	**7.829.736**

SSM contribution SEK	4.550.000
NRPA contribution NOK	800.000
BRS contribution DKK	375.000

	EUR	DKK	DKK
Fortum	26.250	195.153	195.891
TVO	26.250	195.153	195.891
Fennovoima	10.000	74.344	67.163
IFE	12.106	90.002	87.484
Forsmark	13.150	97.762	98.132
Ringhals	12.000	89.213	89.550
OKG	13.070	97.168	97.535
Total EUR / DKK	**112.826**	**838.795**	**831.646**
Complete EUR / DKK	**1.101.647**	**8.190.085**	**8.661.382**

IFE contribution NOK 110000

Exchange rates 2016/17:

NKS 2017:	
DKK	100,0000
EUR	7,4344
NOK	0,8182
SEK	0,7783
NKS 2016:	
SEK 2016	0,8122
EUR 2016	7,4625
NOK 2016	0,7761

Appendix B

Actions from the board meeting
(if nothing else is mentioned to be taken by the coordination group):

A. Ref. item 5: An evaluation report with conclusions and recommendations is close to finalisation. Eva Simic will distribute this report to the board members.
B. Ref. item 5: A new folder (pamphlet) will be published in 2017 (only an electronic version – not printed).
C. Ref. item 8: Action: the program managers shall ask the activity leader when the final report is submitted if they intend to publish, if so the NKS report will be put on the NKS website after the publication is finished.
D. Ref. Item 11: A discussion with the board followed suggesting to find e.g. a French journal for publication and to focus on the results of NKS sponsored activities and the outcome of collaborations.
E. Ref. Item 12: The board was supportive of the seminar outline and the coordination group will develop the seminar plan further for the next board meeting.
F. Ref. item 14: The board supported the initiative and approved the plans. Status report will follow at the next board meeting.

The NKS Secretariat

NKS(17)2
2017-06-08

nks
Nordic nuclear safety research

Financial Statements

for

The Nordic Nuclear Safety Research Programme

2016

8 June 2017
Finn Physant
FRIT

Statement by Management

The Chairmann, Sigurður M. Magnússon and the NKS Secretariat have considered and approved the Financial Statements of The Nordic Nuclear Safety Research Programme (in the following referred to as 'NKS') for the financial year 1 January 2016 - 31 December 2016.

In our opinion, the Financial Statements provide a true and fair view of the organisation's assets, liabilities and equity, financial position as at 31 December 2016 and the results of the organisation's activities for the financial year 1 January 2016 - 31 December 2016.

In our opinion, the management's review includes a fair description of the issues dealt with in the management review.

The Management recommend the financial statement for approval by the Group of Owners.

Copenhagen, 8 June 2017

The Management:

Chairman	**NKS Secretariat**
Sigurður M. Magnússon	Finn Physant

We, the signers, as representatives of the owners of NKS hereby approve The Financial Statements for The Nordic Nuclear Safety Research Programme 2016.

Copenhagen, 8 June 2017

Group of Owners:

Sigurður M. Magnússon Iceland, chairman	Charlotte Bro Denmark	Jorma Aurela Finland
Ole Harbitz Norway	Eva Simic Sweden	

Independent Auditors' Report

To the group of owners of NKS

Opinion

We have audited the Financial Statements of NKS for the financial year 1 January - 31 December 2016, which comprise income statement, balance sheet, notes and financial programme specification, including a summary of significant accounting policies, for NKS. The Financial Statements are prepared in accordance with the agreements and the accounting policies, which is decided by the Management, and which is described at page 12.

In our opinion, the Financial Statements give a true and fair view of NKS' financial position at 31 December 2016 and of the results of NKS' operations for the financial year 1 January - 31 December 2016 in accordance with the agreements and the accounting policies, which is decided by the Management.

Basis for Opinion

We conducted our audit in accordance with International Standards on Auditing (ISAs) and the additional requirements applicable in Denmark as well as in accordance with generally accepted government auditing standards. Our responsibilities under those standards and requirements are further described in the "Auditor's Responsibilities for the Audit of the Financial Statements" section of our report. We are independent of NKS in accordance with the International Ethics Standards Board for Accountants' Code of Ethics for Professional Accountants (IESBA Code) and the additional requirements applicable in Denmark, and we have fulfilled our other ethical responsibilities in accordance with these rules and requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

The Management's Responsibilities for the Financial Statements

The Management is responsible for the preparation of Financial Statements that give a true and fair view in accordance with the agreements and the accounting policies, which is decided by the Management, and for such internal control as the Management determines is necessary to enable the preparation of Financial Statements that are free from material misstatement, whether due to fraud or error.

In preparing the Financial Statements, the Management is responsible for assessing NKS' ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting in preparing the Financial Statements unless the Management either intends to liquidate NKS or to cease operations, or has no realistic alternative but to do so.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the Financial Statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs and the additional requirements applicable in Denmark as well as in accordance with generally accepted government auditing standards, will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users of accounting information taken on the basis of these Financial Statements.

Independent Auditors' Report

As part of an audit conducted in accordance with ISAs and the additional requirements applicable in Denmark as well as in accordance with generally accepted government auditing standards, we exercise professional judgment and maintain professional scepticism throughout the audit.

We also:

- Identify and assess the risks of material misstatement of the Financial Statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of NKS' internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Management.
- Conclude on the appropriateness of the Management's use of the going concern basis of accounting in preparing the Financial Statements and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on NKS' ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the Financial Statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause NKS to cease to continue as a going concern.
- Evaluate the overall presentation, structure and contents of the Financial Statements, including the disclosures, and whether the Financial Statements represent the underlying transactions and events in a manner that gives a true and fair view.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

Statement on Management's Review

The Management is responsible for Management's Review.

Our opinion on the Financial Statements does not cover Management's Review, and we do not express any form of assurance conclusion thereon.

In connection with our audit of the Financial Statements, our responsibility is to read Management's Review and, in doing so, consider whether Management's Review is materially inconsistent with the Financial Statements or our knowledge obtained during the audit, or otherwise appears to be materially misstated.

Based on the work we have performed, we conclude that Management's Review is in accordance with the Financial Statements. We did not identify any material misstatement of Management's Review.

Independent Auditors' Report

Declaration on compliance with other legislation and other regulations

Opinion on legal-critical audit and performance audit

The Management is responsible for ensuring that the transactions covered by the Financial Statements comply with applicable appropriations, laws and other regulations as well as agreements and standard practice and that due financial consideration has been applied to the management of funds and operations of the activities included in the annual accounts.

In conjunction with our audit of the Financial Statements, it is our responsibility in accordance with generally accepted auditing standards to select relevant areas for both legal-critical audit and performance audit. In the case of legal-critical auditing, we assess with a high degree of certainty whether the transactions covered by the Financial Statements comply with the applicable appropriations, laws and other regulations as well as agreements and standard practice. In the performance audit, we assess with a high degree of certainty whether the systems, processes or transactions examined support due financial consideration for the management of the funds and operations of the activities included in the Financial Statements.

If we conclude, on the basis of the work we have carried out, that grounds for significant critical comments exist, we are under obligation to report on this.

We have no critical comments to report in this regard.

Roskilde, 8 June 2017

Dansk Revision Roskilde
Godkendt revisionsaktieselskab, CVR-nr. 14 67 80 93

Palle Sundstrøm
Partner, State-Authorised Public Accountant

Management's review

2016 has been characterised by planned work/operation of the R (Reactor)-part and the B (Emergency Preparedness)-part.

A new Programme manager of the R parts has started.

In the course of 2016, the currency market for the Norwegian currency has developed in a positive direction, while the Swedish currency has developed in a negative direction, in comparison with the Danish currency and the EURO. The total foreign exchange loss at the end of the year is at DKK 175,630/ EUR 23,624/7,4344.

The Financial Statements are presented in DKK, but the amounts are also stated in EUR in a separate column.

The Financial Statements show a deficit of DKK 1,061,243 / EUR 142,748, which is consistent with decisions taken by the Board.

Subsequently, the equity as at 31 December 2016 constitutes DKK 7,159,872 / EUR 963,073.

In assessing the year's deficit and equity as at 31 December 2016, consideration must be made of the contracts for the R and B parts of DKK 6,006,629 / EUR 807,951, which is calculated at 31 December 2016, where invoices have not yet been received or where the work has not yet been completed.

It may also be noted that NKS in accordance with programme managers' statements has received external funding of around DKK 14.6 mio. / EUR 1.96 mio. in the form of un-charged contributions. The external funding is the work performed in connection with the implementation of activities for which invoices will not be sent.

Unused activity, coordination and travel funds for programmes for the year 2015 are returned to the reserve as are unused common programme costs for a total of DKK 960,512 / EUR 129,198.

Income statement 2016

Grants and interest income				Rate 7,4344
Danish Emergency Management Agency	DKK	428.347,50	EUR	57.616,96
Ministry of Economic Affairs and Employment, FI	DKK	2.537.250,00	EUR	341.285,11
Icelandic Radiation Safety Authority	DKK	179.100,00	EUR	24.090,71
Norwegian Radiation Protection Authority	DKK	989.527,50	EUR	133.101,19
Swedish Radiation Safety Authority	DKK	3.695.510,00	EUR	497.082,48
Additional funding	DKK	836.397,08	EUR	112.503,64
Interest income	DKK	5.320,88	EUR	715,71
Total grants and interest income	**DKK**	**8.671.452,96**	**EUR**	**1.166.395,80**
Expenses				
R-Part	DKK	3.454.566,28	EUR	464.673,18
B-Part	DKK	4.642.991,43	EUR	624.528,06
Activity support	DKK	154.915,38	EUR	20.837,64
Fees	DKK	1.122.500,00	EUR	150.987,30
Common program expenses	DKK	172.148,35	EUR	23.155,65
Travels	DKK	9.944,22	EUR	1.337,60
Exchange adjustments	DKK	175.630,45	EUR	23.624,02
Total expenses for the NKS programme	**DKK**	**9.732.696,11**	**EUR**	**1.309.143,46**
Income - Expenses	**DKK**	**-1.061.243,15**	**EUR**	**-142.747,65**

Balance sheet 2016

Assets:				**Rate 7,4344**
Giro and bank accounts converted to DKK, Note 1				
DK/IS-giro 918-9297	DKK	573.799,55	EUR	77.181,69
FI-giro 800015-70837915	DKK	2.849.016,49	EUR	383.220,77
NO-giro 7874.07.06976	DKK	790.983,13	EUR	106.395,02
SE-giro 6 64 63-1	DKK	4.502.672,84	EUR	605.653,83
Giro and bank accounts total	DKK	8.716.472,01	EUR	1.172.451,31
Total Assets	**DKK**	**8.716.472,01**	**EUR**	**1.172.451,31**
Liabilities:				
Equity:				
Retained from previous years	DKK	8.221.115,16	EUR	1.105.820,94
Result of this year	DKK	-1.061.243,15	EUR	-142.747,65
Total equity	**DKK**	**7.159.872,01**	**EUR**	**963.073,28**
Statement for new financial year, Note 2	DKK	1.556.600,00	EUR	209.378,03
Total Liabilities	**DKK**	**8.716.472,01**	**EUR**	**1.172.451,31**

Notes

Note 1: Giro and bank accounts:		Currency	DKK	EUR
DK/IS-giro 918-9297:				
Holding 31.01.2017	**DKK**	573.799,55	573.799,55	77.181,69
FI-giro 800015-70837915				
Holding 31.01.2017	**EUR**	1.267,07	9.419,91	1.267,07
Giro deposits 31.01.2017	**EUR**	381.953,70	2.839.596,58	381.953,70
NO-giro 7874.07.06976				
Holding 31.01.2017	**NOK**	172.428,41	141.080,93	18.976,77
Giro deposits 31.01.2017	**NOK**	794.307,27	649.902,20	87.418,25
SE-giro 6 64 63-1:				
Holding 31.01.2017	**SEK**	5.785.266,40	4.502.672,84	605.653,83
Total			**8.716.472,01**	**1.172.451,31**

Exchange rates pr. 31.12.2016

EUR	**743,44**
NOK	**81,82**
SEK	**77.83**

Note 2: Payment regarding the new financial year from Swedish Radiation Safety Authority:
Owner contribution for 2017 - Paid 30.12.2016

Notes

Financial programme specification - 31 January 2017

	DKK							EURO	7,4344	
Total	Budget from 2015	Returned 2015	Budget 2016	Total budget 2016	Payments made	Contracts signed, but not paid	Rest budget	Payments made	Contracts signed, but not paid	Rest budget
R-Part	2.187.967	-117.172	4.191.467	6.262.262	3.454.567	2.680.220	127.475	464.673	360.516	17.147
B-Part	4.701.547	-764.276	4.151.010	8.088.281	4.642.991	3.326.409	118.881	624.528	447.435	15.991
2016 seminar	52.225	0	100.000	152.225	154.915	0	-2.690	20.838	0	-362
NSFS 2015	14.226	-14.226	0	0	0	0	0	0	0	0
Fees	7.500	-7.500	1.130.000	1.130.000	1.122.500	0	7.500	150.987	0	1.009
Common programme exp.	56.889	-56.889	250.000	250.000	172.149	0	77.851	23.156	0	10.472
Travels	449	-449	10.000	10.000	9.944	0	56	1.338	0	8
I alt	7.020.803	-960.512	9.832.477	15.892.768	9.557.066	6.006.629	329.073	1.285.519	807.951	44.264
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F3 = F$
$F - G = H = H_1 + H_2$

Notes

Detailed financial programme specification - 31 January 2017

	DKK							EURO	7,4344	
Specifikation:	Budget from 2015	Returned 2015	Budget 2016	Total budget 2016	Payments made	Contracts signed, but not paid	Rest budget	Payments made	Contracts signed, but not paid	Rest budget
R-Part: Common program.	320.676	-75.676	641.667	886.667	549.192	250.000	87.475	73.872	33.627	11.766
Activities	1.847.036	-21.241	3.499.800	5.325.595	2.895.375	2.430.220	0	389.456	326.889	0
Travel young scientists	20.255	-20.255	50.000	50.000	10.000	0	40.000	1.345	0	5.380
B-Part: Common program.	335.952	-90.952	600.000	845.000	512.049	250.000	82.951	68.876	33.627	11.158
Preparedness	1.439.865	-543.967	2.250.010	3.145.908	1.775.884	1.370.024	0	238.874	184.282	0
Measurement	2.234.534	-93.400	815.000	2.956.134	1.880.763	1.075.371	0	252.981	144.648	0
Radioecology	570.239	0	436.000	1.006.239	460.225	546.014	0	61.905	73.444	0
Waste	85.000	0	0	85.000	0	85.000	0	0	11.433	0
Travel young scientists	35.957	-35.957	50.000	50.000	14.070	0	35.930	1.893	0	4.833
2016 seminar	52.225	0	100.000	152.225	154.915	0	-2.690	20.838	0	-362
NSFS 2015	14.226	-14.226	0	0	0	0	0	0	0	0
Fee Secretariat	7.500	-7.500	660.000	660.000	652.500	0	7.500	87.768	0	1.009
Fee Chairman incl. travels	0	0	470.000	470.000	470.000	0	0	63.220	0	0
Reports etc.	14.969	-14.969	26.250	26.250	12.531	0	13.719	1.686	0	1.845
Postage etc.	-348	348	7.500	7.500	9.260	0	-1.760	1.246	0	-237
Equipment	2.225	-2.225	15.000	15.000	0	0	15.000	0	0	2.018
Internet	32.300	-32.300	90.000	90.000	63.675	0	26.325	8.565	0	3.541

Notes

Detailed financial programme specification - 31 January 2017

	DKK							EURO	7,4344	
Specifikation:	Budget from 2015	Returned 2015	Budget 2016	Total budget 2016	Payments made	Contracts signed, but not paid	Rest budget	Payments made	Contracts signed, but not paid	Rest budget
Auditing	-3.125	3.125	61.250	61.250	61.250	0	0	8.239	0	0
Information material	-711	711	30.000	30.000	15.392	0	14.608	2.070	0	1.965
Various	11.579	-11.579	20.000	20.000	10.041	0	9.959	1.351	0	1.340
Travels Secretariat	449	-449	10.000	10.000	9.944	0	56	1.338	0	8
Diff.	0	0	0	0	0	0	0	0	0	0
Total	7.020.803	-960.512	9.832.477	15.892.768	9.557.066	6.006.629	329.073	1.285.519	807.951	44.264
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F3 = F$ $F - G = H = H_1 + H_2$

Accounting policies

The Financial Statements is presented in accordance with the agreements and the accounting policies, which is decided by the Management.

The Financial Statements is presented in accordance with the same accounting policies as last year.

Recognition and measurement
The association uses the "open post"-principle, which means, that all expenses, which is paid in the period 1/2-2016 - 31/1-2017, are included in the financial statements.

Conversion of foreign currencies
Transactions in foreign currencies are in the course of the year translated to the exchange rate at the beginning of the financial year. Giro and bank accounts, receivables and payables in foreign currencies, is translated at the exchange rates at the balance sheet date.

Realised and unrealised exchange differences is recognised in the income statement as financial income or financial expenses.

The income statement

Revenue recognitions
Income include grants for the financial year from the owners and the additional funding.

Expenses
Expenses include paid expenses for the financial year's approved projects for respectively the R- and the B-part, including common program expenses and travels, activity supports and fees. The association is not taxable for VAT and therefore the expenses of the association is recognized including VAT.

Interest income
Interest income include interest income.

Income taxes
The association is not liable to pay tax.

Balance sheet

Cash and cash equivalents
Cash and cash equivalents include bankdeposit in giro and bank accounts in Denmark, Finland, Norway and Sweden.

Received prepayments
Received prepayments is measured at the exchange rates at the balance sheet date.

Dansk Revision Roskilde
Godkendt revisionsaktieselskab
Køgevej 46A
DK-4000 Roskilde
roskilde@danskrevision.dk
www.danskrevision.dk
Telefon: +45 44 53 77 44
Telefax: +45 44 53 77 04
CVR: DK 14 67 80 93
Bank: 9173 4783 428768

The Nordic Nuclear Safety Research Programme (NKS)

Long-form audit report of 8 June 2017 regarding Financial Statements for 2016

Long-form audit report of 8 June 2017 regarding Financial Statements for 2016

Contents

Long-form audit report of 8 June 2017 regarding Financial Statements for 2016

1 Audit of the financial statements

1.1 Introduction

As the appointed auditors for The Nordic Nuclear Safety Research Programme (NKS), we have audited the Financial Statements for the financial year 1 January 2016 - 31 December 2016 prepared by the NKS Secretariat.

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

DKK / EUR	Current year	Last year
Result for the year	-1.061.243 / -142.748	240.435 / 32.219
Equity	7.159.872 / 963.073	8.221.115 / 1.101.657

1.2 Conclusion on the executed audit - auditor's report

The audit performed has not given rise to significant remarks to the Financial Statements.

If the Financial Statements are carried in the existing form and if further, significant information does not appear during management's processing, we will provide the Financial Statements for 2016 with an unmodified audit opinion.

The audit has not included the management's review, but we have read the management's review. This has not given rise to remarks. On this background, it is our opinion that the information in the management's review is in accordance with the Financial Statements.

1.3 Scope and execution of the audit

The purpose, planning and execution of the audit, the auditor's responsibility and reporting as well as theGroup of Owners's responsibility have remained unchanged, which is why we refer to our letter of engagement dated 30 March 2011.

As preparation for the audit of the Financial Statements for 2016, we have discussed the expectations to the financial development for 2016 with the Management, including risks related to the association's activities. We have, furthermore, discussed risks connected to the presentation of accounts and the initiatives the Group of Owners has initiated for the management hereof.

On this background, we have prepared our auditing strategy with a view to targeting our work at significant and areas of risk. We have identified the following items and areas to which, according to our opinion, special risks of significant errors and insufficiencies in the Financial Statements are associated:

- Grants
- Project expenses
- Equity

On other areas, the risk of error in the Financial Statements is assessed as normal and the execution of the audit has therefore had a lesser scope.

Long-form audit report of 8 June 2017 regarding Financial Statements for 2016

The audit was executed with a view to verifying whether the information and amount specifications in the Financial Statements are correct. Analyses, review and assessment of administrative procedures, internal control systems and control procedures have been performed as well as a review and assessment of bookkeeping items and documentation for this.

The audit has also included an assessment of whether the prepared Financial Statements fulfil the auditing regulations of legislation and articles of association. In this regard, we have assessed the selected accounting policy, the Group of Owners's accounting opinion as well as, moreover, the information submitted by the Group of Owners.

Furthermore, the audit has been planned and executed in accordance with the international auditing standards as well as generally accepted government auditing standards (legal-critical audit and performance audit) and, in addition to the financial audit, it also includes a review and assessment of whether due financial considerations have been taken with the administration of the funds covered by the accounts.

During the execution of the financial audit, we have checked whether the accounts are without significant errors and insufficiencies. We have also checked the Financial Statements' agreement with the underlying bookkeeping records as well as the Financial Statements' concordance with laws and regulations as well as with commenced agreements and the accounting policies, which is decided by the Management.

The performance audit has been executed as an integrated and parallel part of the financial audit and, among other things, has included random reviews of agreements and contracts, reports, analyses of expense and income items as well as an analysis of budget deviations.

The audit has been executed in connection with the preparation of the Financial Statements.

2 The executed audit

2.1 Legal-critical audit

We have during the execution of the financial audit, not identified terms, that gives us reason to suspect,

- that NKS in its work is not independent, and
- that NKS's funds are not used in accordance with the terms and conditions of NKS.

2.2 Administration

As in previous years, The NKS Secretariat is managed by FRIT ApS.

Agreement has been entered into on an extension of the agreement until 31 July 2018.

It must be noted that the Board has chosen to extend the agreement with Chairman of the Board, Sigurður M. Magnússon, up to and including 2018.

2.3 Attestation procedures

We have performed a follow-up on NKS Secretariat's procedures and internal controls regarding attestation procedures and have found reason to state the following:

Project expenses

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

In addition, we have established that the Secretariat regularly sends programme status to the programme managers. The programme status is forwarded approximately every second month and at the latest on 31 January 2017. The programme status includes, for example, a ledger card for project expenses so that the programme manager can see the individual payments on the project for the current year.

Secretariat expenses

Remuneration for the Secretariat is controlled as per agreement and to the minutes of the board meeting. We checked on a sample basis whether the invoices has been approved by Sigurður M. Magnússon. This review has not given rise to remarks.

2.4 Authorisation to sign

The accounts manager, Finn Physant, owner of FRIT ApS, and chairman, Sigurður M. Magnússon, have authority to make withdrawals on NKS' giro and bank accounts jointly or individually together with Claus Rubin, who is a consultant for FRIT ApS.

Our assessment is that the above terms and conditions for authorisation to sign, in consideration of the few staff members, is appropriately organised.

2.5 Use of IT

In connection with our audit, we have performed a general review and assessment of the association's administrative use of IT, including of system, data and operation security.

Our assessment is that the association is dependent on IT in the daily business processes. However, the association's use of IT is not assessed as being a risk.

2.6 Non-corrected misstatements

Pursuant to the international auditing standards, we must account for non-corrected misstatements that are not insignificant, to the association's senior management.

We can inform, that there were no corrections to the draft for the Financial Statements.

2.7 Discussions with management on fraud

During the audit we have enquired the Management about the risk of fraud and the Management has informed us that according to their assessment, there is no particular risk that the Financial Statements can contain significant erroneous information as a result of fraud.

The Management has, furthermore, reported that they do not have knowledge of fraud or investigations in progress for assumed fraud.

During our audit we have not established conditions that could indicate or arouse suspicion of fraud of significance to the information in the Financial Statements.

3 Comments to the audit and financial statements 2016

For the individual items in the income statement and balance sheet we can supplement the presented Financial Statements for the year 2016 with the following:

3.1 Additional financiers

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

	2016	2015	2014
Fortum Power and Heat Oy, Finland	195.891	189.812	182.777
TVO, Finland / Teollisuuden Voima Oyj, TVO	195.891	189.812	182.777
Fennovoima Oy, Finland	67.162	57.688	55.952
Forsmarks Kraftgrupp AB, Sweden	98.132	97.883	95.268
OKG Aktiebolag, Sweden	97.535	92.673	90.158
Ringhals AB, Sweden	89.550	89.323	89.524
IFE, Norway	92.236	89.323	85.794
Nordic Council of Ministers	0	100.000	0
Total financiers	836.397	906.514	782.250

The additional financiers are in accordance with the supporting documentation.

We have found that in 2016, there has been no new additional financier.

3.2 Exchange rate adjustments

The exchange rate adjustments are mainly the result of foreign currency amounts being registered at the rate on 31 December 2015 throughout 2016. This gives deviations between the utilised rate and the actual rate.

We can report that the principle used does not affect the overall results, but just the allocation of the individual items in the income statement.

3.3 Budget balances brought forward from one year to the next

In the financial survey for 2016, budget figures for all expenses are specified. In addition, an amount transferred from 2015 of, in total, DKK 6,060,291 - cf. the accounts pages 10 to 11, first two columns.

We draw attention to the fact that the remaining budget for joint programme expenses, joint trips and fees similar to previously, have not been transferred from 2015 to 2016 and are thus transferred to NKS' equity (reserve).

It is furthermore noted that the coordination and travel expenses as well as activity expenses granted to the programme managers for the year 2016 that are not used/allocated similar to previous year will be transferred to equity. Thus, only the allocated activity expenses for R Part and B Part will be transferred from 2015 to 2016.

4 Performance 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 2016.

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.

As part of the performance audit, we must check whether the individual projects could be carried out in a more economical manner / efficiency. During our audit, no matters have come to our attention that cause us to believe that this is the case. However, we must state that our lack of technical expertise within nuclear safety means that we do not have the possibility to comment on this.

4.1 Agreement between bookkeeping records and Financial Statements

We noted that there is agreement between the performed bookkeeping and the prepared Financial Statements for the year 2016.

Similar to previous years, all deposits and payments in January 2017 have been included in the accounts as if they were settled before 31 December 2016. This utilised accounting policy does not affect the accounting result. Only the size of the cash available, receivables and debt are affected.

Long-form audit report of 8 June 2017 regarding Financial Statements for 2016

5 Statutory information, etc.

We have ascertained that on all essential areas, the association complies with the Danish Bookkeeping Act, including regulations on the storage of accounting records.

It is our opinion that the requirements of legislation on bookkeeping and storage of accounting records has been complied with. We have furthermore agreed that our archive material will be stored for 7 years after the expiry of the relevant financial year.

6 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 and International Crime).

During our audit we have not come across conditions or indications that any management member have committed economic crimes.

7 Other tasks

In this financial year we have provided the following other services to NKS:

- Assistance with the preparation of the Financial Statements

A fee for the audit of the Financial Statements has been agreed on, including assistance with the preparation of the Financial Statements, participation in accounting meetings and in board meetings as well as the translation to English of the accounts and long-form audit report, in the amount of DKK 49,000 excl. VAT. The amount has not been allocated as debt in the presented accounts.

Long-form audit report of 8 June 2017 regarding Financial Statements for 2016

8 Statements in connection with the audit
8.1 The Managements representation letter

As part of the audit of the Financial Statements, we have obtained confirmation from management of the Financial Statements' completeness, including that they contain all information on mortgages, guarantees, related parties, court cases, events after the balance sheet date as well as other complex auditable areas.

Management has further declared that all errors that have been presented to management are rectified in the Financial Statements. We have ascertained that the rectifications are included.

8.2 Auditor's statement

In compliance with the law regarding the approved auditors and audit firms, we state that:

- We comply with the statutory requirements for independence, and
- during the audit carried out, we have received all the information we have requested.

Roskilde, 8 June 2017

Dansk Revision Roskilde
Godkendt revisionsaktieselskab

Palle Sundstrøm
Partner, state-authorised Public Accountant

Presented at the board meeting on 8 June 2017

Sigurður M. Magnússon
Chairman

Charlotte Bro

Jorma Aurela

Ole Harbitz

Eva Simic

Financial status - 19 May 2017

Incomes

DKK

Expected incomes this year	8.190.086	A = B + C
Received until now	7.621.354	B
Additional payments	568.732	C
Cash balance	11.013.693	D
Available funds	11.582.425	E = C + D

Budget and expenses

DKK

Total budget incl. transfer from earlier years	14.552.534	F = G + H
Paid until now	3.779.472	G
Rest budget incl. contracts signed, but not paid	10.773.062	H

Available

DKK

Reserve available for the board	809.363	I = E - H

Financial programme specification - 19 May 2017

	DKK							EURO	7,4344	
Total	Budget from 16	Returned 16	Budget 17	Total budget 17	Payments made	Contracts signed, but not paid	Rest budget	Payments made	Contracts signed, but not paid	Rest budget
R-Part	2.807.695	-131.770	3.709.000	6.384.925	1.471.333	4.813.592	100.000	197.909	647.476	13.451
B-Part	3.445.290	-352.631	3.709.950	6.802.609	1.399.945	5.302.664	100.000	188.306	713.261	13.451
2016 seminar	-2.690	2.690	0	0	0	0	0	0	0	0
Fees	7.500	-7.500	1.155.000	1.155.000	810.000	345.000	0	108.953	46.406	0
Common programme exp.	77.851	-77.851	200.000	200.000	93.226	0	106.774	12.540	0	14.362
Travels	56	-56	10.000	10.000	4.968	0	5.032	668	0	677
I alt	6.335.702	-567.118	8.783.950	14.552.534	3.779.472	10.461.256	311.806	508.376	1.407.142	41.941
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F3 = F$

$F - G = H = H_1 + H_2$

Detailed financial programme specification - 19 May 2017

	DKK							EURO	7,4344	
Specifikation:	Budget from 16	Returned 16	Budget 17	Total budget 17	Payments made	Contracts signed, but not paid	Rest budget	Payments made	Contracts signed, but not paid	Rest budget
R-Part: Common program.	337.475	-87.475	585.000	835.000	505.000	255.000	75.000	67.927	34.300	10.088
Activities	2.430.220	-4.295	3.099.000	5.524.925	966.333	4.558.592	0	129.981	613.176	0
Travel young scientists	40.000	-40.000	25.000	25.000	0	0	25.000	0	0	3.363
B-Part: Common program.	332.951	-82.951	585.000	835.000	250.000	510.000	75.000	33.627	68.600	10.088
Preparedness	1.370.024	-155.000	2.083.950	3.298.974	761.345	2.537.629	0	102.408	341.336	0
Measurement	1.075.371	-48.750	1.016.000	2.042.621	330.500	1.712.121	0	44.456	230.297	0
Radioecology	546.014	-30.000	0	516.014	58.100	457.914	0	7.815	61.594	0
Waste	85.000	0	0	85.000	0	85.000	0	0	11.433	0
Travel young scientists	35.930	-35.930	25.000	25.000	0	0	25.000	0	0	3.363
2016 seminar	-2.690	2.690	0	0	0	0	0	0	0	0
Fee Secretariat	7.500	-7.500	675.000	675.000	330.000	345.000	0	44.388	46.406	0
Fee Chairman incl. travels	0	0	480.000	480.000	480.000	0	0	64.565	0	0
Reports etc.	13.719	-13.719	26.250	26.250	8.594	0	17.656	1.156	0	2.375
Postage etc.	-1.760	1.760	7.500	7.500	2.188	0	5.312	294	0	715
Equipment	15.000	-15.000	5.000	5.000	4.694	0	306	631	0	41
Internet	26.325	-26.325	70.000	70.000	27.750	0	42.250	3.733	0	5.683
Auditing	0	0	61.250	61.250	50.000	0	11.250	6.725	0	1.513
Information material	14.608	-14.608	20.000	20.000	0	0	20.000	0	0	2.690
Various	9.959	-9.959	10.000	10.000	0	0	10.000	0	0	1.345
Travels Secretariat	56	-56	10.000	10.000	4.968	0	5.032	668	0	677
Diff.	0	0	0	0	0	0	0	0	0	0
Total	6.335.702	-567.118	8.783.950	14.552.534	3.779.472	10.461.256	311.806	508.376	1.407.142	41.941
	F_1	F_2	F_3	F	G	H_1	H_2	G	H_1	H_2

$F_1 + F_2 + F3 = F$ $F - G = H = H_1 + H_2$

nks

nordic nuclear safety research

DENMARK FINLAND ICELAND NORWAY SWEDEN

A common Nordic view

Nordic problems need Nordic solutions. NKS aims to facilitate a common Nordic view on nuclear safety and radiation protection including emergency preparedness. This requires common understanding of rules, practice and measures, which may vary between countries, as well as with time. The work builds on a foundation of over sixty years of Nordic collaboration on related issues. Non-Nordic participation may be allowed under certain circumstances.

Securing Nordic competence and knowledge building

Through collaborative NKS activities, Nordic competence and capabilities are maintained and strengthened, and solutions to Nordic problems are disseminated through a sustained informal network. NKS publications are available cost-free on the internet. A special effort is made to engage young scientists and students, to ensure knowledge and expertise for the future.

Strengthening response capacities

By maintaining vital informal networks between Nordic authorities, nuclear power companies, scientists and other stakeholders, the region's potential for a fast, coordinated and targeted response to urgent issues is strengthened. Thereby, problems can be tackled quicker, more efficiently and consistently and at lower cost than if they needed to be addressed on a national scale.

Addressing current societal questions

NKS keeps an open eye to societal changes and events that might influence requirements and perception of nuclear safety, radiation protection and emergency preparedness in the Nordic countries. For instance the Fukushima accident prompted the arrangement of NKS joint reactor safety and emergency preparedness seminars on lessons learned and future implications for Nordic society.

NKS activities

These can take the form of research activities, test exercises or information collation/review exercises. Alternatively they can aim to harmonize approaches to common problems or spread and distribute knowledge and results through seminars, workshops and educational/training courses. Common to all NKS activities is that the results should be beneficial and made available to concerned end users in all Nordic countries. Aspects of nuclear safety, radiation protection and emergency preparedness may be combined in one activity.

Research areas

Areas of interest covered by NKS activities fall under two main programmes, NKS-R and NKS-B, which cover the following specified research areas.

NKS-R programme:

- Reactor safety
- Nuclear power plant life management and extension
- Decommissioning and handling of generated waste
- Organizational issues

NKS-B programme:

- Emergency preparedness
- Measurement strategy, technology and quality assurance
- Radioecological assessments
- Wastes and discharges

Some recent examples of NKS activities

Safety Culture in the Nuclear Industry

A good safety culture is an essential ingredient for ensuring safety in the nuclear industry. The predominant approaches for safety culture are based on the assumption of stable and relatively homogeneous organizations, which often does not apply to contemporary project-oriented and turbulent environments.

The theoretical and empirical work performed within the NKS-R activity SC_AIM resulted in the development of a preliminary framework for evaluating the applicability of safety culture assurance and improvement methods (NKS-381).

Extraction and Analysis of Reactor Pressure Vessel Material

Irradiation induced ageing of the weld material of the reactor pressure vessel (RPV) is a limiting factor from a long term operation perspective. The closed Barsebäck 2 reactor gives an opportunity to harvest samples from the RPV, which was manufactured and welded with the same technique and high amounts of nickel and manganese as most Nordic RPVs. A test program to analyze the as-aged material properties has been prepared within the NKS-R activity BREDA-RPV (NKS-385).

Unmanned Aerial Monitoring Platforms

With the forthcoming of small and inexpensive drone platforms, new possibilities for radiological surveys have arisen. Drones can be used as a supplement to existing measurement capabilities, enabling fast measurements in potential hazardous areas without danger to humans. The NKS-B activity NORDUM made a first approach to cover and compare different systems and approaches for use of drones in the Nordic countries, and the scope is expanded in the NKS-B activity NEXUS, including exercises for, e.g., urban environments (NKS-383).

Meteorological Uncertainty in Predicting Airborne Contaminant Dispersion

A series of NKS-B activities have looked into the influences of meteorological uncertainties on long-range atmospheric dispersion calculations. These have been found to be large depending on the weather situation, with significant implications for nuclear emergency preparedness and decision making. In the NKS-B MESO activity, the focus was on short-range dispersion models used up to about a hundred km distance. Results also here show large influences. A new activity, NKS-B AVESOME, combines uncertainties from meteorology and source term (NKS-380).

How to apply

Nordic companies, authorities, organizations and researchers can submit proposals for NKS activities under the NKS-R and NKS-B programmes. Usually at least three of the five Nordic countries should participate in an activity. Activities submitted under annual calls for proposals are assessed according to criteria important to the objectives of NKS, with final funding decisions made by the NKS board.

Do you have suggestions for a nuclear safety or radiation protection related activity? Contact us via www.nks.org

Financing of NKS activities

NKS is mainly financed by Nordic authorities, with additional contributions from Nordic organizations that have an interest in nuclear safety. The budget for NKS in 2017: about 9 million Danish kroner (€ 1.2 million). In addition to the funding sought from NKS, participating organizations are asked to provide a similar amount of in-kind contributions. This may take the form of working hours, travel expenses or laboratory resources. Without these in-kind contributions it would not be possible to carry out NKS activities.

Main financiers

- Danish Emergency Management Agency
- Ministry of Economic Affairs and Employment, Finland
- Icelandic Radiation Safety Authority
- Norwegian Radiation Protection Authority
- Swedish Radiation Safety Authority

Co-financiers

- Fennovoima Oy, Finland
- Fortum Power and Heat Ltd, Finland
- TVO, Finland
- Institute for Energy Technology (IFE), Norway
- Forsmark Kraftgrupp AB, Sweden
- OKG AB, Sweden
- Ringhals AB, Sweden

The NKS website

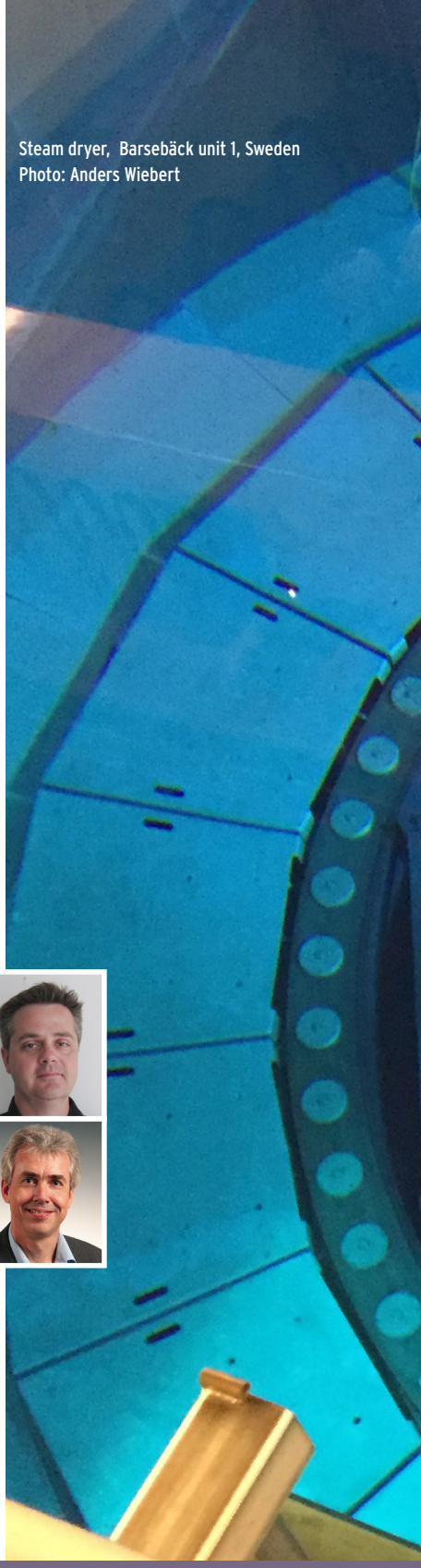
On the NKS website (www.nks.org) information is available on funding opportunities, travel support for young scientists, current activities and upcoming seminars. Presentations from seminars held are available for download as are reports from all completed NKS activities. It is also possible to discover more information on NKS and the history of Nordic co-operation in nuclear safety. For funding www.nks.org/handbook
For reports www.nks.org/reports

NKS email list

NKS sends out newsflashes and newsletters throughout the year providing information on call for proposals, upcoming seminars and published reports. If you wish to join the NKS email list please sign up at www.nks.org

NKS on LinkedIn

Follow NKS on LinkedIn at
https://www.linkedin.com/company-beta/16196099/



Steam dryer, Barsebäck unit 1, Sweden
Photo: Anders Wiebert

Contact

If you wish to learn more about NKS and NKS activities visit our website or contact the NKS secretariat.

nks@nks.org

Telephone +45 4677 4041

NKS Secretariat
P.O. Box 49
DK-4000 Roskilde, Denmark

Christian Linde, NKS-R programme manager

Kasper Grann Andersson, NKS-B programme manager

Sigurður M Magnússon, NKS chairman

Finn Physant, NKS secretariat

nks
Nordic nuclear safety research

This is NKS

Nordic Cooperation Forum

NKS (Nordic Nuclear Safety Research) is a forum for Nordic cooperation and competence in nuclear safety, including emergency preparedness, serving as an umbrella for Nordic initiatives and interests. It runs joint activities of interest to financing organisations and other end users producing seminars, exercises, scientific articles, technical reports and other types of reference material. The work is financed and supported by Nordic authorities, companies and other organisations. The results which should be practical and directly applicable are used by participating organisations in their decision making processes and information activities.

The Nordic Approach

The Nordic region comprises five countries, i.e., Denmark (including the Faroe Islands and Greenland), Finland, Iceland, Norway and Sweden. Building on the foundation of a common cultural and historical heritage and a long tradition of collaboration, NKS aims to facilitate a common Nordic view on nuclear and radiation safety. A common understanding of rules, practice and measures, and national differences in this context, is an essential requirement. Through collaborative efforts problems may be tackled quicker, more efficiently, more consistently, and at a lower cost.

Why Nordic Cooperation on Nuclear and Radiological issues?

One reason to maintain this collaboration between the Nordic countries is the common challenges in relation to nuclear installations. While nuclear power plants are in operation in Finland and Sweden, research reactors have been operated in Denmark, Finland, Norway and Sweden. Clearly, exchange of operational expertise and new ideas can be beneficial. Some of the Nordic research reactors have been closed down and the experience gained in subsequent decommissioning may be useful in connection with the planned decommissioning of Swedish nuclear power reactors. Also knowledge exchange between Sweden's nuclear fuel production plant and other Nordic nuclear installations may be beneficial. The Fukushima accident highlighted the need for an effective operational emergency preparedness for accidents at nuclear installations. By continuously improving detection, response and decision aiding tools while maintaining an informal collaborative network between relevant stakeholders in the Nordic countries, the capacity and capability to respond optimally to an emergency is enhanced. Experience has shown that nuclear and radiological challenges to society are far from static, and the response systems require continuous development. Radiological issues need to be addressed coherently and effectively in the Nordic countries, and some of these are on the NKS agenda. They range from exposure to naturally occurring radioactive material in the environment to the threat of malicious use of radioactive material. In addition to the NKS cooperation there is an extensive co-operation between the Nordic radiation safety authorities regarding general radiation safety issues.

Nordic and International Benefits

NKS with its program for nuclear safety including emergency preparedness is of common benefit for all five Nordic countries. The hallmark of NKS is a spirit of sharing – all results are available free of charge on the NKS web site (www.nks.org), not only to the NKS family but also worldwide providing an international benefit of the NKS work. When quoting NKS material, a reference to the source will be appreciated.

Two Program Areas

NKS activities are divided into two program areas:
NKS-R: Reactor safety; Nuclear power plant life management and extension; Decommissioning and handling of generated waste; Organisational issues.
NKS-B: Nuclear and radiological emergency preparedness; Measurement strategy, technology and quality assurance; Radioecology and environmental assessments; Management of radioactive waste and discharges.

Owners and Financiers of NKS

The owners and main financiers are:
Danish Emergency Management Agency (DEMA, Denmark)
Ministry of Employment and the Economy (TEM, Finland)
Icelandic Radiation Safety Authority (GR, Iceland)
Norwegian Radiation Protection Authority (NRPA, Norway)
Swedish Radiation Safety Authority (SSM, Sweden)

The co-financiers are:
Fennovoima Oy (Finland)
Fortum Power and Heat Ltd. (Finland)
TVO (Finland)
Institute for Energy Technology (IFE, Norway)
Forsmark Kraftgrupp AB (Sweden)
OKG AB (Sweden)
Ringhals AB (Sweden)

Financial Contribution

In 2016 the contributions of the owners and additional financiers were about 9 million Danish crowns (1.2 million euros). To this should be added contributions in kind by participating organizations, worth approximately the same amount, without which this program would not be possible.

NKS(16)4
2016-04-19

HANDBOOK FOR NKS APPLICANTS AND ACTIVITY LEADERS

April 2016

TABLE OF CONTENTS

1 INFORMATION FOR APPLICANTS

1.1 Subscribe to NKS News

Ensure that you will not miss any important information (regarding e.g. call for proposals) by subscribing to NKS News at: www.nks.org.

1.2 Who can apply?

Organisations such as universities, research centres, institutes and companies in the Nordic countries can apply for NKS funding for research activities. The activity budget should distribute the NKS funding between participant organisations from at least 3 Nordic countries (in some special cases, involvement of only 2 Nordic countries has been accepted in the NKS-R programme). Non-Nordic participation in NKS activities is possible, but NKS funding of Non-Nordic organisations is not possible. The activity leader must come from a Nordic country (i.e. work for a Nordic organisation).

1.3 What kind of work would be funded?

NKS funds work related to nuclear safety, including emergency preparedness, radioecology, measurement strategies and waste management, considered to be of importance to the Nordic community. The work should be of interest to the owners and financing organisations of NKS. The results must be of relevance, e.g., practical and directly applicable. The work can be in the form of scientific research, including experimental work, or joint activities producing seminars, workshops, courses, exercises, scientific articles, technical reports and other type of reference material. Examples of research topics can be found in the framework documents for NKS-R (http://www.nks.org/en/nksr/call_for_proposals/nks-r_framework_2015.htm) and NKS-B http://www.nks.org/en/nksb/call_for_proposals/nks-b_framework_2014.htm.

1.4 Requirements for NKS activities

The proposal shall fulfil the following requirements:

- Demonstrated compatibility with the current framework program
- NKS funded participation of organisations in at least three Nordic countries in all major activities (occasionally, two countries may be acceptable)
- Results of NKS activities are publicly available for free
- 50 % of the funding from own contribution

1.5 Criteria for NKS activities

The entire NKS program as well as the various activities is evaluated against the following criteria:

1. *Added Nordic value*
   Will the proposed activity lead to an increase in Nordic competence and/or building of informal networks within a relevant NKS-R framework area and how will this be achieved?
2. *Technical and/or scientific standard*
   How does the proposed activity demonstrate a suitable technical and/or scientific standard?
3. *Distinct and measurable goals*

What will the proposed activity deliver as a result of the proposed work programme in the year for which funding is applied for? It is important to ensure that it is clear to the evaluators what the proposed activity will set out to achieve.

4. *Relevance to NKS end-users*
   Is the proposed activity relevant to NKS end-users and which NKS end-users is the proposed activity targeting? It will strengthen the proposal if the interest of relevant end users is clearly demonstrated and not only assumed.
5. *Participation of young scientists*
   Will the proposed activity involve young scientists in the proposed work programme and if so, how? In this context, those studying towards a masters degree or a PhD and those in their first 4 years of their professional career after obtaining an academic degree would be considered as 'young scientists'
6. *Links to other national/international programmes*
   Does the proposed activity have a link to ongoing or past research programmes or activities? In particular, it should be clear where a proposed activity builds upon previously funded NKS activities.

1.6 What do I have to do in return for the money

The activity partners are expected to report the work carried out each year. The most common type of output is a scientific report at the end of the year. A report with clear results is requested even if the activity continues the next year. Other forms of reporting can be for example presentations and proceedings from a seminar. All material produced must be available for publishing on the NKS webpage, where they are free to be downloaded by anyone.

1.7 NKS financing

The NKS funding is granted for one year at a time. Generally, an activity will not receive more than 600 kDKK per year from NKS. The first 50% of the contribution is paid when an activity is started and the rest 50% when the final results of one year's work are available. The first part of the funding can be invoiced when a contract has been made between NKS and the activity leader.

1.8 Working language

The main working language in NKS is English. Applications for NKS funding as well as final reports and other material should be submitted in English. However, each working group determines its own language for meetings.

1.9 How do I apply?

It is up to the applicants themselves to find collaboration partners in the Nordic countries. The programme managers can help with getting into contact with Nordic organisations. NKS seminars are good places for networking. More information on ongoing research and all the published reports are available on the NKS website.

NKS funding is announced in the annual Call for Proposals. It is usually organised in September - October. All the necessary information, material and instructions are distributed on the NKS website. The Call for Proposals is also announced in the NKS electronic newsletter. The applicant is requested to fill in an application form. A voluntary annexe with further details about the proposal

may also be handed in. Detailed instructions on how to fill in the application form will be available when the Call for Proposal opens. The applicant is encouraged to read these instructions carefully. 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 organisations. In other words, the participants are expected to put in the same amount of money in the project as they are applying from NKS. These contributions may be work hours, travel expenses, etc. and should be clearly specified in the proposal form.

Please note that all funding by NKS includes possible VAT

1.12 What happens next

Proposals received before deadline are evaluated against the requirements by the NKS programme managers. Projects fulfilling these requirements are then evaluated against the criteria in section 1.5by the NKS board members. The board members have the right to use the help of external experts in the evaluation process if needed. Each proposal will be given marks based on how well the proposal fulfils the NKS criteria. Based on the evaluation results and the available budget, the programme managers make a suggestion for the next year's NKS-R and NKS-B programme. The suggestions are discussed at the January board meeting and the final decision of successful applicants is made by the board. The programme managers inform the applicants of the outcome as soon as possible after the board meeting.

1.13 Useful links for applicants

NKS webpage
Information about NKS
Owners and supporting financiers of NKS
The NKS-B programme
The NKS-R programme
Information about the Call for Proposals, NKS-B programme
Information about the Call for Proposals, NKS-R programme
NKS Seminars
NKS Reports
Travel support for young scientists: NKS-B, NKS-R

2 INFORMATION FOR ACTIVITY LEADERS

2.1 Contract

The Activity Leader will shortly after the Board's grant decision receive a contract template from the manager of the relevant NKS Programme, which is to be filled in with information on the activity deliverables or stages of work to be done, *always* including the submission of a final activity report (normally by the end of the funding year). In the contract template, the Activity Leader must also include a budget for each of the various activity partners, in line with the Board's decision. The contract is valid when signed by an authorised representative of the Activity Leader's organisation and by the Programme Manager. The NKS Programme Manager will have provided the contract template with a reference number (format: AFT/{R or B}({year}) {serial number}). This reference number is the identifier of the activity, and must be stated in all official management documents concerning the project (contracts, invoices, etc.). Contracts are generally for one year's work, and further continuation of activities is subject to submission and approval of a new proposal.

2.2 Invoices

When the contract is duly signed by both parties, the Activity Leader should inform the participants that they can invoice NKS for 50 % of their total contractual amount. When the work has been completed and the final report of the activity has been approved by the Programme Manager, the Activity Leader should inform the participants that NKS can be invoiced for the remaining 50 % of the amount. All invoices are to be addressed to the NKS Secretariat, but mailed to the relevant Programme Manager (NKS-R or NKS-B).

2.3 Activity progress reporting and communication

If deviations are foreseen from the agreed activity work schedule, the Activity Leader must immediately notify the Programme Manager so that any problems may be solved and contingency plans implemented if necessary. On request, the Activity Leader is also obliged to inform the Programme Manager of the state of progress at various stages of the activity.

2.4 Progress documentation if applying for continued funding

If participants in an activity wish to apply for funding for continuation of the activity, they need to document significant progress with the ongoing work (e.g., in relation to declared milestones and deliverables) in connection with the application for continuation.

2.5 Advertisement of dissemination activities

Events like seminars, workshops, courses and exercises connected to NKS activities need to be advertised timely and efficiently to be successful. NKS Programme Managers can help Activity Leaders in advertising these, e.g., through NewsFlashes sent to subscriber lists and posted on the NKS internet site http://www.nks.org/en/news/subscribe_to_our_newsletter/. It is however the responsibility of the Activity Leader and partners to plan and execute all aspects of the activities. Seminars should generally be open and not held exclusively for a closed circle of participants.

2.6 Travel support for dissemination activities

NKS particularly encourages participation of young scientists in NKS events to maintain a high level of competence in the longer perspective, and can offer travel support for this purpose

(http://www.nks.org/en/nksr/travel_assistance/). All other costs for NKS in connection with NKS activities are to be covered by the amount approved in the contract.

2.7 Final reporting of the activity

All NKS activities, regardless of their nature, must produce a final report that should be in the standardised NKS report format (see template/instructions: report template). **Please note**, that where an activity is anticipated to continue for more than one year, a final report is expected to be delivered after each year of the activity as funding cannot be guaranteed for continuing activities. Note that Activity Leaders must also supply a filled-in bibliographic datasheet (http://www.nks.org/en/this_is_nks/administration/) together with the final report.

Final reports from research activities or exercises aimed at filling knowledge gaps or developing methodologies should be in line with standards expected for scientific publications. Final reports from exercise activities in the form of intercomparisons or proficiency tests should seek to address any discrepancies or problems highlighted by the exercise, to increase knowledge and competencies where necessary. Final reports from seminar or workshop activities should contain extended abstracts from each presenter as well as a final overview of any discussions and conclusions. Presentation slides should not be presented in final reports. Final reports for educational and training courses should contain all course documents presented as well as feedback from participants. The conclusion of any NKS activity (and thus the final payment) is subject to the approval of the final report by the Programme Manager. In addition to the final report, activity participants are urged to disseminate activity results (with due credit to NKS) in scientific journal articles as well as at conferences, seminars and workshops. The Programme Manager in charge of the activity should be notified of any dissemination efforts.

The final report can be a paper and electronic report, or only an electronic one, but in both cases the report will be formally registered at the NKS and through the international library network. Printing costs of modest paper reports can be covered centrally by NKS (there is no need to use the activity funding for this), but printing of more sophisticated reports (e.g. thick reports using colour figures) may need to be included in the budget of the activity. Information about possible printing costs can be obtained from the NKS Secretariat.

2.8 Internet hosting of NKS activity material

All final reports of NKS activities are hosted on the NKS internet site (http://www.nks.org/en/nks_reports/). In connection with NKS events like seminars and workshops it is encouraged that the Activity Leader seeks the permission of the participants to publish presentations (slides) on the NKS internet site (http://www.nks.org/en/seminars/presentations/presentations.htm). Also information on other available software (e.g., as downloads) or hardware generated by NKS activities can be hosted on the NKS internet site (http://www.nks.org/en/nksb/supporting_material/). For further information contact the relevant Programme Manager.

NKS(17)3
2017-05-22
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Nordic nuclear safety research

NKS Administrative Handbook

Introduction

This is the NKS Administrative Handbook. The Handbook is aimed at the coordination group for internal programme use. The Handbook describes the most important administrative functions and procedures within the programme. The overall objective is to document the procedures of NKS so that continuation can be maintained. It is also the objective 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, you find the general presentations of NKS on http://www.nks.org/en/this_is_nks/ and the pamphlet “nks”.

Content:

10 NKS websites

11 NewsLetters

12 Areas of responsibility and work

13 The NKS Calendar Year

Attachments

1. Bibliographic data sheet
2. Example of NKS report front page
3. Information on seminars
4. NKS agreement with programme Managers' organisations

4.1 Attachment to Programme Manager agreement

5. Practical information about call for proposals
6. Contract check list
7. Areas of responsibility and work
8. The NKS Calendar year

1. **Working language**
   The NKS working language is English.

2. **Reporting**
   Currently, NKS is running two programmes/major activities: the R (reactor safety) Programme and the B (emergency preparedness) Programme. It is given high priority that the activity reporting reaches the largest number of stakeholders possible. Reporting on the activities takes the form of final reports, technical reports and status reports made by the Programme Managers for the Board. The Programme Managers determine the form in which the activities are to be finally reported. All reports must be submitted in appropriate electronic format by the author to the Programme Manager, who will on receipt of the report ask the Activity Leader if the activity group has plans to publish (part of) the work in journal papers, and it might be helpful to this process to postpone publication of the NKS report until the journal papers have been published. If the NKS report publication is postponed, an agreement must be made that the Activity Leader informs the Programme Manager immediately when the journal papers are published, so that the NKS report publication is delayed as little as possible. It is the responsibility of the Programme Manager to approve the report and forward it to the secretariat if the standard is judged to be acceptable.
   A bibliographic data sheet must be filled in by the author and submitted together with the report (see Attachment 1).
   All reports being published under the auspices of NKS should contain an acknowledgement by NKS of the financing and participating organisations/persons. This 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 participating organisations must be set clearly on the title sheet.

All reports being published under the auspices of NKS must contain a disclaimer, which may be worded as follows:

Disclaimer:
The views expressed in this document remain the responsibility of the author(s) 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 this report.

2.1 Final activity reports

- All activities must culminate in a suitable final report.
- For major activities a separate final report must be published.
- The publication of the final report and a number of the activity's technical reports in appropriate media must be considered (primarily the NKS website). During the programme, the Programme Manager should therefore store all relevant contributions to allow such publications.

A general guide:

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. The target group should be both as large and international as possible.

Language and wording
The report must be written in English and include a summary. The report should be written in clear language. If needed reports 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 understandable and of high (graphic) quality.

Library routines
Reports are provided with an ISBN number by the NKS Secretariat. The activity manager is responsible for ensuring that the author completes the bibliographic data sheet (Attachment 1).

Printing and international distribution
If a report is to be printed, the Secretariat will assist in this process. A print-ready manuscript must be submitted to the Secretariat.
Special distribution lists must be prepared for each report. The Programme Manager should prepare distribution lists for stakeholders 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
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 any 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 magazines which should also provide information on where the reports can be found.

2.2 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 below). The report should be given an NKS front page (see Attachment 2). The Programme Manager should approve the report.
All reports must include a bibliographic data sheet (Attachment 1) which is to be completed by the author.
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 the 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.

2.3 Status 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. Numbering and layout of NKS documents, reports and contracts

3.1 The numbering system
All final and technical reports must be published in a common, numbered series. Other relevant documents like evaluations, history documents, etc. will also be published in this 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 agendas, minutes, 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(12)2. Joint agreements and contracts relating to Programme Managers, Secretariat, accounting, etc. are numbered by the Secretariat, e.g. NKS/AFT(12)3.

R and B Programme contracts with participating organisations are to be numbered by the respective Programme Manager, e.g. NKS/AFT/B(12)4. Other documents are not covered by the numbering system, but should be carrying the NKS logo, which can be downloaded from http://www.nks.org/en/this_is_nks/administration/nks_logo_download.htm.

3.2 Layout and logo

As mentioned NKS's logo can be found on the NKS website http://www.nks.org/en/this_is_nks/administration/nks_logo_download.htm. It should be used where practically possible. Only the official NKS logo may be used. The NKS Board has decided that Arial should be used as the title font. A green cover may only be used for publications/documents numbered by the Secretariat – please contact the Secretariat.

Reports – a standard report front page must be used (see Attachment 2). This will be provided by the Secretariat and can be placed as an additional front page in reports being published in the institutions' own series of reports.

4. Meetings and minutes

4.1 Meetings

The owners meet as required. Board meetings are called by the Chairman. The Programme Managers and the Secretariat 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 in May or June).

Coordination meetings with participation of the Chairman, the Programme Managers and the Secretariat are usually held twice a year in November/December and April/May. Agenda proposal is sent out by the Secretariat. The main objects for these meetings are budget and activity proposals for the Board in November/December and activity status and finalisation of last year's accounts in April/May.

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.

4.2 Minutes

A notetaker from the Secretariat is appointed to take the minutes of the Board meetings. The minutes are sent to the members of the Board by e-mail no later than two weeks after the meeting, and the members of the Board should then comment on the minutes within another two weeks. Based on the comments, amendments to the draft are prepared by the Chairman and the notetaker, if needed. A silent procedure of two 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. The Board will be informed by the Secretariat when the draft has been uploaded. "Draft" will be erased, when the Board approves the minutes during the following meeting. 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 the participants for approval.
For programme meetings a secretary can be appointed to take the minutes and distribute them to participants.

5. Seminars, activity 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-Nordic 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, Nordic safety authorities and other stakeholders who are not themselves involved in the activities/programme.

Practical questions
Suitable 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.

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. 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 3).

6. Administration and financial functions

6.1 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.

In practice sign off's of scanned printed versions sent by e-mail to the Secretariat of the mentioned approved invoices, contracts etc. are sufficient. The Secretariat will archieve prints of these as well as the accompanying e-mails attached to these.

6.2 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.

6.3 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 4. The cooperation agreement should be described in detail in an attachment to the agreement (Attachment 4.1). NKS's Chairman must be informed in due 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.

6.4 New activities
Proposals for new activities are presented to the Programme Managers, usually in conjunction with the *Call for Proposals* (see Attachment 5 and www.nks.org). Proposals are assessed by the Programme Managers and Board members. The Programme Manager recommends them to the Board at its January meeting 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.

6.5 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 6.5. 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 6). 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 of the NKS Administrative Handbook.
The Programme Manager must either submit a hard copy of the signed contract to the Secretariat or file a hard copy and submit a copy 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
- 50% when work has been finally 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. The NKS Secretariat provides the relevant documentation to make this reconciliation possible.

6.6 Services in kind and other contributions

Reporting
In connection with annual accounts reporting the Programme Managers each year report the amount of external funding received for the activities. An estimate is reported to the Secretariat, and this estimate is announced in the NKS annual financial statement under review of the year.

6.7 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 the Nordic Countries. 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.

6.8 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.

6.9 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
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.

6.10 Organisational registration, Invoices and VAT

NKS is registered as an association with a Danish CVR (Det Centrale Virksomhedsregister) number. This registration must be renewed every three years.

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

7. 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.

7.1 Transfer of funds

NKS has accounts in Denmark, Finland, Norway and Sweden. For Iceland, the Danish account is used. 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.

7.2 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 the 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.

7.3 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.

Determination of the budget for the following year takes place as decided by the Board in January 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 the reserves and be allocated by the Board.

7.4 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).*

Auditor's reports and annual accounts are discussed by the Board and approved by the owners. The original accounts and the long-form audit reports are kept by the NKS Secretariat.

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

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 by the Secretariat and the Programme Managers 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.

11. NewsLetters

NewsLetters 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.

12. Areas of responsibility and work

The division of areas of responsibility and duties between NKS Owners, Board, Chairman, Secretariat and Programme Managers is described in Attachment 7.

13. The NKS Calendar Year

For reasons of overview and in order to facilitate continuation the main procedures and routines of NKS have been described in Attachment 8.

Attachment 1

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 4041, e-mail nks@nks.org, www.nks.org.

Attachment 2

NKS-261
ISBN 978-87-7893-333-1

Guidelines for reliability analysis of digital systems in PSA context - Phase 2 Status Report

Stefan Authén (1)
Johan Gustafsson (2)
Jan-Erik Holmberg (3)

1. Risk Pilot AB, Sweden
2. Royal Institute of Technology, Sweden
3. VTT, Finland

February 2012

Attachment 3

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 4

NKS/AFT(XX)X

Agreement

between XX (hereinafter called XX) and Nordic Nuclear Safety Research (hereinafter called NKS) for the period 1 January – 31 December XX

XX shall hereby undertake management responsibility for the NKS R/B 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 she/he 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 attachment 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.

Fortum certifies that XX has accepted the job as programme manager for the NKS R/B Programme and that she/he is able to work on the R/B Programme for approximately 50% of a full-time position. The cost to NKS for her/his 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 of NKS.

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 January 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 attachment.

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

Attachment 4.1

Attachment to agreement NKS/AFT(XX)X:

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

The programme manager must in 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 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 her/his own travels within the Nordic countries within a set budget frame. 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.

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

Attachment 5

Practical information about call for proposals

This attachment aims to describe and explain how a Call for Proposals (CfP) 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 starts with the coordination meeting which is usually held in April / May before the May / June Board meeting. The timeframe for the CfP is determined at the April / May coordination meeting. The usual start date falls in the end of August or the beginning of September with the final application deadline in mid-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 coordination meeting in November / December which takes place before the January 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.

As soon as possible after the January Board meeting contracts are prepared and signed with the parties and coordinators concerned.

Attachment 6

Checklist for contracts, agreements etc.

All contracts / agreements should be written on the programme manager'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 programme 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 programme manager and the contracting party.

_____	_____
NKS Programme Manager	The contracting party

Attachment 7

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, participates in Board meetings and takes minutes at these 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.
- Requires 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) are 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.
- 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 and participate in Board meetings.
- 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 8

The NKS Calendar Year

January: Board meeting early January with status reports from the programmes – the Board approves the new year's activities and budget. – A NewsLetter is published approximately one week before the Board meeting, and a NewsFlash is published approximately one week after the meeting.

January/February: New programme activity agreements are signed, and the new activities start. End and start of NKS's fiscal year.

February/March/April: Preparation of last year's accounts.

March/April: A NewsFlash presentation of new programme activities including reports, seminars etc.

April/May: Coordination meeting with follow-up after the January Board meeting and preparation and planning of the upcoming May/June Board meeting and programme status reports.

May/June: Board meeting with status reports from the programmes and presentation and approval of last year's accounts. Plans are made for this year's call for proposals (CfP). – A NewsLetter is published approximately one week before the Board meeting, and a NewsFlash is published approximately one week after the meeting.

August/September: CfP for next year's activities is started with a combined website and NewsFlash release.

October: deadline for CfP.

October/November: Evaluation of new proposals.

November/December: Coordination meeting with preparation of the January Board meeting, programme status reports, new proposals/activities, new budget etc.

NKS-R STATUS REPORT

Christian Linde
NKS-R Programme Manager
May 2017

Table of contents

Appendices

A) "STATUS REPORT OF NKS-SPARC PROJECT - Scenarios and Phenomena Affecting Risk of Containment Failure and Release Characteristics", May 2017 – Full report May 15, 2017
B) "Status report for Project: WRANC", May 2017 – Full report

1 Overall status summary

This report provides a short overview of the current status of the NKS-R programme.

Since the last NKS board meeting in January, nine final reports from five of the eight NKS-R activities from CfP 2016 have been published on the NKS website.

Nine out of eleven contracts have been signed for the seven activities from CfP 2017. The process for the remaining two contracts from COPSAR and SPARC is expected to be completed in June.

All activities from CfP 2015 and earlier are completed. The publication issue related to the ATR-2015 activity that appeared in the end of 2016 has been resolved. The partners of ATR-2015 will resubmit a revised version of their final report with a link to published material.

1.1 Published NKS reports

The following reports have been published within the NKS reports series since the last board meeting in January. All the reported work was performed in 2016.

Report nr	Project	Title	Published
NKS-381	SC_AIM	*Safety Culture Assurance and Improvement Methods in Complex Projects – Intermediate Report from the NKS-R SC_AIM*	25 Jan 2017
NKS-382	COPSAR	*Sparger Tests in PPOOLEX on the Behaviour of Thermocline*	17 Mar 2017
NKS-383	COPSAR	*Mixing Tests with an RHR Nozzle in PPOOLEX*	17 Mar 2017
NKS-384	COPSAR	*Preliminary Spray Tests in PPOOLEX*	17 Mar 2017
NKS-385	BREDA	*Barsebäck as Research and Development Platform, Extraction and Analysis of Reactor Pressure Vessel Material*	17 Mar 2017
NKS-386	L3PSA	*Addressing off-site consequence criteria using Level 3 PSA*	27 Mar 2017
NKS-387	HYBRID	*Development of a hybrid neutron transport solver in 2 energy groups*	25 Apr 2017
NKS-388	HYBRID	*Data and visualization solutions for HYBRID core simulation method*	27 Apr 2017
NKS-389	COPSAR	*Simulation of PPOOLEX stratification and mixing experiment SPA-T1*	27 Apr 2017

1.2 Seminars and publications

Project	Seminar date
L3PSA	Final seminar, L3PSA 2016, was held on 14th of February 2017.
NORDEC	Workshop on challenges and opportunities for improving Nordic nuclear decommissioning, 20-21 November 2017, Halden, Norway
SC_AIM	Three researcher workshops on the following topics: *a) How to build an adaptive safety culture in the nuclear industry?* (28-29 March, 2017) *b) Safety culture improvement and assurance methods* (3-4 May, 2017) *c) Safety culture methods and their underlying assumptions in the context of safety paradigms* (21-22 June, 2017)
FIREBAN	Workshop for PRA Integration in Q4 2018.

Project	Publications
ATR-2015	Kärkelä, T.; Kajan, I.; Tapper, U.; Auvinen, A.; Ekberg, C. *Progress in Nuclear Energy*, Vol. 99, **2017**, 38–48.
SPARC	1. Dmitry Grishchenko, Simone Basso, Pavel Kudinov, "Development of a surrogate model for analysis of ex-vessel steam explosion in Nordic type BWRs," Nuclear Engineering and Design, Volume 310, 15 December 2016, Pages 311-327, 2016. 2. Basso S., Konovalenko A., and Kudinov P., "Preliminary Probabilistic Risk Analysis of Debris Bed Coolability for Nordic BWRs Under Severe Accident Conditions," Nuclear Engineering and Design, Submitted 2017. 3. Galushin S. and Kudinov P., "Analysis of Core Degradation and Relocation Phenomena and Scenarios in a Nordic-type BWR," Nuclear Engineering and Design, Volume 310, 15 December 2016, Pages 125–141, 2016. 4. Kudinov P., Grishchenko D., Konovalenko A., Karbojian A. "Premixing and Steam Explosion Phenomena in the Tests with Stratified Melt-Coolant Configuration and Binary Oxdic Melt Simulant Materials," Nuclear Engineering and Design, Volume 314, Pages 1-338 (1 April 2017). 5. L. Manickam, P. Kudinov, W.M. Ma, S. Bechta and D. Gishchenko, "On the influence of subcooling and melt jet parameters on debris formation," Nuclear Engineering and Design 309: 265-276, 2016. PhD Dissertations: • Viet-Anh Phung, "Input Calibration, Code Validation and Surrogate Model Development for Analysis of Two-phase Circulation Instability and Core Relocation Phenomena," KTH, March, 2017. • Simone Basso, "Particulate Debris Spreading and Coolability," KTH, April, 2017.

1.3 Young scientist travel support

Two requests have been received from Chalmers students presenting at the 18th biennial meeting on Reactor Physics in the Nordic Countries (RPNC-2017), hosted by DTU Nutech, Risø on May 8-9, 2017.

- Klas Jareteg (PhD student): *"Fine-mesh multiphysics of LWRs: two-phase flow challenges and opportunities"*
- Huaiqian Yi (MSc student): *"Sensitivity analysis in reactor noise simulations"*

The total request is ca 8000 DKK.

2 Summary and status for activities initiated in 2016

Eight activities were initiated in 2016. Three of the activities were continuing activities and five were new. Nine final reports from five of the eight NKS-R activities from CfP 2016 have been published on the NKS website. Four activities are completed and one activity has submitted two out of three reports. A draft report was received from one activity. From two activities no reports have been received.

An overview of the status of the 2016 NKS-R activities is presented below in Table 1.

Table 1. NKS-R 2016 activities

Activity	Title	First invoice	Second invoice	Report number	Status
ADdGround	*Modelling as a tool to augment ground motion data in regions of diffuse seismicity*	3/6	-	-	a)
BREDA-RPV	*Barsebäck RPV trepan*	x	x	NKS-385	Done
COPSAR	*Containment Pressure Suppression Systems Analysis for Boiling Water Reactors*	x	2/3	NKS-382 NKS-383 NKS-384 NKS-389	b)
FIREBAN	*Determination of fire barriers's reliability for fire risk assessment in NPP*	2/5	-	-	c)
HYBRID	*Development of hybrid neutron transport methods and data visualization tools*	1/2	-	NKS-387 NKS-388	Done
L3PSA	*Addressing off-site consequence criteria using Level 3 PSA*	x	3/5	NKS-386	Done
SC_AIM	*Safety culture assurance and improvement methods in complex projects*	x	1/2	NKS-381	Done
SPARC	*Scenarios and Phenomena Affecting Risk of Containment Failure and Release Characteristics*	x	-	-	d)

a) **ADdGround –** Delayed reporting announced on Jan 26. New request for update sent on April 18.
b) **COPSAR –** Two partners out of three are done. Final report from the third partner will be delivered in June.
c) **FIREBAN –** Draft report received on May 16.
d) **SPARC –** Final report will be delivered in mid-June.

2.1 ADdGround

Modelling as a tool to augment ground motion data in regions of diffuse seismicity

Research Area: *Risk Analysis*

The technical aim of the ADdGROUND project is to build new capabilities in earthquake source modelling for ground motion simulations. The scarcity of empirical observations of near-field ground motions from large magnitude earthquakes in Fennoscandia has been an impediment for deeper understanding of the possible earthquake loading scenarios on nuclear installations, even if empirical data has been exhaustively analysed. With recent advances in computational methods, the opportunity exists for numerical models to give realistic estimates of earthquake loads. In addition to the technical outcome, the ADdGROUND project also aims to establish and maintain a network

of experts focused on diffuse seismicity areas of the Nordic Countries, and further enhance the cooperation between VTT and Uppsala University in the area of earthquake source modelling. The project outcomes will support STUK and SSM, providing background information for the safety assessments of nuclear plants, but are also relevant for nuclear repositories.

Activity leader: Ludovic Fülöp, VTT Technical Research Centre of Finland.
Funded organizations: VTT, SEI, ÅFC, AAU, GEUS, UU

Funding: 500 kDKK

Status: Delayed reporting announced on Jan 26. New request for update sent on April 18.

2.2 BREDA-RPV

Barsebäck RPV trepan

Research Area: *Plant life management and extension*

Studies of mechanical and microstructural properties of Irradiated Low Alloy Steel trepan samples from the Reactor pressure vessel wall of Barsebäck 2 (BREDA-RPV).

Irradiation induced ageing of the reactor pressure vessel (RPV) steel is closely monitored in specified ageing management programs called surveillance programs. These consist of a number of capsules positioned inside the RPV to allow for accelerated irradiation of the RPV material to predict the evolution of the mechanical properties of the material as a function of neutron dose. The closed Barsebäck 2 reactor gives an opportunity to harvest samples from the aged reactor pressure vessel (RPV).

Activity leader: Pål Efsing, Royal Institute of Technology (KTH)

Funded organizations: KTH, VTT, Chalmers

Funding: 400 kDKK

Status: *Completed*

2.2.1 Final report NKS-385

Report Number: NKS-385 (ISBN 978-87-7893-471-0)

Report Title*: Barsebäck as Research and Development Platform, Extraction and Analysis of Reactor Pressure Vessel Material*

Abstract:
As part of the NKS-R program, VTT, Chalmers and KTH has performed a baseline study to prepare for a test program to analyze the as aged material properties of the retired reactor pressure vessel, RPV, from Barsebäck unit 2. The project started at July 1st, 2016. The initial activities focused on mapping of possibilities for future work between VTT, Chalmers and KTH, liason activities with Vattenfall to discuss extraction of the test material from the Barsebäck plant and collection of material for the base line testing. The group has collaboratively prepared an extraction outline to give the basis for further discussions with the Swedish utilities regarding the materials extraction scheme and proposed amounts of materials and positions in the RPV. The work at Chalmers University focused on base-line high resolution atom probe tomography, APT, testing on un-irradiated material as well as sample materials irradiated in a test reactor. In addition to this some samples of thermally aged material was included to visualize the features that develops during both types of ageing. VTT has performed a base-line testing utilizing miniature fracture toughness testing samples of un-irradiated RPV material obtained from the original tests of the RPV of Barsebäck 2. The actual retrieval of materials from Barsebäck, is foreseen to occur in 2018 and -19. The material harvesting is outside the scope of the research oriented program that was supported in 2016. The work has been supported from both SSM and SKC in Sweden and by the Finnish nuclear safety program, the SAFIR-program. The main outcome so far apart from the actual data that has been produced and the proposed cutting scheme for materials retrieval, is the fact that the work enhances the collaboration in this technology driven area between two Swedish technical universities KTH and CTH and Aalto University in Finland, and the Finnish research institute VTT. In addition to this, it is functioning as a facilitator for contacts between the research driven academic world, safety and operability driven Finnish and Swedish nuclear operating companies and the Finnish and Swedish nuclear safety authorities.

Keywords: Low alloy steel, irradiation effects, fracture toughness, ductile to brittle transition temperature, constraint effects, high resolution microscopy

2.3 COPSAR

Containment Pressure Suppression Systems Analysis for Boiling Water Reactors

Research Area: Thermal Hydraulics

Thermal hydraulics experiments on the behaviour of a safety relief sparger (SRV) and a containment spray system are carried out at the PPOOLEX facility at Lappeenranta University of Technology (LUT). The effectiveness of mixing a thermally stratified water pool due to injection through a sparger is studied. Modelling work is done at VTT Technical Research Centre of Finland Ltd (VTT) and at Kungliga Tekniska Högskolan (KTH).

Activity leader: Markku Puustinen, Lappeenranta University of Technology (LUT)

Funded organizations: LUT, VTT, KTH

Funding: 500 kDKK

Status: Two partners out of three are done. Final report from the third partner will be delivered in June.

2.3.1 Final report NKS-382

***Report Number**:* NKS-382 (ISBN 978-87-7893-468-0)

***Report Title**: Sparger Tests in PPOOLEX on the Behaviour of Thermocline*

***Abstract**:*
This report summarizes the results of the two sparger pipe tests (SPA-T8R and SPA-T9) carried out in the PPOOLEX facility at LUT in 2016. Steam was blown through the vertical DN65 sparger type blowdown pipe to the condensation pool filled with sub-cooled water. Two different flow conditions were tested. Flow was either through all the 32 injection holes at the sparger head or just through eight holes in the bottom row. The main objective of the tests was to obtain data for the development of the EMS and EHS models to be implemented in GOTHIC code by KTH. KTH plans to extend the models to cover also situations where steam injection into the pool is via a sparger pipe. The test parameters were selected by KTH on the basis of pre-test simulations and analysis of the results of the earlier sparger tests in PPOOLEX. Particularly the behaviour of the thermocline between the cold and warm water volumes was of interest. For this purpose also PIV measurements were tried during the tests. In SPA-T8R, where flow was via 32 injection holes, the thermocline seemed to be around the elevation of 670 mm at the end of the stratification phase just as predicted by the pre-test simulations. The thermocline moved downwards as the erosion process progressed. The prevailing mixing mechanism during the final mixing phase was also erosion rather than internal circulation. In SPA-T9, where flow was via eight injection holes, the thermocline was at first at a higher elevation than in SPA-T8R. It then started to shift downwards as the flow rate was increased in small steps. Complete mixing of the pool was achieved with the steam mass flow rate of 85 g/s. Erosion was again the prevailing mechanism in the mixing process. The few sequences with recognized flow patterns from the PIV measurements indicate that some kind of swirls could exist at the elevation of the thermocline. The flow direction just under the thermocline can also be opposite to that just above the thermocline. The somewhat chaotic nature of the investigated phenomenon creates problems when measuring with a slow-speed PIV system and therefore definitive conclusions on the detailed behaviour of the thermocline can’t be made. These tests in PPOOLEX verified that mixing of a thermally stratified water pool can happen through an erosion process instead of internal circulation if suitable flow conditions prevail.

Keywords: condensation pool, sparger, thermocline, mixing

2.3.2 Final report NKS-382

Report Number: NKS-383 (ISBN 978-87-7893-469-7)

***Report Title:** Mixing Tests with an RHR Nozzle in PPOOLEX*

Abstract:
This report summarizes the results of the RHR nozzle tests carried out in the PPOOLEX facility at LUT in 2016. The test facility is a closed stainless steel vessel divided into two compartments, drywell and wetwell. For the RHR nozzle tests the PPOOLEX facility was equipped with a model of an RHR nozzle and an associated water injection line. The main objective of the tests was to obtain additional data for the development of the EMS and EHS models to be implemented in GOTHIC code by KTH. Mixing of a thermally stratified pool with the help of water injection through an RHR nozzle was of special interest. Particularly the effects of nozzle orientation, ΔT in the pool, injection water temperature and injection water mass flow rate were studied. In the tests there were two stratification phases and two mixing phases. During the stratification phases two regions with clearly different water temperatures and a narrow thermocline region between them developed in the pool. When the target temperature difference between the bottom and the top layer of the pool had been reached the mixing process was initiated by starting water injection into the pool through the RHR nozzle. With the vertical orientation of the RHR nozzle mixing was otherwise successful but incomplete above the nozzle elevation. This was the case with both of the used water injection flow rates, 0.5 kg/s and 0.3 kg/s. Compete mixing was achieved with the horizontal orientation of the RHR nozzle by using a large injection flow rate (1.0-1.05 kg/s). The pool mixed in about 4000 seconds. With a 0.3 kg/s injection flow rate the water volume above the thermocline started to cool down as soon as the mixing phase started whereas below the thermocline the mixing process proceeded very slowly and only a small fraction of the bottom volume mixed completely before the test was terminated because the wetwell became full of water. These tests in PPOOLEX verified that orientation of an RHR nozzle plays an important role in the success of the mixing process of a thermally stratified pool. The nozzle injection flow rate, injection water temperature and ΔT in the pool have an effect on the mixing process but it is not as dominant as the nozzle orientation.

Keywords: condensation pool, RHR nozzle, mixing

2.3.3 Final report NKS-384

Report Number: NKS-384 (ISBN 978-87-7893-470-3)

Report Title: *Preliminary Spray Tests in PPOOLEX*

Abstract:
This report summarizes the results of the preliminary spray tests carried out in the PPOOLEX facility at LUT. The test facility is a closed stainless steel vessel divided into two compartments, drywell and wetwell. For the spray tests the facility was equipped with a model of a spray injection system with four nozzles. The main objective of the tests was to study interplay between suppression pool behaviour and the spray system operation. Particularly we were interested to find out if mixing of a thermally stratified pool with the help of spray injection from above is possible. An additional goal was to obtain data for improving simulation models related to spray operation in CFD and system codes as well as contribute to the development of the EMS and EHS models for sprays to be implemented in the GOTHIC code by KTH. In the first two tests the initial stratified situation was created by injecting first warm and then cold water from the tap into the wetwell. In the third test the stratified situation was created with the help of small steam injection through the model of the sparger pipe in PPOOLEX by starting from a cold state. In all three tests, the spray injection flow rate was the maximum available from the water supply system of the laboratory i.e.

about 128 l/min. When divided to the four spray nozzles it gives 32 l/min per nozzle. In the first two tests, mixing of the topmost layers of the pool was achieved easily. The initial temperature difference between the bottom and surface was 28 °C and 33 °, respectively. It can be speculated that the whole water volume could have been mixed if the tests had been continued for a longer period of time. In the third test, complete mixing of the initial 60 °C temperature difference between the pool bottom and the surface layer was achieved in about 4200 seconds as a result of internal circulation in the pool induced by the density difference between the cold spray water and warm pool water. The pool water level rose by 2 meters during the spray operation. These preliminary spray tests in PPOOLEX indicate that it might be possible to mix a stratified pool with the help of spray injection from above. If spray injection was continued long enough internal circulation developed and finally mixed the pool.

Keywords: condensation pool, spray, mixing

2.3.4 Final report NKS-389

Report Number: NKS-389 (ISBN 978-87-7893-475-8)

Report Title: *Simulation of PPOOLEX stratification and mixing experiment SPA-T1*

Abstract:
Thermal stratification of the pressure suppression pool of the PPOOLEX facility has been studied at Lappeenranta University of Technology in experiments, where steam was injected into water pool through a sparger. In the stratification phase of the experiment SPA-T1, steam was injected into the pool at a small mass flow rate of 30 g/s for time 13 650 s. Then the mass flow rate was increased to 123 g/s in order to mix the pool. In the present report, CFD calculation of the experiment SPA-T1 is presented. The stratification phase and the mixing phase of the experiment were calculated by using the ANSYS Fluent 16.2 CFD code. Single-phase calculation was performed, where the mass, momentum and enthalpy sources of the injected steam were added in front of the sparger holes. Comparison of the CFD calculation to the measurements shows that the simulation predicts the temperature trends over time rather well. However, during the long stratification phase the calculated mixing between the lower part and the upper part is too strong. This might be corrected by adding grid resolution in the density and velocity gradient layer near the injection. Due to the excessive mixing during the stratification phase the predicted thermal transient in the mixing phase is somewhat milder than in the experiments.

Keywords: BWR, pressure suppression pool, condensation pool, stratification, mixing, CFD, computational fluid dynamics

2.4 FIREBAN

Determination of fire barriers's reliability for fire risk assessment in NPP

Research Area: Risk Analysis

The scope of the project is to investigate and assess the reliability of fire barriers in NPP during realistic fire scenarios to support the plant-scale risk assessment. The objective is to establish data and methods to determine the conditional probabilities for failure of fire barrier. Statistics, literature review, calculation and specific unique designed fire tests are used as methods.

Activity leader: Patrick van Hees, Lund University

Funded organizations: LU, VTT, AAU, DBI, RAB

Funding: 450 kDKK

Status: Draft report received on May 16.

2.5 HYBRID

Development of hybrid neutron transport methods and data visualization tools

Research Area: Reactor physics

The modelling of neutron transport typically relies on two rather opposite approaches: the probabilistic approach, and the deterministic approach. The probabilistic approach or Monte Carlo approach relies on tracking the individual lives of neutrons, and requires a large computing power for nuclear reactors. The deterministic approach, on the other hand, is based upon fast running algorithms, that solve the problem at hand in only an approximate manner. The purpose of HYBRID is to combine both approaches in order to obtain fast running methods (thanks to the deterministic route) and accurate results (thanks to the probabilistic route).

Activity leader: Christophe Demazière, Chalmers University of Technology

Funded organizations: Chalmers, IFE

Funding: 500 kDKK

Status: *Completed*

2.5.1 Final report NKS-387

Report Number: NKS-387 (ISBN 978-87-7893-473-4)

Report Title: *Development of a hybrid neutron transport solver in 2 energy groups*

Abstract:
This project investigates the feasibility of performing reactor physics calculations for nuclear cores using a hybrid neutron transport methodology, by combining deterministic and probabilistic modelling techniques. In the presented implementation, a deterministic response matrix method was developed in Matlab. The necessary probabilities appearing in the response matrix method were estimated in advance using a probabilistic solver – the Monte Carlo code Serpent2. Ultimately, the hybrid framework will combine the advantages of the deterministic approach (fast running calculations) with the ones of the probabilistic approach (high flexibility in modelling any geometry and high accuracy). In the response matrix method, two grids are used: one fine grid for estimating the scalar neutron flux and a coarse grid for computing the neutron currents on this grid. Because of the large efforts developing a new computational framework represents and because such a developmental work is error-prone, this first phase of the project implemented and tested the hybrid framework on a system as simple as possible: a two-dimensional representation of a simplified BWR fuel assembly. Such a choice was governed by the necessity to lower the computational time and to have a tractable system during the developmental phase of the framework. The development of the hybrid route was demonstrated to be feasible, after some modifications of the Serpent2 code. Although promising, the solution computed by the framework was demonstrated to be not fully realistic. Additional investigations are necessary to identify the root cause of the observed deviations from the expected physical behaviour of the system.

Keywords: nuclear reactor calculations, neutron transport, deterministic methods, probabilistic methods, hybrid methods

2.5.2 Final report NKS-388

Report Number: NKS-388 (ISBN 978-87-7893-474-1)

Report Title*: Data and visualization solutions for HYBRID core simulation method*

Abstract:
The modelling of neutron transport typically relies on two rather opposite approaches: the probabilistic approach, and the deterministic approach. The purpose of the present project is to combine both approaches in order to obtain fast running methods (thanks to the deterministic route) and accurate results (thanks to the probabilistic route). This so-called hybrid method will result in larger amounts of high-fidelity data than previous solutions to this problem. Viewing, comparing and storing this data should utilize the latest in data handling technology, covering input generation, data storage and output visualization. This report summarizes work performed so far in analysing the data aspects of this problem. This data system will not only be required to interface correctly with the proposed HYBRID method but will also have to interact with the envisaged user organization. At this stage of the project, the organizations are research institutes and universities. In the future, they may be reactor operators, fuel vendors or even reactor construction companies. Even further in the future spent fuel disposal companies may require some parts of the data

solution. Considering these users we have proposed a list of requirements related to quality assurance, continuous development and aging management. This report makes a start at describing the data problem. Data types, uses and possible database configurations are discussed. Finally, some examples of different data structures are given and possible consequences investigated. The next project phase will focus on constructing and testing different data solutions and showing possible visualizations.

Keywords: Neutron Transport, Database, SQL, NoSQL, Big Data

2.6 L3PSA

Addressing off-site consequence criteria using Level 3 PSA

Research Area: Risk analysis and probabilistic methods

Level 3 PSA provides a tool to assess the risks to society posed by a nuclear plant, and could be useful in making objective decisions related to the off-site risks of nuclear facilities. The intention of this study was to further Nordic understanding of the potential of Level 3 PSA to determine the influences and impacts of off-site consequences, the effectiveness of off-site emergency response, and the potential contributions of improved upstream Level 1 and Level 2 PSA.

Activity leader: Andrew Wallin-Caldwell Lloyd's Register Consulting

Funded organizations: LRC, Risk Pilot, ÅF, Vattenfall AB, VTT

Funding: 140 kDKK

Status: *Completed*

2.6.1 Final report NKS-386

Report Number: NKS-386 (ISBN 978-87-7893-472-7)

Report Title: *Addressing off-site consequence criteria using Level 3 PSA*

Abstract:
The goal of this project is to further Nordic understanding of the potential for Level 3 PSA to determine the influences and impacts of off-site consequences, the effectiveness of off-site emergency response, and the potential contributions of improved upstream Level 1 and Level 2 PSAs. This report summarizes the developments from four years of work, but focuses on the finalization of a Nordic Level 3 PSA Guidance Document, which has been worked upon mainly during calendar years 2015 and 2016. Other activities that has been conducted, and provided valuable input to the Guidance Document, are an Industrial Survey, a study of potential Risk Metrics, a summary of Regulations & Standards, and two Pilot Studies (one Swedish and one Finnish). The main objective of the pilot studies was to gain practical experience that, together with insights from the other tasks included in the project, could be transferred to recommendations into a final guidance document. During the project, targeted discussions between consultancies, utilities, regulators, and insurance companies on the subject of Level 3 PSA have taken place and at the end of each years working period a seminar has been arranged. The working group has also been

engaged in international activities surrounding Level 3 PSA, i.e. the development of the IAEA Level 3 PSA TECDOC and the ANS/ASME Level 3 PSA Standard through the 2016 continuation of the project.

Keywords: PSA, PRA, Level 3 PSA, Probabilistic Consequence Analysis

2.7 SC_AIM

Safety culture assurance and improvement methods in complex projects

Research Area: *Organisational issues and safety culture*

Networks of companies typically carry out major projects in the nuclear industry. Current safety culture and safety management models and practices are largely focused on single organisations and it is far from clear how to apply them in the dynamically changing project networks. Traditional cultural approaches emphasize that it takes time and certain amount of continuity to create a culture, both of which are in short supply in projects with short time frames, diversity in both personnel and companies involved, and often a high personnel turnover.

Several issues remain unanswered, e.g., what should a safety culture improvement or assurance program be like in an "organization", which is actually a dynamic network of actors from different companies? How to utilize the concept of safety culture in network and project settings?

Activity leader: Elina Pietikäinen, VTT Technical Research Centre of Finland

Funded organizations: VTT, Vattenfall AB

Funding: 410 kDKK

Status: *Completed*

2.7.1 Final report NKS-381

Report Number: NKS-381 (ISBN 978-87-7893-467-3)

Report Title: *Safety Culture Assurance and Improvement Methods in Complex Projects – Intermediate Report from the NKS-R SC_AIM*

Abstract:
A good safety culture is an essential ingredient for ensuring safety in the nuclear industry. The predominant approaches for safety culture are based on the assumption of stable and relatively homogeneous organizations, which often does not apply to contemporary project-oriented and turbulent environments. This study aims to identify and specify safety culture assurance and improvement methods for project environments. A variety of approaches and practical methods for safety culture improvement was identified in the literature. Based on their apparent objectives, the methods were classified into the following groups: organizational structures, direct behavioural modification, interaction and communication, commitment and participation, training, promotion and selection. The literature review did not reveal methods intended specifically for project environments or guidelines for tailoring the existing ones to suit project environment. Further

review of the literature concerning project environments revealed a multitude of project-specific challenges and boundary conditions in the domains of time, team, task and context that can potentially influence safety culture assurance and improvement. Three empirical case studies in Nordic nuclear industry organizations were conducted. In the first case study, which focused on the use of safety culture ambassador group, it was found that this method can influence safety culture through multiple mechanisms and that the flexibility of this method can potentially rectify some of the challenges posed by project environment, or even benefit from them. Another case study focused on a safety-oriented project management seminar and showed the potential of this method in influencing safety culture through providing a forum for dialogue between different stakeholders. Finally, information exchange with experts provided additional insight into the current challenges and opportunities of safety culture work in projects. As a result of the theoretical and empirical work, a preliminary framework for evaluating the applicability of safety culture assurance and improvement methods was developed.

Keywords: Safety culture, project management, organizational change

2.8 SPARC

Scenarios and Phenomena Affecting Risk of Containment Failure and Release Characteristics

Research Area: *Severe Accidents*

A robust severe accident management strategy is paramount for minimizing the environmental impact in the case of a severe accident involving melting of a reactor core. Both physical phenomena (deterministic) and accident scenarios (stochastic) are sources of uncertainties in the assessment of effectiveness of the accident mitigation. Adequate approaches are necessary in order to address both deterministic (epistemic) and stochastic (aleatory) sources of uncertainty in a consistent manner.

Activity leader: Pavel Kudinov, Royal Institute of Technology (KTH)

Funded organizations: KTH, LRC, VTT

Funding: 600 kDKK

Status: Final report will be delivered in mid-June, see Appendix A for more details.

3 Summary and status for activities initiated in 2017

Seven activities were approved funding in CfP 2017. Five of these are continuing activities and two are new (NORDEC and WRANC). Nine out of eleven contracts have been signed. Contracts remain to be signed for one partner in COPSAR and one partner in SPARC. The process for these contracts is expected to be completed in June.

An overview of the 2016 NKS-R activities is presented below in Table 2.

A request for status updates of ongoing activities were sent to the Activity Leaders on April 25. The status of all activities are summarized in the sections below.

Additional details for two activities are available in Appendix A (SPARC) and B (WRANC).

Table 2. NKS-R 2017 activities

Activity	Partners	Contract sent	Contract received	First invoice	Funding
COPSAR	LUT	2017-01-26	2017-03-02	-	493
	KTH	2017-01-26	Expected May 31	-	
	VTT	2017-01-26	2017-04-06	-	
FIREBAN	LU + 4 partners	2017-01-27	2017-05-03	-	393
HYBRID	CTH + 1 partner	2017-01-30	2017-03-03	1 (2)	493
NORDEC	IFE + 8 partners	2017-01-26	2017-03-08	3 (9)	524
SC_AIM	VTT + 1 partner	2017-01-26	2017-03-16	1 (2)	279
SPARC	KTH	2017-02-08	Expected May 31	-	524
	VTT	2017-02-08	2017-05-29	-	
	LRC	2017-02-08	2017-05-30	-	
WRANC	Inspecta + 2 partners	2017-01-31	2017-03-09	1 (3)	393

3.1 COPSAR

Containment Pressure Suppression Systems Analysis for Boiling Water Reactors

Summary

Thermal hydraulics experiments on the behaviour of a safety relief sparger (SRV) and a containment spray system are carried out at the PPOOLEX facility at Lappeenranta University of Technology (LUT). The effectiveness of mixing a thermally stratified water pool due to injection through a sparger is studied. Modelling work is done at VTT Technical Research Centre of Finland Ltd (VTT) and at Kungliga Tekniska Högskolan (KTH).

Summary of the experimental work at LUT:

Efficiency of mixing a thermally stratified pool with the help of steam injection through a safety relief valve (SRV) sparger pipe or water injection through a residual heat removal (RHR) nozzle has been studied in tests carried out with the PPOOLEX facility in 2016. In 2017, the SRV sparger will be moved to the center of the pool and the submergence will be reduced from 1.8 to 1.5 m. This will allow developing a thicker stratified layer at the bottom and will contribute to the Effective Heat Source (EHS) and Effective Momentum Source (EMS) models based on the

Richardson scaling. A small-scale separate effect facility, where it is possible to measure directly the effective momentum induced by a steam injection through a single hole, will be designed and constructed. Tests with the facility will help to map the effective momentum of many condensation regimes. Closures for the EMS model development for spargers by KTH will be provided.

Wet well spray tests for studying the interplay between the suppression pool behavior and the spray system will continue. Mixing of a thermally stratified pool as a result of spray injection from above will be of interest. With the help of pre-test simulations done at VTT and KTH a representative test matrix, the initial thermal hydraulic state of the facility and the correct spray injection rate to be used can be determined.

Summary of the modelling work at VTT:

Pre-calculations will be performed with ANSYS Fluent for the small-scale separate effect facility, where steam will be injected through a single hole into water pool. The Euler-Euler method of Fluent with condensation model will be used. The effective momentum and heat sources generated by the steam injection into the water pool will be studied and later compared to the experimental results.

A spray experiment performed at PPOOLEX will be calculated with ANSYS Fluent. The water pool will be modelled with the Euler-Euler model of Fluent, where droplets will be described with the Discrete Particle Model (DPM). The effect of the spray droplets on the stratified pool will be calculated. The results will be compared to PPOOLEX experiment.

Summary of the modelling work at KTH (contract expected by May 31):

KTH will perform pre-test analysis and simulations for selection of operational regimes and test procedures, and post-test analysis and validation with EHS/EMS models implemented in GOTHIC against PPOOLEX tests. Further development of the EHS/EMS models for spargers and RHR nozzles will be pursued to simulate dynamics of the pool mixing and stratification. The models will be validated against respective separate effect tests.

Activity leader: Markku Puustinen, Lappeenranta University of Technology (LUT)

Funded organizations: LUT, VTT, KTH

Funding: 493 kDKK

Milestones
Lappeenranta University of Technology:

Milestones in October 2017:

1. The SRV sparger has been moved to the centre position in PPOOLEX.
2. A small scale separate effect test facility for direct measurement of momentum has been designed and constructed.
3. Wet well spray tests in PPOOLEX have been carried out.

Deliverables of LUT in 2017:

1. A SRV sparger test with the sparger in the centre of the pool.
2. A small scale separate effect facility for the direct measurement of effective momentum
3. Tests in the small scale separate effect facility with different condensation regimes
4. Wet well spray injection tests in PPOOLEX
5. Delivery of relevant experiment data to the simulation partners

VTT Technical Research Centre of Finland Ltd:

Milestones to be achieved by October 2017 are:

- Pre-calculation of small-scale separate effect test on condensation has been performed.
- The first CFD calculations of the spray effect on the stratification in the wet well have been performed.

Deliverables of the Contractor in 2017 are:

- Report on the CFD calculations of the condensation in the small-scale separate effect facility.
- Report on the CFD calculations of the spray effect on the stratification in the wet well.

Kungliga Tekniska Högskolan:

The milestones below are the expected deliverables based on the status update on May 15 (contract expected by May 31):

Deliverable 1: Pre-test analysis for selection of operational regimes and test procedures
Deliverable 2: Development of the EHS/EMS models
Deliverable 3: Post-test analysis and validation using GOTHIC and Fluent codes
Deliverable 4: Reporting

Status (May 15, 2017)
Work progressing according to plan. The update below was received on May 15.

Work at LUT, Markku Puustinen, Jani Laine, Antti Räsänen, Eetu Kotro, Lauri Pyy

Deliverable 1: A SRV sparger test with the sparger in the centre of the pool and with reduced submergence
The sparger test series in PPOOLEX will be completed in 2017 with the sparger first moved to an alternative position, center of the pool, and the submergence reduced from 1.8 to 1.5 m. Modifications needed to the PPOOLEX test facility and its instrumentation will be implemented as soon as KTH delivers a detailed suggestion. The test parameters will be decided together with KTH. The test will be carried out after the summer.

Deliverable 2: Construction of a small scale separate effect facility for the direct measurement of effective momentum
A small pool with transparent walls and a sparger pipe having a single injection hole will be designed and constructed. An updated design of the test facility will be received from KTH on week 20. The test facility will be constructed during the summer.

Deliverable 3: Tests in the small scale separate effect facility with different condensation regimes
Effective momentum will be evaluated with the help of a direct force measurement. High speed cameras will be used for recording condensation regimes and collapsing bubbles and high frequency pressure measurements for obtaining the detachment and collapse frequencies of the bubbles. The tests will help to map the effective momentum of many condensation regimes and hopefully will provide closures for the EMS model development for spargers by KTH. The tests will start after the summer when the construction of the test facility has been finished.

Deliverable 4: Wet well spray injection tests in PPOOLEX
Mixing of a thermally stratified pool with the help of spray injection from above will be studied. Test matrix is being developed on the basis of the preliminary spray tests in January 2017.

Deliverable 5: Delivery of relevant experiment data to the simulation partners
No activity.

Work at VTT, Timo Pättikangas and Ville Hovi

Deliverable 1: Report on the CFD calculations of the condensation in the small-scale separate effect facility
Pre-calculations are performed with ANSYS Fluent for the small-scale separate effect facility, where steam will be injected through a single orifice into water pool. The calculated condensation rate and penetration of the vapor jet into the pool is calculated and later compared to the experimental data.
New condensation models of ANSYS Fluent 18.0 have been tested for the pre-calculations of the small-scale separate effect facility. The Lee model and the Thermal Phase Change model of Fluent have been tested. The results have not so far been very promising. Therefore, the work will be continued with the condensation model implemented at VTT with User-Defined Functions of Fluent. Design of the test facility has been delayed at LUT, which affects the pre-calculations and achieving the Milestone in October.

Deliverable 2: Report on the CFD calculations of the spray effect on the stratification in the wet well
A spray experiment performed at PPOOLEX is calculated with ANSYS Fluent. The water pool is modelled with the Euler-Euler model of Fluent, where droplets are described with the Discrete

Particle Model (DPM). The effect of the spray droplets on the stratified pool is calculated. The possible deterioration of the thermal stratification of the pool is studied. The results will be compared to PPOOLEX experiment.
Preliminary wet well spray test SPR-T3 performed with the PPOOLEX facility is calculated. In the experiment, spray was injected from four nozzles into thermally stratified water pool. Simulation of mixing of the pool caused by the spray injection has been started.

Work at Royal Institute of Technology (KTH), Ignacio Gallego-Marcos, Walter Villanueva and Pavel Kudinov

Deliverable 1: Pre-test analysis for selection of operational regimes and test procedures
Design and test procedure of the separate effect facility has been proposed to LUT. The goal of this experiments is to measure the effective momentum induced by a steam injection in the oscillatory bubble and stable jet regimes. Sensitivity studies will be done on the steam mass flux, pool temperature, injection hole diameter, number of holes, and geometry of the hole (chamfer).

Deliverable 2: Development of the EHS/EMS models
EHS/EMS models for blowdown pipes have been extended to enable prediction of the pool behaviour during a prototypic LOCA transient using GOTHIC. The model estimates the condensation regime based on a new regime map, the effective momentum induced by chugging using new correlations, and allows computing non-uniform heat fluxes along the blowdown pipe walls. The model has been validated against the PPOOLEX MIX-04 experiment.

EHS/EMS models for spargers are under development in Fluent. The results show a large sensitivity on the flow structure and the effective momentum. Thus, the separate effect facility is needed to measure the effective momentum and reduce the uncertainty of the simulations.

Deliverable 3: Post-test analysis and validation using GOTHIC and Fluent codes
An in-depth analysis of the PPOOLEX and PANDA experiments with spargers has been performed. The results showed similar phenomena in PPOOLEX and PANDA in terms of steam jet condensation, and pool behaviour of stratification, erosion, and mixing. A correlation has been proposed to model the erosion velocity of the stratified layer as a function of the pool geometry and steam injection conditions. All of these observations have been used for the development of the EHS/EMS models for spargers.

Deliverable 4: Reporting
NKS report will be delivered in June.

3.2 FIREBAN

Determination of fire barriers's reliability for fire risk assessment in NPP

Summary
The scope of the project is to investigate and assess the reliability of fire barriers in NPP during realistic fire scenarios to support the plant-scale risk assessment. The objective is to establish data and methods to determine the conditional probabilities for failure of fire barrier. Statistics, literature review, calculation and specific unique designed fire tests will be used as methods. The next steps in the process are the final definition of criteria for reliability and also further calculation supported by fire tests.

Activity leader: Patrick van Hees, Lund University

Funded organizations: LU, VTT, AAU, DBI, RAB

Funding: 393 kDKK

Milestones

Tasks, milestones and deliverables until 2017-12-31

Risk-based acceptance criteria (MS1, included in D1)
Current state of the art for determination of reliability of fire barriers (MS2), First year report (D1)
Risk besign design curves for nuclear facilities (MS3)
Second Year report (D2)

Status (May 16, 2017)
Work progressing according to plan. The update below was received on May 16.

The project has now delivered it first year report. This includes an extra paper on sensitivity analysis which was produced in the end of 2016 but published early 2017. The report includes three publications of which one is a peer review paper.

The project group needed to discuss first the reduction of the budget as it had implications on the fire test program. This caused some delay in the activities and in the first year reporting. We have now signed the second year contract and it is foreseen that this will be solved in the second part of 2017. During June one of the reports in the first year report will be presented at the IAFSS conference in Lund as a poster.

The project group will meet during the IAFSS conference to discuss the progress and the test programme. No real technical problems are foreseen.

Apart from dissemination at the IAFSS conference (the largest conference on fire safety science in the world) also a workshop will be organised by VTT. Participants of the workshop are mainly from the NPP companies, Finnish authorities, and research organizations. One objective of the workshop is to create a roadmap for the Finnish Fire PRA development work.

3.3 HYBRID

Development of hybrid neutron transport methods and data visualization tools

Summary
The modelling of neutron transport typically relies on two rather opposite approaches: the probabilistic approach, and the deterministic approach. The probabilistic approach or Monte Carlo approach relies on tracking the individual lives of neutrons, and requires a large computing power for nuclear reactors. The deterministic approach, on the other hand, is based upon fast running algorithms, that solve the problem at hand in only an approximate manner.

The purpose of the present project is to combine both approaches in order to obtain fast running methods (thanks to the deterministic route) and accurate results (thanks to the probabilistic route). The so-called response matrix method was the method investigated in the first phase of the project undertaken in 2016 with NKS support. This method was originally derived in the early seventies in a pure deterministic sense. In the proposed project, the computation of the collision probabilities required for applying the method is carried out using a probabilistic solver instead.

The level of details of the simulations, and the approach allowing a direct computation of whole core problems produces a large-scale data set. There is however, a need to support rapid awareness of the complex 4D (3D + time) data-set for end users. This problem can be divided into;

a) Which data are necessary for situational awareness (power, flux, etc.)?
b) How should these data be visualized for rapid visual perception?
c) How can the visualization principles be implemented in a software application?

The outcome is enhanced visualization tools. This requires the construction of an adequate data management system with visualization capabilities. In sum, the technology is supporting the efficient development of reactor core simulations, useable first for research purposes by Chalmers, and later by commercial companies.

In 2017, the project will involve 2 MSc students under the supervision of senior scientists, and make use of the complementary expertise from Chalmers University of Technology (deterministic neutron transport), the Technical Research Centre of Finland - VTT (probabilistic neutron transport), and the Institute for Energy Technology - IFE (visualization tools).

Activity leader: Christophe Demazière, Chalmers University of Technology

Funded organizations: Chalmers, IFE

Funding: 493 kDKK

Milestones

Tasks	*Milestones*	*Deliverables*
Consolidation of the hybrid probabilistic/deterministic framework based on the work performed in 2016 for two-dimensional systems.	Assessment of the reliability of the hybrid solution as compared to the reference solution. Assessment of the influence of the boundary conditions applied in the coarse mesh modelling and in the corresponding computation of the probabilities. Estimation of the computational cost of the hybrid framework in relation to the cost of the full Monte-Carlo solution.	Short progress report (2-3 pages maximum) summarizing the work performed and the achieved milestones to be ready by October 31, 2017
Development of a benchmark between the developed method and a reference solution obtained entirely from Monte Carlo on a two-dimensional test case of small/medium size.		
Extension of the hybrid probabilistic/deterministic framework to three dimensions.	Assessment of the reliability of the hybrid solution as compared to the reference solution. Assessment of the influence of the boundary conditions applied in the coarse mesh modelling and in the corresponding computation of the probabilities. Estimation of the computational cost of the hybrid framework in relation to the cost of the full Monte-Carlo solution.	Short progress report (2-3 pages maximum) summarizing the work performed and the achieved milestones to be ready by December 31, 2017
Development of a benchmark between the developed method and a reference solution obtained entirely from Monte Carlo on a three-dimensional test case of small/medium size.		

Identify the criteria for selecting which data is suitable for visualisation in 4D (3D + time). Identifying the research-oriented principles for how to visualize the data-set.	Criteria for selecting variables suitable for visualization and examples of their use. A set of design-principles describing how to visualize the data set.	Short progress report (2-3 pages maximum) summarizing the work performed and the achieved milestones to be ready by September 30, 2017
Continue to develop problem analysis methodology. Apply this methodology to the current data structures proposed by Chalmers for the HYBRID project. Suggest a data-base architecture and demonstrate with practical examples. Demonstrate alternative methods of accessing the data as an aid to development. E.g connection of data base to Python or Matlab.	Updated report on data-architecture assessment methodology. Description and demonstration of a data-base and processing tools for HYBRID data showing a link to a general processing tool such as Python or Matlab.	Short progress report (2-3 pages maximum) summarizing the work performed and the achieved milestones to be ready by September 30, 2017
		Final report to be ready by January 31, 2018

Status (April 26, 2017)
No major deviations have been identified. The update below was received on April 26, 2017.

In summary, we are creating the conditions to have staff allocated to the project, but the actual work will not start before the summer.

For the data visualization part, IFE has started the process of finding an MSc student. There will be a presentation of the project at the Østfold University College next week. The MSc project will be starting after the summer vacation. Preliminary work by other IFE researchers are scheduled to start in the summer.

For the neutron hybrid solver, Chalmers is currently preparing the advertisement of a PhD position (the position will be mainly financed by a grant from the European Union). Nevertheless, we plan to have this PhD student working on the HYBRID project as well, as part of his/her "institutionstjäntgöring". This will hopefully create the conditions for continuity in the HYBRID project. The PhD position will start from September 1st, 2017.

3.4 NORDEC

Challenges and opportunities for improving Nordic nuclear decommissioning

Summary
Approaching large-scale nuclear decommissioning projects in the Nordic countries make it important for both regulators and operators to build new capabilities for handling up-coming challenges. Sweden and Finland both have a mixed legacy of nuclear sites, including plants and research reactors in different stages of operation or decommissioning, whereas in Denmark, some decommissioning projects have been completed for research reactors and others are well on the way to completion. In Norway, while no immediate decommissioning activities are foreseen, the existing decommissioning plans and regulations can be improved by means of the information and lessons learned from the other Nordic countries.

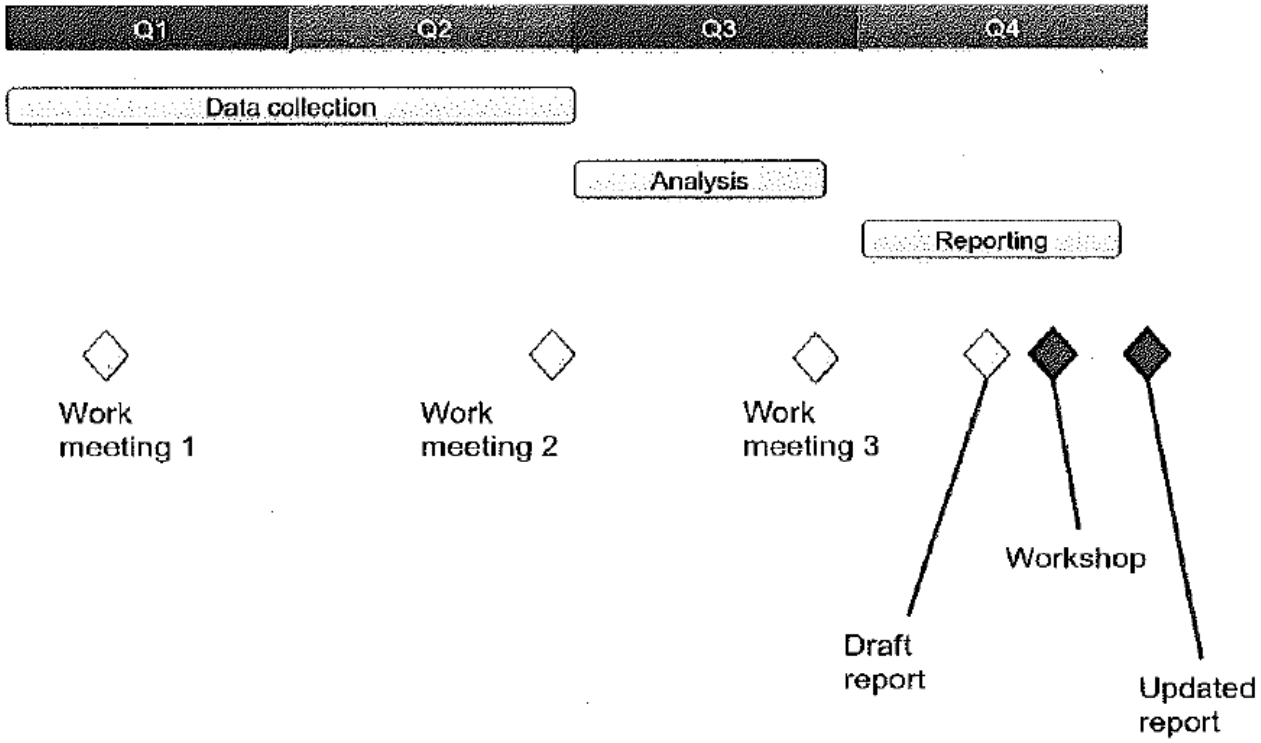
This project will conduct a study on how decommissioning is regulated, planned and performed in the Nordic countries, identify where the main challenges lie, collect best practices and share experiences between the Nordic participants. The contributions for this project will come from regulators, operators and contractors, thus having a wide span of stakeholder involvement. The Norwegian Radiation Protection Authority (NRPA), Swedish Radiation Safety Authority (SSM), Danish Health Authority (SIS), Finnish Radiation and Nuclear Safety Authority (STUK), the energy companies Fortum and Vattenfall, the consulting firm ÅF of Sweden, VTT Technical Research Center of Finland, and Institute For Energy Technology (IFE) in Norway are participating in the project. The project will involve collecting experiences from completed and ongoing decommissioning-related activities in Sweden, Finland, Denmark and Norway. The experiences' evaluation aims to identify possible improvements in processes, methods and tools. The project will foster collaboration among Nordic stakeholders through sharing of challenges and best practices.

Activity leader: István Szőke, Institute for Energy Technology

Funded organizations: IFE, NRPA, SSM, STUK, SIS, VTT, Vattenfall AB, Fortum, ÅF

Funding: 524 kDKK

Milestones



As shown in the figure above, the main phases for all work packages will be:

- Data collection: Semi-structured interviews with key actors in Nordic decommissioning.
- Analysis: Work meetings, capability maturity analysis, and identification of key challenges and opportunities.
- Reporting: Draft report, workshop and final report.

Main milestones for all the activities will be three work meetings, a draft report, workshop and final report, as shown in the figure.

Work packages

Activity 1: Decommissioning of Nordic legacy sites
Data collection to identify main challenges and best practices for planning of decommissioning of legacy sites in Nordic countries

- Main challenges identified
- Interactions between regulatory body, licensees and contractors regarding decommissioning approaches and practices
- Lessons learned in a Nordic setting

Activity 2: Large scale decommissioning in a Nordic setting
Data collection to identify main challenges and best practices for planning of decommissioning of commercial reactors. Use Nordic experiences as well as the NorDec participants' collected knowledge of international lessons learned.

- Interactions between regulatory body, licensees and contractors regarding decommissioning approaches and practices
- Foreseen challenges and needs for future research and technology development
- Experiences with international decommissioning that may be transferred to Nordic projects

Activity 3: Nordic collaboration arena

Comparisons based on an analysis of the insights from Nordic decommissioning regulators, utilities, contractors and research organizations. Specific and common issues and practices among and within Nordic countries from a regulatory, licensee, contractor and research organization perspective.

- Common interests among Nordic countries for collaborative developments for solving issues and share experience and results, including adapting international lessons learned to a Nordic setting
- Ways for shortening the gap between different stakeholders in each country by collaboration around identified issues
- Issues and practices related to decommissioning strategy, e.g. immediate and deferred dismantling. Which considerations, such as radiation protection optimization, co-implementation of the decommissioning with other nuclear facilities, or the availability of disposal facilities, support the chosen strategy?

Status (May 15, 2017)
Work progressing according to updated plan. The update below was received on May 15.

Based on the current work progress there are no issues foreseen that might cause major deviations to the deliverables promised or the proposed work strategy. However, due to delayed decision from the NKS, we condensed the work schedule initially proposed. Due to the shorter schedule, we decided to merge Work meeting 2 and 3 (see schedule in the proposal) into one work meeting followed by a Workshop as planned.

<u>Current progress</u>

Work meetings and workshop:

- *Collaboration between participants of the project will mainly be realised through work meetings and a workshop. Work meeting 1 has been performed using video/phone conferencing. Individual phone / email communication has been conducted with participants that were not available for the meeting.*
- *Work meeting 2 is scheduled to be performed on Tuesday 13th June close to the Gardermoen airport.*
- *The Workshop is scheduled to be held in Halden, Mon 20th - Tue 21st November.*

Data collection:

- *On Work meeting 1 (video/phone meeting) main focus areas for this project have been discussed. During and after the meeting, suggestions for topics of interest have been received from the participants.*
- *Preliminary work for performing a literature review has been performed to identify a literature base for the topics of this project. One important piece of input will be the results*

of the group discussions during an international decommissioning workshop held in February by the implementation team of this project.
- *A questionnaire has been developed and sent out to the project team to be completed and forwarded to other nominees.*
- *An interview guide has been developed.*

Next steps
- *Individual interviews (in person or through video/phone) will be scheduled with people nominated by the project participants.*
- *Results of questionnaires and interview will be analysed.*
- *A second work meeting will be performed to discuss preliminary findings with the project team.*
- *Further analyses of questionnaire and interview results, cross referenced with findings of the literature study, will be discussed on a Workshop.*
- *A final report will be produced as described in the project proposal.*

3.5 SC_AIM

Safety culture assurance and improvement methods in complex projects

Summary
Despite a long research tradition, empirical studies of culture improvement in the safety field are scarce, especially in comparison to the amount of research on identifying the elements of safety culture or evaluation of safety culture. Safety culture and safety management models and practices have largely focused on single organisations, mainly in the operational phase. It is far from clear how to apply them in the dynamically changing project settings or other transitional phases such as commissioning or decommissioning. The methods that are effective in a project environment may differ from "traditional" methods of safety culture improvement as promoted by e.g. IAEA and WANO. The question is, what should a safety culture improvement and assurance program be like in an "organization" which is in a dynamic state of transition and may involve actors from different companies?

A basic premise of the project is that so far there has been a lot of attention on how to diagnose and evaluate safety culture, but actually not so much on how to improve the safety culture. A second premise is that improvement of safety culture in projects sets some unique requirements due to e.g. multiple organizations interacting, diverse background of personnel, schedules and contract issues etc. The same methods that have been applied in operating power plants may not work. Further, the long supply chains and the licensee's responsibility to oversee the safety culture of the entire network put more demands on safety culture assurance methods.

The project is planned as a two years' effort (2016-2017) between partners in two Nordic countries: VTT and Tmi Teemu Reiman (Finland) and Royal Institute of Technology, KTH (Sweden). The project has two aims:

1. To identify and specify methods to improve and facilitate safety culture in complex projects
2. To identify and specify methods to assure safety culture in complex projects

In the year 2017, we will carry out a follow-up study on the implementation progress of Safety Culture Ambassadors Group. This work provides valuable insight regarding good practices and

other experiences of implementing a safety culture improvement method in a growing organization, which is at design phase of the NPP life cycle. The information exchange with other power companies will continue, which full provide further information about safety culture improvement in various organizational contexts. The information exchange partnership is also an opportunity for the power companies to gain information from researchers. Furthermore, three researcher workshops will be held on the topics of safety culture improvement methods, assurance methods and an integrative workshop on the topic of building an adaptive safety culture in the nuclear industry. The findings from these workshops will result in three scientific publications. In addition, new methods for safety culture improvement or assurance will be developed and piloted based on needs identified in collaboration with the case organizations. Finally, the overall project findings from the two-year's effort will be documented in NKS final report.

TASKS IN 2017

1) Follow-up study at Fennovoima on the implementation progress of Safety Culture Ambassadors Group
2) Information exchange with additional organizations (incl. Forsmark, Fortum and OKG)
3) Three researcher workshops on the following topics:
    a. Safety culture improvement and assurance methods
    b. Safety culture methods and their underlying assumptions in the context of safety paradigms
    c. How to build an adaptive safety culture in dynamic organizational environments
4) Three scientific publications based on the findings from tasks 1-3
5) Development of new methods based on identified needs, potentially useful methods, and existing methods in workshops with the researchers and the case organizations
6) Pilot test of the selected new methods in the selected case organizations
7) Final report and dissemination of results
8) Administration

Activity leader: Kaupo Viitanen, VTT Technical Research Centre of Finland

Funded organizations: VTT, KTH

Funding: 279 kDKK

Milestones

MILESTONES AND DELIVERABLES IN 2017

- Researcher workshop (How to build an adaptive safety culture in dynamic organizational environments) 28.3. – 29.3.2017
- Conference paper: "Building an "adaptive safety culture" in a nuclear construction project – insights to safety practitioners" 30.4.2017
- Researcher workshop (Safety culture improvement and assurance methods) 3.5.2017 – 4.5.2017
- Researcher workshop (Safety culture methods and their underlying assumptions in the context of safety paradigms) 21.6. – 22.6.2017
- Main case study completed (Task 1) 30.6.2017
- Workshop paper and presentation: "Towards actionable safety science" [working title] 30.6.2017
- Scientific publication "Improving safety culture – what do we really know?" [working title] 31.12.2017
- Final report 31.12.2017

Status (May 15, 2017)
Work progressing according to updated plan. Note that there is a minor change in relation to original plans: the Fennovoima case study follow-up will be conducted during the autumn (instead of spring as was originally planned). The update below was provided on May 15.

Project group: Kaupo Viitanen (VTT, coordinator), Carl Rollenhagen (KTH/Vattenfall), Nadezhda Gotcheva (VTT)

Description: The SC AIM project aims to increase understanding on how to improve nuclear safety culture in complex project settings (e.g. in the presence of multiple organizations interacting, diverse background of personnel, etc.). The practical goals of the projects are to identify and specify methods to improve and facilitate safety culture in complex projects and to identify and specify methods to assure safety culture in complex projects.

Overall evaluation and status: Overall, the project is progressing according to plan. The only deviation from the original plans is the scheduling of Fennovoima case study follow-up (implementation of the Safety Culture Ambassadors Group), which was originally planned to be conducted in spring but will be postponed to autumn. The reason for the delay is that significant developments have not been achieved at the case study organization, rendering the follow-up study less relevant at this point. It was agreed with the Fennovoima representatives that follow-up will instead be carried out during this autumn.

To date, the project has held researcher workshops on the topics of adaptive safety culture and safety culture improvement and assurance methods. Researcher workshops will continue during the spring. A two-day researcher workshop is being arranged and will be held in Stockholm with all the participating research organizations (VTT, Tmi Teemu Reiman, KTH/Vattenfall) to enable Nordic collaboration.

The project has produced a finalized conference paper on the topic of adaptive safety culture. The paper discusses safety management from the perspective of complex adaptive systems and relates this thinking to safety culture improvement tools with the purpose of increasing understanding of how safety culture can be developed in dynamic environments such as projects. Another paper on the topic of actionable safety science is currently being written. This paper examines what needs to be taken into account when attempting to utilize insights from safety science in the practical work of safety practitioners.

Information exchange workshops with the NPPs are planned to be carried out during the autumn. Arrangements are being made for holding a workshop with OKG and Fennovoima in Stockholm in October (specific date not yet set) on the topic of Safety Culture Ambassadors. Opportunities for organizing workshops or online sessions with other NPPs are being discussed.

Milestones and deliverables for 2016		
Milestone / deliverable	*Planned completion date*	*Status*
Researcher workshop (How to build an adaptive safety culture in dynamic organizational environments)	*28.3. – 29.3.2017*	*Completed.*
Conference paper: "Building an "adaptive safety culture" in a nuclear construction project – insights to safety practitioners"	*30.4.2017*	*The conference paper was completed and submitted to Resilience Engineering Symposium. A poster presentation will be held at the conference in Liège, Belgium in 26th-29th June.*
Researcher workshop (Safety culture improvement and assurance methods)	*3.5.2017– 4.5.2017*	*The first part of this workshop was completed. Another researcher workshop on this topic will be held on 5.-6.6. in Stockholm. The arrangements and preliminary agenda for this workshop have been made.*
Researcher workshop (Safety culture methods and their underlying assumptions in the context of safety paradigms)	*21.6. – 22.6.2017*	*Arrangements have been made.*
Main case study completed (Task 1)	*~~30.6.2017~~ 31.12.2017*	*Follow-up study at Fennovoima on the implementation progress of Safety Culture Ambassadors Group will be delayed and will be completed by the end of the year.*
Workshop paper and presentation: "Towards actionable safety science"	*30.6.2017*	*Abstract has been completed and submitted to WOS2017 conference.*
Scientific publication "Improving safety culture – what do we really know?" [working title]	*31.12.2017*	*The content has been discussed and preliminarily planned in researcher workshops*
Final report	*31.12.2017*	*The preliminary structure of the final report has been prepared*

Detailed status report by tasks		
Task description	*Estimated completion*	*Progress by 16.05.2017*
1) Follow-up study at Fennovoima on the implementation progress of Safety Culture Ambassadors Group	*5 %*	• *Will be delayed to autumn. Follow-up interviews are planned to be conducted.*
2) Information exchange with additional organizations (incl. Forsmark, Fortum and OKG)	*10 %*	• *A workshop with OKG and Fennovoima facilitated by VTT has been planned for the autumn. The date has not yet been fixed.*
3) Three researcher workshops on the following topics: *a) How to build an adaptive safety culture in dynamic organizational environments* *b) Safety culture improvement and assurance methods (partly in Stockholm)* *c) Safety culture methods and their underlying assumptions in the context of safety paradigms (in Paris together with J.-C. Le Coze and a group of invited young generation safety scientists)*	*50 %*	• *Researcher workshop a completed* • *Research workshop b partially completed*
4) Three scientific publications based on the findings from tasks 1-3 *a) "Towards actionable safety science" [working title]* *b) "Building an 'adaptive safety culture' in a nuclear construction project – insights to safety practitioners"* *c) "Improving safety culture – what do we really know?" [working title]*	*50 %*	• *Deliverable a abstract completed and submitted to WOS2017, and full paper is being written* • *Deliverable b completed and submitted to Resilience Engineering Symposium*
5) Development of new methods based on identified needs, potentially useful methods, and existing methods in workshops with the researchers and the case organizations	*10 %*	• *Preliminary ideas have been discussed with case study organizations*
6) Pilot test of the selected new methods in the selected case organizations	*10 %*	• *Preliminary ideas have been discussed with case study organizations*
7) Final report and dissemination of results	*5 %*	• *Preliminary structure of the final report has been prepared*
8) Administration	*33 %*	• *Ongoing*

3.6 SPARC

Scenarios and Phenomena Affecting Risk of Containment Failure and Release Characteristics

Summary
A robust severe accident management strategy is paramount for minimizing the environmental impact in the case of a severe accident involving melting of a reactor core. Both physical phenomena (deterministic) and accident scenarios (stochastic) are sources of uncertainties in the assessment of effectiveness of the accident mitigation. Adequate approaches are necessary in order to address both deterministic (epistemic) and stochastic (aleatory) sources of uncertainty in a consistent manner.

The goal of the project is to develop approaches and data for addressing the effects of scenarios and phenomena on the risk of containment failure and characteristics of release in case of a severe accident. There are 4 work packages that provide tightly coupled with each other activities.

WP1: *Development and application of risk oriented accident analysis framework (ROAAM+) for prediction of conditional containment failure probability for a Nordic type BWR.* (KTH)

The main tasks are:
1.1 Core degradation and relocation to the lower head (using MELCOR code). Obtained results will be compared with VTT analysis for Station Blackout (SBO) with delayed power recovery and other scenarios of risk importance.
1.2 In-vessel debris coolability (using DECOSIM code).
1.3 Debris remelting, melt pool formation and vessel failure (using PECM model).
1.4 Experiments on multi-component debris remelting will be carried out to understand basic physical phenomena.
1.5 Melt release and vessel ablation model and experiments for validation of the model.
1.6 Ex-vessel debris bed formation, agglomeration, spreading and coolability (using DECOIM and Agglomeration models). With focus on the mechanisms of the debris spreading that can help to reach a coolable state. Particulate Debris Spreading (PDS) experiments on debris spreading in the pool and after settlement will be carried out using different particles. Collaboration with VTT will be established for validation of the models.
1.7 Steam explosion (using TEXAS code) will be carried out with quantification of different sources of uncertainty.
2. Development of computationally efficient (surrogate) models for approximation of the full model response parameters.
3. Coupling of the surrogate models into ROAAM+ framework.
4. Connection of the framework to PSA-L1 and different plant damage states will be carried out in collaboration with LRC and VTT.
5. Development and implementation of the methods for quantification of uncertainty, identification of failure domains and prediction of the conditional failure probabilities using ROAAM+ framework will be carried out.
6. Development of data clustering techniques for coupling of ROAAM+ frameworks with PSA-L2, source term prediction tools and PSA-L3 will be done in collaboration with LRC and VTT.

WP2: *Development of the methods for coupling of Integrated Deterministic Probabilistic Safety Analysis tools such as ROAAM+ developed by KTH with PSA in general and PSA-L2 in particular.* (LRC)

The main tasks are:
1. Development of IDPSA generated data processing techniques for informing PSA about importance of (i) timing of events and (ii) epistemic uncertainty.
2. Different approaches will be considered in collaboration with KTH and VTT to addressing of dynamic events and physical phenomena in (i) cut sets; (ii) success and failure paths; (iii) connections to PSA-L3.
3. Cross code comparison for modelling of key phenomena of different accident progression scenarios (in collaboration with WP1 and WP3).

WP3: *Deterministic modelling of core degradation, melt relocation, vessel failure, debris spreading and coolability and threats for the containment integrity.* (VTT)

The main tasks are:
1. Development and verification of modelling approaches to core degradation, melt relocation and vessel failure. Comparison of MELCOR and ASTEC results for SBO with delayed power recovery and other scenarios of risk importance in collaboration with KTH.
2. Implementation and validation of debris bed spreading models (e.g. Lagrangian particle tracking model in CFD) against PDS-P data in collaboration with KTH.
3. Analytical investigation of the effect of debris bed multidimensionality on coolability (using the CFD approach developed at VTT and the MEWA code). This consist of refining the temperature-based coolability criteria for heap-like debris beds, which is a main unresolved question in the coolability of realistic debris beds. Collaboration with KTH on comparison of results obtained with DECOSIM code analysis.
4. MELCOR analyses of hydrogen explosions in order to address the interactions between deterministic phenomena, stochastic events and operator actions (in collaboration with WP1 and WP4).
5. MC3D analysis on the effect of vessel breaking mode to dynamic pressure loads on cavity wall induced by steam explosion.
6. Consideration of the implications of the analysis results for source term characteristics in collaboration with KTH, LRC and WP4.

WP4: *Level 2 PSA modelling of phenomena and factors affecting containment failure probability and release characteristics. The input is from KTH, LRC and VTT analysis in WP1, WP2 and WP3.* (VTT)

The main tasks are:
1. PSA-L2 analysis with the focus on the factors affecting source term characteristics. The factors to be considered are: (i) plant damage states (from PSA level 1), (ii) plant design and (iii) accident progression phenomena.
2. Consideration of the factors affecting the probability and magnitude of relevant phenomena such as (i) hydrogen explosions (in collaboration with WP3), (ii) steam explosions (in collaboration with WP1); (iii) non-coolable debris bed formation and core-concrete interaction (in collaboration with WP1 and WP3).

Activity leader: Pavel Kudinov, Royal Institute of Technology.

Funding: 524 kDKK

Milestones

KTH work is focused in WP1 on Tasks 1, 2, 3 and 5 with the following goals:

1. Development and validation of detailed (full) deterministic models for analysis of severe accident phenomena in Nordic BWRs.
2. Development and application of computationally efficient surrogate models for uncertainty and risk analysis.
3. Collaboration with VTT and LRC on cross code comparison, code validation, and development of approaches to informing PSA with the ROAAM+ framework results.
4. Reporting of the results.

LRC work is focused in WP2 on Task 1 and 2 with the following goals:

1. Perform the integration case outlined during 2016 with a large scale PSA model.
2. The test case will identify the need for further necessary refinements of the method for including time into cut sets (dynamic approach).
3. Discuss the potential for the method (dynamic cut-set) to be used for other purposes than tested in the integration test.
4. Reporting of the results.

VTT work in WP3 will be focused on Task 3 and 5 with the following goals:

1. Further analyses of debris bed temperature in post-dryout conditions for developing temperature-based coolability criterion.
2. Analysis on the effect of vessel breaking mode to the steam explosion loads.
3. Comparison of obtained results with KTH and LRC data.
4. Reporting of the results.

***VTT** in* WP4 will be focused on Task 1 and 2 with the following goals:

1. PSA-L2 analysis results addressing important factors for the release characteristics.
2. Consideration of the relevant phenomena, namely steam and hydrogen explosions.
3. Reporting of the results.

Status (May 16, 2017)

The partners have agreed upon the distribution of the funding offered by NKS. Contracts have been received from LRC and VTT. The contract from KTH is expected by May 31.

From the status report received on May 16, work is progressing according to updated plan from CfP 2017. There are no major deviations between plans and results so far. Five articles have been published in peer-review journals since last NKS Board meeting in January. Two PhD theses have been published.

More details about the status of SPARC can be found in the attached update in Appendix A.

3.7 WRANC

Warm Pre-Stressing – Validation of the relevance of the main mechanisms behind Warm Pre-Stressing in assessment of nuclear components

Summary
The embrittlement of the reactor pressure vessel (RPV) due to extended operation can lead to difficulties in demonstrating safe operation beyond 40 years when using traditional assessment methods. Therefore, utilizing the beneficial WPS (Warm Pre-Stressing) effect in assessments is important for continued operation beyond 40 years of the RPV. The practise of utilizing the beneficial WPS effect in RPV assessments have been adopted already in several European countries. However, there are still some uncertainties about the limitations of the engineering methods that are being used. These uncertainties need to be addressed to ensure safe utilization of the WPS effect.

The WPS effect is the increase of the apparent brittle fracture toughness for a ferritic component when pre-loaded at a temperature in the ductile upper shelf region and then cooled to the brittle lower shelf region of the material fracture toughness transition curve.

The WPS effect can be attributed to four main mechanisms. These mechanisms have different impact, depending on the pre-load level and load path. All the mechanisms are related to plastic straining at pre-load. The engineering methods used today do not consider constraint and do not take into account the different impact of the mechanisms in relation to different load paths.

There is a need to evaluate thoroughly the importance of the four main mechanisms behind WPS for realistic situations that could be encountered in a RPV. This in order to understand the limitations and possibilities in the engineering methods used to assess the magnitude of the WPS effect.

Within this research project (Inspecta Technology AB (Sweden), Royal Institute of Technology (Sweden), SINTEF (Norway) and Swedish Radiation Safety Authority (Sweden)), the main mechanisms behind WPS and their importance relating to RPV assessments will be validated using both experiments and numerical methods. This project will try to answer the question of which of these mechanisms, or combination of, is the governing mechanism in situations that closely resemble those that can arise in a RPV. This is important to be able to assess the reliability and limitations of the engineering methods that are employed today in assessing the magnitude of the WPS effect. The results will also be used to formulate guidelines in utilizing the WPS effect in RPV assessments.

Activity leader: Tobias Bolinder, Inspecta Technology AB

Funding: 393 kDKK

Milestones

Tasks and Deliverables:	
Design of experimental program	2017-03-31
Execution of experimental program	2017-04-30
Numericall investigation	2017-05-31
Fractographical examination	2017-05-31
Formulate guidelines	2017-06-30
Final report	2017-09-30

Status (May 16, 2017)
Work progressing according to updated plan. The original experimental program has been expanded and revised. The update received on May 16 reveals that informative results were obtained from the first test sets. Additional funding from SSM enables the project to expand the experimental program with new test sets, see attached update in Appendix B for details.

Below is a summary of deliverables.

Completed tasks:

- *Design of experimental program*
- *Acquired material for testing (RPV steel 18MnD5) from EDF France.*
- *Numerical modelling*
- *Numerical investigation (Master thesis)*
- *Manufactured test specimens for experimental program*
- *Carried out 70 % of the complete experimental program*

Remaining tasks:

- *Complete the experimental program (will be completed before the mid of June)*
- *Carry out the fractographical examination (delayed, SINTEF have not yet received the test specimens this should not delay the final report)*
- *Analyse the results*
- *Write final report*

4 Overview of all NKS-R activities in 2010-2016

It is seen from the table below that all activities started in 2015 and earlier have been finalised. ATR-2015 needs to submit a revised final report.

An activity is considered to be started at the January board meeting, and ended when the final report has been delivered.

Activity	NKS number	Started	Ended
Decom-sem	NKS_R_2010_83	01/2010	12/2010
DIGREL	NKS_R_2010_86	01/2010	12/2010
IACIP	NKS_R_2008_61	01/2010	12/2010
INCOSE	NKS_R_2009_75	01/2010	05/2011
MOSACA10	NKS_R_2008_69	01/2010	01/2011
NROI	NKS_R_2008_70	01/2010	04/2011
POOL VTT	NKS_R_2007_58	01/2010	05/2011
POOL KTH	NKS_R_2007_58	01/2010	06/2011
POOL LUT	NKS_R_2007_58	01/2010	03/2011
AIAS	NKS_R_2011_98	01/2011	12/2012
DIGREL	NKS_R_2010_86	01/2011	01/2012
ENPOOL	NKS_R_2011_90	01/2011	03/2012
ENPOOL	NKS_R_2011_90	01/2011	05/2012
ENPOOL	NKS_R_2011_90	01/2011	05/2012
MoReMO	NKS_R_2011_95	01/2011	02/2012
NOMAGE4	NKS_R_2008_63	01/2011	11/2011
POOLFIRE	NKS_R_2011_96	01/2011	02/2012
SADE	NKS_R_2011_97	01/2011	03/2012
RASTEP	NKS_R_2010_87	06/2011	09/2012
AIAS	NKS_R_2011_98	01/2012	06/2013
DECOSE	NKS_R_2012_100	01/2012	07/2013
DIGREL	NKS_R_2010_86	01/2012	02/2013
ENPOOL VTT	NKS_R_2011_90	01/2012	04/2013
ENPOOL LUT	NKS_R_2011_90	01/2012	03/2013
ENPOOL KTH	NKS_R_2011_90	01/2012	05/2013
MoReMO	NKS_R_2011_95	01/2012	03/2013
Nordic-Gen4	NKS_R_2012_103	01/2012	11/2012
POOLFIRE	NKS_R_2011_96	01/2012	02/2013
RASTEP	NKS_R_2010_87	01/2012	10/2013
SADE	NKS_R_2011_97	01/2012	03/2013
Decom-sem	NKS_R_2013_106	01/2013	02/2014

Activity	NKS number	Started	Ended	
DECOSE	NKS_R_2012_100	01/2013	10/2014	
DIGREL	NKS_R_2010_86	01/2013	03/2014	
DPSA	NKS_R_2013_107	01/2013	07/2014	
ENPOOL	NKS_R_2011_90	01/2013	10/2014	
Exam HRA	NKS_R_2013_110	01/2013	03/2014	
HUMAX	NKS_R_2013_108	01/2013	02/2014	
L3PSA	NKS_R_2013_109	01/2013	03/2014	
POOLFIRE	NKS_R_2011_96	01/2013	12/2014	
SADE	NKS_R_2011_97	01/2013	02/2014	
ATR	NKS_R_2014_111	01/2014	06/2015	
DECOSE	NKS_R_2012_100	01/2014	07/2015	
DIGREL	NKS_R_2010_86	01/2014	02/2015	
DPSA	NKS_R_2013_107	01/2014	08/2015	
ENPOOL	NKS_R_2011_90	01/2014	07/2015	
HUMAX	NKS_R_2013_108	01/2014	01/2015	
L3PSA	NKS_R_2013_109	01/2014	04/2015	
Nordic-Gen4	NKS_R_2012_103	01/2014	02/2015	
ProCom	NKS_R_2014_112	01/2014	03/2015	
ADdGROUND	NKS_R_2015_113	01/2015	04/2016	
ATR-2015	NKS_R_2014_111	01/2015	06/2016	revised report to be completed
COPSAR	NKS_R_2015_114	01/2015	08/2016	
DECOSE	NKS_R_2012_100	01/2015	10/2016	
L3PSA	NKS_R_2013_109	01/2015	11/2016	
LESUN	NKS_R_2015_115	01/2015	12/2015	
MODIG	NKS_R_2015_116	01/2015	03/2016	
PLANS	NKS_R_2015_117	01/2015	01/2016	
ADdGROUND	NKS_R_2015_113	01/2016	Not completed	
BREDA-RPV	NKS_R_2016_118	01/2016	03/2017	
COPSAR	NKS_R_2015_114	01/2016	Not completed	two out of three partners are done
FIREBAN	NKS_R_2016_119	01/2016	Not completed	draft report has been received
HYBRID	NKS_R_2016_120	01/2016	04/2017	
L3PSA	NKS_R_2013_109	01/2016	03/2017	
SC_AIM	NKS_R_2016_121	01/2016	01/2017	
SPARC	NKS_R_2016_122	01/2016	Not completed	

STATUS REPORT OF NKS-SPARC PROJECT
Scenarios and Phenomena Affecting Risk of Containment Failure and Release Characteristics
May 15, 2017

Work at Royal Institute of Technology (KTH), Division of Nuclear Power Safety NKS-SPARC and APRI-9

Pavel Kudinov, Galushin, Sergey, Dmitry Grishchenko, Sergey Yakush, Alexander Konovalenko, Simone Basso, Walter Villanueva.

WP1: Development and application of risk oriented accident analysis framework (ROAAM+) for prediction of conditional containment failure probability for a Nordic type BWR.

KTH work is focused in WP1 on Tasks 1, 2, 3 and 5 (see details below) with the following goals:

1. Development and validation of detailed (full) deterministic models for analysis of severe accident phenomena in Nordic BWRs.
2. Development and application of computationally efficient surrogate models for uncertainty and risk analysis.
3. Collaboration with VTT and LRC on cross code comparison, code validation, and development of approaches to informing PSA with the ROAAM+ framework results.
4. Reporting of the results.

1.1 Core degradation and relocation to the lower head (using MELCOR code). Obtained results will be compared with VTT analysis for Station Blackout (SBO) with delayed power recovery and other scenarios of risk importance.

MELCOR model of Nordic BWR has been used to evaluate the effect of severe accident scenario (timing of activation of safety systems) on the resultant properties of relocated debris in LP. Obtained Typical debris configurations are: small relocation; large relocation with significant debris oxidation; large relocation with smaller debris oxidation; transition regime. Major part of the core relocates to LP within ~30-60min after onset of core support plate failure. ECCS is effective in preventing massive core relocation only within relatively small time window after activation of ADS. Delay in activation of ADS can significantly delay massive core relocation to LP and results in greater extent of core materials oxidation. Debris composition (i.e. metallic/oxidic debris fraction) in different layers are highly influenced by severe accident scenario.

Sensitivity analysis has been performed to evaluate the effect of modelling options in MELCOR on the properties of relocated debris in LP. The most influential parameters for determining debris mass in LP and time of core support plate failure are: oxidized fuel rod collapse temperature and particulate debris porosity. Hydrogen generation and metallic debris fraction in the first axial level are mostly affected by: velocity of falling debris and particulate debris porosity. Non-linear interactions between physical models in MELCOR make results sensitive to selection of numerical parameters.

Data base of MELCOR solutions is being generated with new versions of MELCOR 2.1 and 2.2. Lower plenum nodalization has been refined to obtain properties of relocated debris in LP in the vicinity of vessel Lower Head. Noticeable differences have been found between predictions with 2.1 and 2.2, while a reasonable agreement was observed between 1.8.6 and 2.1 versions. Investigation of the reasons for the discrepancies is ongoing. Computationally efficient Core Relocation Surrogate Model will be used for prediction of the properties of relocated debris in LP that are necessary for the analysis of in-vessel debris coolability, debris remelting, melt pool formation and vessel failure in ROAAM+ framework.

1.2 In-vessel debris coolability (using DECOSIM code).

Coolability of a porous debris bed in the lower plenum of reactor pressure vessel is considered using DECOSIM code in the conditions of limited water supply, with initially dry and hot porous debris beds of different shapes (flat-top, heap), mass, and properties (e.g. particle size). It was shown that for larger particles, water penetration into the initially hot debris bed proceeds mainly along the vessel wall. As a result, temperature escalation and remelting occurs in the top part of debris bed. For smaller particles, hot zone can be in direct contact with the wall. Total evaporation of water occurs faster for larger particles due to different rates of water ingress. Temperatures of debris in the locations of the nozzle welds for penetrations are studied to clarify possible vessel failure modes for different debris bed configurations.

1.3 Debris remelting, melt pool formation and vessel failure (using PECM model).

An approach is under development for coupling of the PECM model with MELCOR data on the debris properties in the lower head for analysis of debris bed heatup, remelting, and melt pool formation is ongoing.

1.4 Experiments on multi-component debris remelting will be carried out to understand basic physical phenomena.

REMCOD (REmelting of MultiCOmponent Debris) with quartz walls was designed and manufactured. The feasibility of experimental approach i.e. no apparent wall effects and a possibility of visualization of debris remelting through a quartz glass in a 2D sliced test section is demonstrated in the commissioning tests. Exploratory tests of the REMCOD are ongoing with tin as melt simulant and steel and ceramic and glass particles as debris bed simulants. In each test up to 0.5 liters of superheated tin (~400 ºC) is poured into debris. The depth of penetration apparently depends on the debris: sizes and thermal properties (heat capacity and thermal conductivity). Several series of tests are planned to investigate (i) the effects of absolute temperature of debris and temperature profile; (ii) the effect of specific interfacial area (determined by the particle size); (iii) the effect of wettability of debris by liquid metal.

1.5 Melt release and vessel ablation model and experiments for validation of the model.

Melt release and vessel ablation model is currently under development. The ablation rate of initial breach is predicted given transient melt release properties. The preliminary analysis using the model has demonstrated that total melt mass defines final jet diameter. Melt release velocity affects jet diameter at the water surface and respective risks of containment failure due to steam explosion or debris bed agglomeration and non-coolability. Importance of different phenomena of debris remelting and melt relocation that may delay or limit melt release from the vessel are investigated parametrically.

1.6 Ex-vessel debris bed formation, agglomeration, spreading and coolability (using DECOSIM and Agglomeration models). The focus is on the mechanisms of the debris spreading that can help to reach a coolable state. Particulate Debris Spreading (PDS) experiments on debris spreading in the pool and after settlement will be carried out using different particles. Collaboration with VTT will be established for validation of the models.

Coolability of the debris depends on the bed shape. Therefore, particle spreading (i) after settlement on the debris bed; (ii) in the water pool above the bed affect coolability. Debris self-levelling model, based on PDS-C (Particulate Debris Spreading – Closures) experiments, was used to carry out sensitivity and uncertainty analysis for the efficacy of the particulate debris spreading in prototypic accident conditions. An artificial neural network was employed as a surrogate model (SM). It is demonstrated that conditional containment failure probability (CCFP) due to non-coolable debris bed can vary in wide ranges depending on the combinations of the randomly selected probability distributions for the input parameters. Sensitivity analysis identified: effective particle diameter and debris bed porosity as the largest contributors to the output uncertainty.

Investigation of the debris spreading driven by large turbulent flows in the pool (PSD-P) is ongoing in order to develop a database with wider ranges of pool configuration, particle properties and debris release

conditions. The work on validation of the DECOSIM code against PDS-P experimental is ongoing. Predicted and experimental mass distributions of debris at the bottom of the pool (local values and mean spreading distance) were compared. A reasonable agreement is observed for steel and glass particles. A series of experiments on two-phase flows (no particles) with flow pattern identification has been carried out. Further validation of the code is ongoing. The study of the influence of debris agglomeration on coolability is ongoing using DECOSIM code with (i) impermeable "cake" on top of the bed and (ii) distributed fraction of agglomerates that reduce open porosity for coolant flow. It is shown that while a dry and hot zone almost certainly develops in the debris bed with a "cake", there exist conditions under which the dry zone temperature can stabilize at some level by steam cooling.

1.7 Steam explosion analyses (using TEXAS code) will be carried out with quantification of different sources of uncertainty.

The Full Model (FM) for analysis of steam explosion in Nordic BWR was implemented in TEXAS-V. A statistical characterization of the possible explosion energetics for a single melt release scenario was introduced, considering different possible timing of the triggering. An extended database of FM solutions has been generated and is used for the development of a computationally efficient Surrogate Model (SM) that predicts impulses corresponding to 50, 65, 78, 95, 99 and 100% percentiles of the cumulative distribution for the explosion impulse. The results of the failure domain analysis in ROAAM+ framework for Nordic BWR suggest that the impulse will be higher than ~6kPa s in most of the possible met release scenarios if jet diameters is larger than Ø26 cm (independently on the other parameters) or if jet diameters >Ø10 cm in case if melt release velocity is high (>7 m/s) and water pool depth is large (>9m). If jet diameters are limited to 30 cm the probability of exceeding 50 kPa s impulse is less than 10^{-3} for the most of the possible combinations of eth distributions of the uncertain parameters. Several critical modelling assumptions have been verified and demonstrated to be valid: fixed ratio between the jet radius and the mesh cell cross section, reduced free gas volume compared to containment volume.

Task 5: Development and implementation of the methods for quantification of uncertainty, identification of failure domains and prediction of the conditional failure probabilities using ROAAM+ framework.

A new approach was proposed for taking into account the uncertainty in approximation of the surrogate model of the full model solution. The approach is currently employed for analysis of the containment failure due to steam explosion.

Work on Tasks 4,6 is postponed due to reduction of the project budget:

Task 4: Connection of the framework to PSA-L1 and different plant damage states will be carried out in collaboration with LRC and VTT.

Task 6: Development of data clustering techniques for coupling of ROAAM+ frameworks with PSA-L2, source term prediction tools and PSA-L3 will be done in collaboration with LRC and VTT.

Work at LRC Loyd's Register Consulting – Energy AB NKS-SPARC and LRC:

Yvonne Adolfsson, Ola Bäckström

LRC is responsible for WP2: Development of the methods for coupling of Integrated Deterministic Probabilistic Safety Analysis tools such as ROAAM+ developed by KTH with PSA in general and PSA-L2 in particular.

LRC work is focused in WP2 on Task 1 and 2 (see detailed status of each task below) with the following goals:

1. Perform the integration case outlined during 2016 with a large scale PSA model.
2. The test case will identify the need for further necessary refinements of the method for including time into cut sets (dynamic approach).
3. Discuss the potential for the method (dynamic cut-set) to be used for other purposes than tested in the integration test.
4. Reporting of the results.

Task 1: Development of IDPSA generated data processing techniques for informing PSA about importance of (i) timing of events and (ii) epistemic uncertainty.

Perform the integration case with a large scale PSA model

Risk Spectrum model of Nordic BWR has been used to evaluate the impact on the PSA results based on achieved results from MELCOR studies of severe accident scenario with the ROAAM+ framework which is described in WP1. Different methods to implement the results in PSA model has been studied during the implementation phase.

The test case will identify the need for further necessary refinements of the method for including time into cut sets (dynamic approach).

The results from the performed PSA study on the test case shows to some extent new results. Since the study is small these results indicates that there is a need for further refinement before, eventually, new assumptions are made related to the studied phenomena described in WP1 and how they in general are represented in a PSA model. The recommendations are at the moment formulated and reviewed.

Task 2: Different approaches will be considered in collaboration with KTH and VTT to addressing of dynamic events and physical phenomena in (i) cut sets; (ii) success and failure paths; (iii) connections to PSA-L3.

Studies have been made related to different possibilities to incorporate results from IDPSA analysis with the PSA model. Result from these studies have been presented at the SAFECOMP'2016 "*Effective Static and Dynamic Fault Tree Analysis*". The use of dynamic fault trees makes it possible to enrich the static analysis with a more precis modelling but they are at present only possible to use in small models. The paper presents so called SD fault trees. The purpose of these is to give the user a possibility to specify failure data as either traditionally, statical, or more dynamical. The applicability has also been studied on fault trees of nuclear power plants. Conclusions from studies with large PSA models has also been presented in "*Dynamic Features in Large PSA Studies*" at ESREL 2016.

Task 3: Cross code comparison for modelling of key phenomena of different accident progression scenarios (in collaboration with WP1 and WP3).

The comparison is on-going.

Work at VTT Technical Research Centre of Finland Ltd NKS-SPARC and SAFIR2018:

VTT is responsible for WP3 and WP4 of the SPARC project:

Anna Nieminen, Magnus Strandberg, Veikko Taivassalo

WP3: Deterministic modelling of core degradation, melt relocation, vessel failure, debris spreading and coolability and threats for the containment integrity. (VTT)

VTT work in WP3 will be focused on Task 3 and 5 (see detailed status of each task below) with the following goals:

1. Further analyses of debris bed temperature in post-dryout conditions for developing temperature-based coolability criterion.
2. Analysis on the effect of vessel breaking mode to the steam explosion loads.
3. Comparison of obtained results with KTH and LRC data.
4. Reporting of the results.

Work on Tasks 1-2 is postponed due to reduction of the project budget:

Task 1: Development and verification of modelling approaches to core degradation, melt relocation and vessel failure. Comparison of MELCOR and ASTEC results for SBO with delayed power recovery and other scenarios of risk importance in collaboration with KTH.

Task 2: Implementation and validation of debris bed spreading models (e.g. Lagrangian particle tracking model in CFD) against PDS-P data in collaboration with KTH.

Task 3: Analytical investigation of the effect of debris bed multidimensionality on coolability (using the CFD approach developed at VTT and the MEWA code). This consist of refining the temperature-based coolability criteria for heap-like debris beds, which is a main unresolved question in the coolability of realistic debris beds. Collaboration with KTH on comparison of results obtained with DECOSIM code analysis.

VTT's MEWA results on debris bed post-dryout temperature behaviour were compared to KTH's DECOSIM results and notable differences were found. Previously the effect of heat transfer models were studied and now the focus has been on the effect of friction models. Tung & Dhir models are considered being the most complete since they include also friction between liquid and gas. Modified Tung and Dhir model is considered most suitable for analysing small particle cases, but there are several versions of the model in different codes and code versions. The work on solving the reason for the differences between MEWA and DECOSIM results continue.

Task 4: MELCOR analyses of hydrogen explosions in order to address the interactions between deterministic phenomena, stochastic events and operator actions (in collaboration with WP1 and WP4).

The existing MELCOR input deck for Nordic BWR plant was converted from MELCOR 1.8.6 to MELCOR 2.1. The results of the new and old version were compared by analyzing a SBO accident scenario. New version produced lower corium temperature in the cavity, which caused differences e.g in timing of the RPV failure, containment pressure and concrete ablation. The risk of hydrogen fire in the reactor building was studied analyzing hydrogen concentrations in different volumes. The results for the SBO scenario showed such low concentrations that a hydrogen fire is considered very unlike. Also a SBO accident with a non-

inerted containment was analysed and this resulted in a hydrogen fire in the containment. However, these hydrogen fires did not cause explosions. The timing of the RPV failure was also very similar to the standard case result.

Task 5: MC3D analysis on the effect of vessel breaking mode to dynamic pressure loads on cavity wall induced by steam explosion..

Previously steam explosion loads in Nordic BWR geometry were assessed and sensitivity of the results to key input parameters was examined using MC3D code. First, the effect of triggering time was analysed. The results showed that as long as the mixture is triggerable the strength of the resulting explosion does not change notably. Sensitivity analysis results showed that the melt drop size that is dependent on the physical properties of the melt had the strongest effect on the explosion strength. Surprisingly, the melt temperature did not affect the explosion strength as long as the temperature was high enough to cause an explosion. Also different side breaks scenarios were tested in 3D but here the mixture did not trigger despite high explosivity value. This result is considered unphysical and several attempts were made to complete the analysis unsuccessfully. Now the effect of RPV breaking location on dynamic pressure load on cavity wall induced by a steam explosion has been analysed with MC3D performing a functioning 3D simulation. The results seem promising as mixture is now properly ignited and the results are much more in line with what could be expected based on the theory and previous 2D simulations..

Task 6: Consideration of the implications of the analysis results for source term characteristics in collaboration with KTH, LRC and WP4.

The work is postponed.

Ilkka Karanta, Tero Tyrvainen

WP4: Level 2 PSA modelling of phenomena and factors affecting containment failure probability and release characteristics.

***VTT** in* WP4 will be focused on Task 1 and 2 (see detailed status of each task below) with the following goals:

1. PSA-L2 analysis results addressing important factors for the release characteristics.
2. Consideration of the relevant phenomena, namely steam and hydrogen explosions.
3. Reporting of the results.

Task 1: PSA-L2 analysis with the focus on the factors affecting source term characteristics, i.e. release energy (temperature), altitude, and probability. The factors to be considered are: (i) plant damage states (from PSA level 1), (ii) plant design and (iii) accident progression phenomena.

Release height and temperature have been considered for different accident scenarios based on general knowledge, literature and discussions with deterministic safety analysis experts. Roughly speaking, there are three different cases with regard to the release height:

- The release height is the height of the place where the reactor building leaks after containment failure.
- The release height is the height of the stack if filtered venting is performed.
- An explosion throws the releases in the air above/surrounding the containment and reactor building.

In most cases, the location of the containment failure (which normally can be inferred from containment failure mode) is the basis for the analysis of the release height, but the reactor building also affects the height significantly. Therefore, in addition to the containment failure modes, the migration paths of the radionuclides in the reactor building need to be analysed to determine release height accurately. This is a challenge because safety analyses focus mostly on events occurring inside the containment.

Literature search gives very little about the release heights directly. Some papers where release heights for Fukushima accident were given were found. Concerning release altitude when the containment fails, a list of possible containment failure modes for generic BWR's and PWR's has been constructed. The list is based on research literature and international guidance (IAEA, Asampsa), and contains the failure modes, prerequisites of failure in a particular mode, and some major possible causes of a failure in a particular mode.

Also release energy has not received much attention in the scientific literature. The temperature of release from containment is in most cases close to 100°C, but the temperature of radionuclides can potentially change during their migration in reactor building. Building structures can cool down radionuclides, whereas fires and explosions either within or outside the containment can cause higher temperatures of the atmospheric release. There are fluid dynamics software that can be used to analyse radionuclide flows in reactor building and determine the release heights and temperatures.

An old BWR containment event tree model (see VTT-R-05974-13) has also been developed further by implementing uncertainty analysis for release probabilities, and adding release height and temperature variables. The plan is to continue the development of the model in the forthcoming years. A conference paper on the model was published in PSAM 13 proceedings:

Task 2: Consideration of the factors affecting the probability and magnitude of relevant phenomena such as (i) hydrogen explosions (in collaboration with WP3), (ii) steam explosions (in collaboration with WP1); (iii) non-coolable debris bed formation and core-concrete interaction (in collaboration with WP1 and WP3).

Hydrogen explosions in a BWR plant have been studied based on literature and discussion with deterministic safety analysis experts. Results from deterministic analyses were not available in 2016.

Typically in BWR plants, the containment is inert during operation which prevents the hydrogen explosions from occurring inside the containment with certainty. However, the containment is not inert during start-up and shut-down, and accidents occurring at those times can lead to hydrogen explosions. Also, it is possible that the inerting system fails. Hydrogen explosions are typically modelled in level 2 PSAs of BWRs in very simple ways with conservative probabilities.

In practice, there are three probabilities that need to be determined for a given accident scenario:

1. the probability that the containment is not inert

2. the probability that an explosion occurs if the containment is not inert

3. the probability that the containment is broken if an explosion occurs.

The probability that containment is not inert due to start-up, shut-down or refueling can be taken from level 1 results. In addition, reliability analysis can be performed for the inerting system to account for the possibility of inerting failure during normal operation. If the containment is not inert, the probability of an explosion can be analysed based on deterministic simulations that determine hydrogen and steam volumes in different accident scenarios. MELCOR software could be used, but start-up, shut-down and refueling require different models than normal operation. Deterministic analyses can also be used to estimate the strength of an explosion in order to estimate the probability of containment failure.

Hydrogen explosion can also occur outside the containment if hydrogen leaks from the containment to the reactor building. This kind of hydrogen explosions occurred at Fukushima causing significantly larger releases than what had occurred before that because the roofs were destroyed. Despite of their potentially significant impact on the releases, explosions outside containment have not usually been modelled in PSA. Taking ex-containment hydrogen explosions into account causes the need to redefine level 2 PSA, because traditionally level 2 has stopped at the loss of containment integrity whereas ex-containment hydrogen explosion is most likely a consequence of a containment leak. A more comprehensive definition of level 2 would encompass anything in accident progression inside the reactor building (naturally including the containment) that may affect release probability or its characteristics. PSA modelling will be considered in 2017 based on the results of WP3. In addition to events leading to loss of containment integrity, also events and factors leading to an ex-containment hydrogen explosion, and its consequences to release characteristics have to be taken into account; therefore PSA modelling is different from the inside containment case; Nevertheless, the approach of utilising deterministic analyses in the extended model can be quite similar.

Overall Project Summary

Comparison between plans and results with explanation of any deviations:
There are no major deviations between plans and results so far.

Expected submit date of the final report

- Expected date for submitting the reports for 2016 is mid of June 2017.

Any issues you would like the board to know

- No.

Relevant Publications

Defended PhD Dissertations:

1. Viet-Anh Phung, "Input Calibration, Code Validation and Surrogate Model Development for Analysis of Two-phase Circulation Instability and Core Relocation Phenomena," KTH, March, 2017.
2. Simone Basso, "Particulate Debris Spreading and Coolability," KTH, April, 2017.

Peer reviewed publications

1. Dmitry Grishchenko, Simone Basso, Pavel Kudinov, "Development of a surrogate model for analysis of ex-vessel steam explosion in Nordic type BWRs," Nuclear Engineering and Design, Volume 310, 15 December 2016, Pages 311-327, 2016.
2. Basso S., Konovalenko A., and Kudinov P., "Preliminary Probabilistic Risk Analysis of Debris Bed Coolability for Nordic BWRs Under Severe Accident Conditions," Nuclear Engineering and Design, Submitted 2017.
3. Galushin S. and Kudinov P., "Analysis of Core Degradation and Relocation Phenomena and Scenarios in a Nordic-type BWR," Nuclear Engineering and Design, Volume 310, 15 December 2016, Pages 125–141, 2016.
4. Kudinov P., Grishchenko D., Konovalenko A., Karbojian A. "Premixing and Steam Explosion Phenomena in the Tests with Stratified Melt-Coolant Configuration and Binary Oxdic Melt Simulant Materials," Nuclear Engineering and Design, Volume 314, Pages 1-338 (1 April 2017).
5. L. Manickam, P. Kudinov, W.M. Ma, S. Bechta and D. Gishchenko, "On the influence of subcooling and melt jet parameters on debris formation," Nuclear Engineering and Design 309: 265-276, 2016.
6. Phung, V.-A. Galushin, S. Raub, S. Goronovski, A., Villanueva, W., Kööp, K., Grishchenko, D., Kudinov, P., "Characteristics of debris in the lower head of a BWR in different severe accident scenarios," NED, Volume 305, 15, August 2016, pages 359-370, 2016.
7. Basso S., Konovalenko A., Yakush S. E. and Kudinov P., "The Effect of Self-Leveling on Debris Bed Coolability Under Severe Accident Conditions," Nuclear Engineering and Design, Volume 305, 246-259, 2016.
8. Basso S., Konovalenko A., Yakush S. E. and Kudinov P., "Effectiveness of the debris bed self-leveling under severe accident conditions," Annals of Nuclear Energy, Volume 95, September 2016, Pages 75-85, 2016.
9. Basso, S., Konovalenko, A., Kudinov, P. "Empirical Closures for Particulate Debris Bed Spreading Induced by Gas-Liquid Flow", Nuclear Engineering and Design, 297, 19-25, (2016).
10. Konovalenko A., Basso S., Kudinov P., Yakush S. E., "Experimental Investigation of Particulate Debris Spreading in a Pool", Nuclear Engineering and Design, Volume 297, pp208-219, 2016.
11. Y Butkova, H Hermanns, P Krcal, O Backstrom, W Wang, "*Dynamic Features in Large PSA Studies*" ESREL 2016.
12. Tyrväinen T, Silvonen T, Mätäsniemi T. Computing source terms with dynamic containment event trees. 13th International Conference on Probabilistic Safety Assessment and Management, PSAM 13, 2 - 7 October 2016, Seoul, Korea. International Association for Probabilistic Safety Assessment and Management, IAPSAM (2016).

Appendix B

Inspecta

Status report for Project: *WRANC*

Short summary:

The embrittlement of the RPV due to extended operation can lead to difficulties in demonstrating safe operation beyond 40 years when using traditional assessment methods. Therefore, utilizing the beneficial WPS (Warm Pre-Stressing) effect in assessments is an important possibility for demonstrating continued safe operation beyond 40 years of the RPV.
The WPS effect is the increase of the apparent brittle fracture toughness for a ferritic component when pre-loaded at a temperature in the ductile upper shelf region and then cooled to the brittle lower shelf region of the material fracture toughness transition curve. The WPS effect can be attributed to four main mechanisms. These mechanisms have different impact, depending on the pre-load level and load path. All the mechanisms are related to plastic straining at pre-load.
The project will contribute to answer which are the active main mechanisms behind the WPS effect for different situations that are realistic in a RPV. A thorough study of this has not, to our knowledge, been published before. This will lead to an understanding of the possibilities and limitations of the engineering methods for WPS. Hence, the project will clarify limitations for safe use of engineering methods for utilizing the WPS effect in RPV integrity assessments.
The approach taken to answer this is a combination of both numerical and verifying experimental work. Within the experimental program two of the mechanisms are isolated to evaluate their individual contribution to the WPS effect at different loading conditions. The remaining two mechanisms are studied using advanced numerical methods.
The experimental work will also lead to a deeper understanding of the origin of the initiation sites and the effect that WPS have on the initiation sites for brittle fracture.

Completed tasks:

- Design of experimental program
- Acquired material for testing (RPV steel 18MnD5) from EDF France.
- Numerical modelling
- Numerical investigation (Master thesis)
- Manufactured test specimens for experimental program
- Carried out 70 % of the complete experimental program

Remaining tasks:

- Complete the experimental program (will be completed before the mid of June)
- Carry out the fractographical examination (delayed, SINTEF have not yet received the test specimens this should not delay the final report)
- Analyse the results
- Write final report

Status of the project

A master thesis has been conducted within the project. The master thesis focused on two of the mechanisms in the warm pre-stressing phenomenon. By the use of a probabilistic model for evaluating cleavage fracture the two mechanisms have been evaluated and compared. The two mechanisms that were evaluated were the closing residual stress field around a macroscopic crack tip and the change of material properties during cooling.
The main results and conclusions from the master thesis will in short be summarised below.
The LCF (Load Cool Fracture) load cycle was the most beneficial load cycle. Thus a conclusion was that the mechanism referred to as 'change of material properties during cooling' is a more beneficial mechanism than the residual stress field.

As can be seen in Figure 1 the LTUCF (Load Transient Unload Cool Fracture) cycles showed similar results as the results obtained by the LUCF (Load Unload Cool Fracture) load cycles which suggests that path independence can be assumed from the end of preloading to the start of reloading under the assumption that the load does not increase during this phase.
Furthermore, as can be seen in Figure 1 below, the LPUCF (Load Partially Unload Cool Fracture) load cycles showed results similar to the results obtained from the LCF load cycles even though a large portion of the preload had been unloaded. This suggests that the mechanism called "change of material properties during cooling" is the dominating mechanism of the two investigated. All the results of the master thesis will be incorporated in the final report.

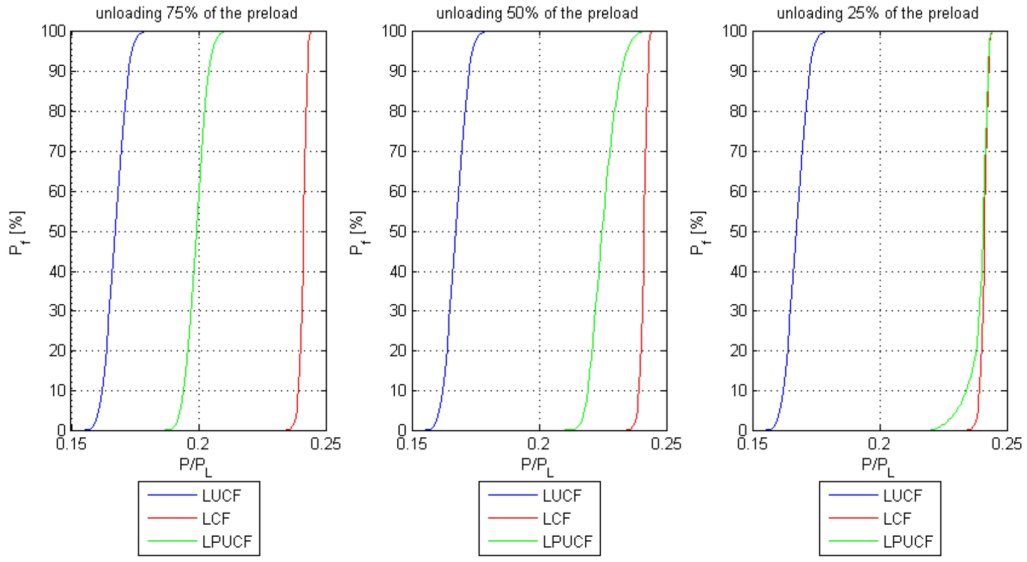


Figure 1. Comparison of LUCF, LCF and LPUCF load cycles with a pre-load level corresponding to load level C/D (*J*=105 kN/m).

The original experimental program have been expanded and revised. The motive for the changes arouse after the first Sets (Set 1, 2, 3, and 4) had been conducted at a pre-load level C/D. Very informative results were obtained from the first sets. The changes consists of adding three additional test sets with 7 specimens in each leading to 21 additional test specimens. The budget of the project has thus increased. Part of the funding for this increase of the project have been received from the Swedish Radiation Safety Authority.
Two additional sets Set 5 and 6 were added. Both sets have a LUCF load cycle and with sharp crack and EDM crack respectively. Set 5 and 6 are not heat treated after pre-loading. Set 5 and 6 were added as references cases with the full WPS effect. In addition Set 3 and 5 are pre-loaded to two different load levels (level A/B and C/D). This was earlier planned for set 3 and 4. Finally a Set 2* has been added where an EDM crack is machined with the same notch size as the notch size for Set 4 after pre-load. The revised experimental program is shown below in Figure 1.

Inspecta

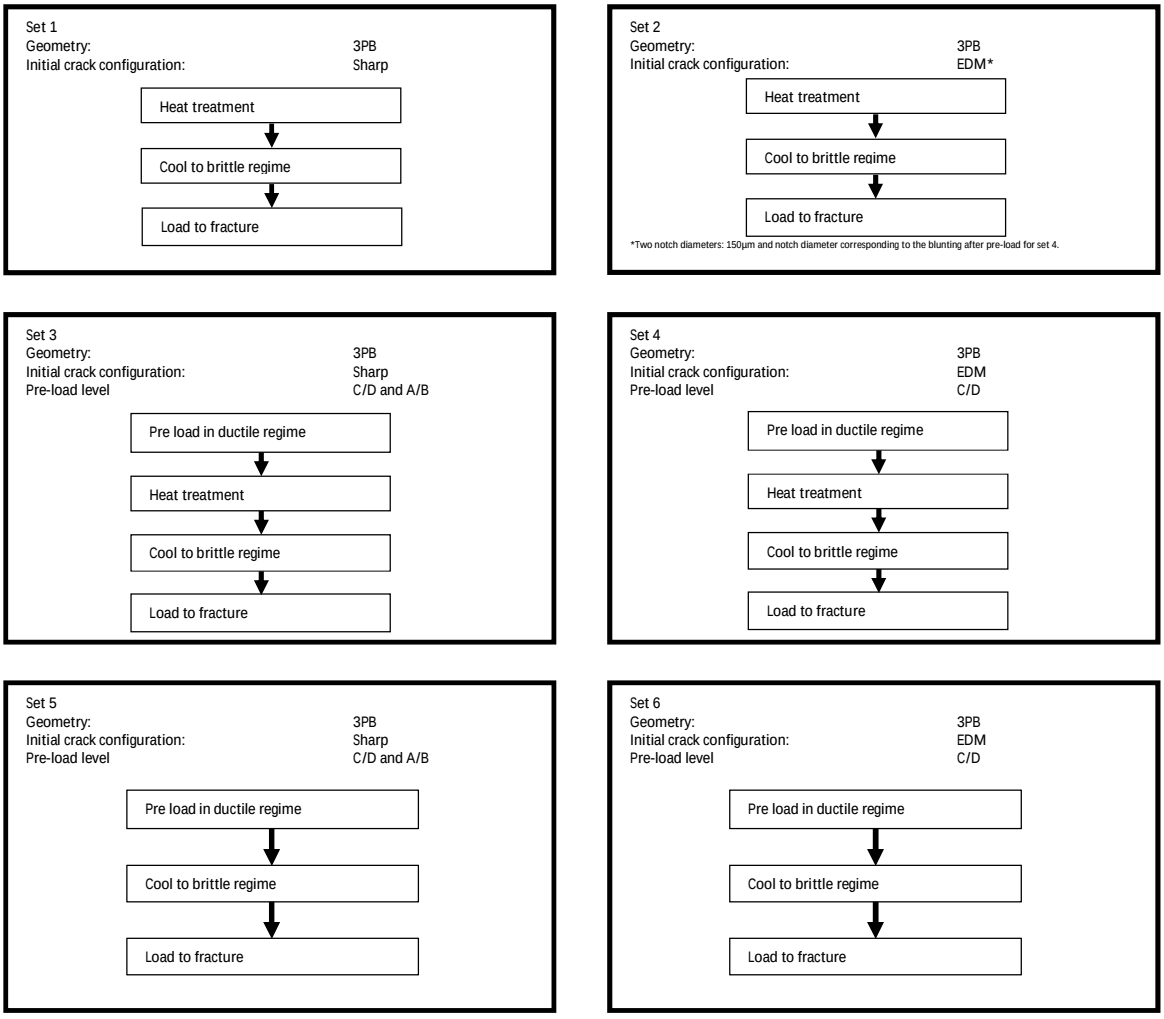


Figure 1. Revised experimental program a total of 63 test specimens.

Approximately 70 % of the test program have been completed. The results of the performed tests show some very interesting results. In Figure 2 results from Set 1, 2, 3 and 5 with a pre-load level corresponding to level C/D (K_I=155 MPam$^{1/2}$) are shown. As can be seen from the results a clear WPS effect is seen for Set 5 which is the set without any heat treatment after pre-load. This is as predicted. Active WPS mechanisms in Set 5 are compressive residual stress field, blunting of crack tip and inhibition of initiation sites. We can also see an effect on the fracture toughness for Set 2 compared with the reference case Set 1 where the mechanism is the artificially blunted crack tip due to EDM machining. Hence crack tip blunting can contribute to the WPS effect, it should be noted though that the size of the EDM crack for Set 2 is approximately 155 µm and this should be compared with the blunting due to pre-load which is approximately 72 µm at a pre-load level C/D (K_I=155 MPam$^{1/2}$). This is interesting due to the results from Set 3 which show a higher apparent fracture toughness even without a compressive residual stress field (heat treatment reduce the residual stresses to approximately 10%) and with a less blunted crack tip. This leads to the preliminary conclusion that the mechanism of inhibition of initiation sites is a mechanism that is active at least for high pre-load levels.

Inspecta

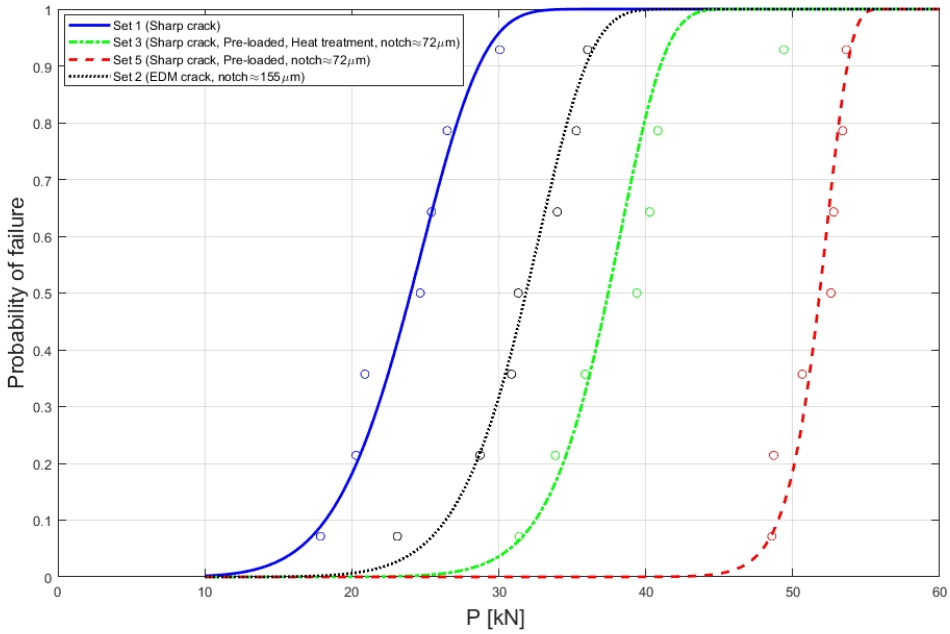


Figure 2. Preliminary experimental results from Set 1, 2, 3 and 5.

Remaining work

The experimental work will be completed with Set 6, Set 2* with pre-load level C/D and Set 3 and 5 with a pre-load level corresponding to load level A/B (K_I=70 MPam$^{1/2}$). This work is planned to be completed in the end of May or early June.

It remains to carry out the fractographical examination. This work has not yet started and is therefore delayed according to the original plan. The test specimens have not yet been sent to SINTEF. This should not necessarily influence the date for the delivery of the final report.

The results from the experimental program and fractographical examination will be studied and from this conclusions will be drawn. This work has already started by analysing the numerical and experimental results.

Write final report were the numerical, experimental and fractographical results are all presented and discussed to obtain a comprehensive understanding of mechanisms behind the WPS-effect.

NKS-R Status

May 2017

Christian Linde
NKS-R Programme Manager

NKS Board meeting, Copenhagen,
8th June 2017

Status for activities from CfP 2016

Activity	Partners	Final report received	Report number	Status
BREDA_RPV	KTH + 4 partners	2017-03-15	NKS-385	Completed
HYBRID	Chalmers + 2 partners	2017-04-18	NKS-387 (CTH) NKS-388 (IFE)	Completed
L3PSA	LRC + 4 partners	2017-03-21	NKS-386	Completed
SC_AIM	VTT + 3 partners	2017-01-02	NKS-381	Completed
COPSAR	LUT + 2 partners	LUT 2017-03-13 VTT 2017-04-13	NKS-382, 383 and 384 (LUT) NKS-389 (VTT)	Partly completed (2/3) KTH missing
SPARC	KTH + 2 partners	Report reviewing ongoing (LRC) Updates requested from KTH and VTT (18 April)		Not completed
ADdground	VTT + 4 partners	Update requested (April 18)		Not completed
FIREBAN	LU + 4 partners	Draft received (May 16)		Not completed

New NKS-R reports published on website

- BREDA-RPV
  - NKS-385: *Barsebäck as Research and Development Platform, Extraction and Analysis of Reactor Pressure Vessel Material*
- HYBRID
  - NKS-387: *Development of a hybrid neutron transport solver in 2 energy groups*
  - NKS-388: *Data and visualization solutions for HYBRID core simulation method*
- L3PSA
  - NKS-386: *Addressing off-site consequence criteria using Level 3 PSA*
- SC_AIM
  - NKS-381: *Safety Culture Assurance and Improvement Methods in Complex Projects – Intermediate Report from the NKS-R SC_AIM*
- COPSAR
  - NKS-382: *Sparger Tests in PPOOLEX on the Behaviour of Thermocline*
  - NKS-383: *Mixing Tests with an RHR Nozzle in PPOOLEX*
  - NKS-384: *Preliminary Spray Tests in PPOOLEX*
  - NKS-389: *Simulation of PPOOLEX stratification and mixing experiment SPA-T1*

Status for activities from CfP 2017

Activity	Partners	Contract sent	Contract received	Funding
COPSAR	LUT	2017-01-26	2017-03-02	493
	KTH	2017-01-26	2017-06-02	
	VTT	2017-01-26	2017-04-06	
FIREBAN	LU + 4 partners	2017-01-27	2017-05-03	393
HYBRID	CTH + 1 partner	2017-01-30	2017-03-03	493
NORDEC	IFE + 8 partners	2017-01-26	2017-03-08	524
SC_AIM	VTT + 1 partner	2017-01-26	2017-03-16	279
SPARC	KTH	2017-02-08	2017-06-02	524
	VTT	2017-02-08	2017-05-29	
	LRC	2017-02-08	2017-05-30	
WRANC	Inspecta + 2 partners	2017-01-31	2017-03-09	393

Status reports have been received from all activities.
No major deviations have been reported.

NKS-R seminars/conferences/publications

- L3PSA seminar - LRC in Sundbyberg 14th February 2017:
  - The objective of the seminar was to present and discuss the NPSAG/NKS Level 3 Probabilistic Safety Assessment Project and to present the final conclusions in the Guidance Document that had been completed recently
  - The seminar included a workshop with discussions on purposes and benefits of the results, identifying stakeholders and how to use the results
- NORDEC - 20-21 November 2017, Halden, Norway
  - Workshop on challenges and opportunities for improving Nordic nuclear decommissioning
- SC_AIM
  - 3 research workshops planned within the area of safety culture
  - 3 scientific publications planned based on outcomes from workshops
- FIREBAN - Workshop for PRA Integration in Q4 2018

NKS-R seminars/conferences/publications

- Publication issue for ATR-2015 is solved

Background: The Editor rejected a manuscript from ATR based on a reviewer comment that the results had been published already in NKS-372. NKS removed the report to enable publication of the article.

  - VTT's article has been accepted for publication*
  - VTT will submit an updated NKS report with reference to the journal article
  - Open access fee: EUR 1704,41 (excl. tax) – to be split by VTT and NKS

*Kärkelä, T.; Kajan, I.; Tapper, U.; Auvinen, A.; Ekberg, C. *Progress in Nuclear Energy*, Vol. 99, **2017**, 38–48.

Travel assistance for young scientists

- Two requests have been received from Chalmers students who will present at the *18th biennial meeting on Reactor Physics in the Nordic Countries (RPNC-2017)*, hosted by DTU Nutech, Risø on May 8-9
  - Klas Jareteg (PhD student): *"Fine-mesh multiphysics of LWRs: two-phase flow challenges and opportunities"*
  - Huaiqian Yi (MSc student): *"Sensitivity analysis in reactor noise simulations"*
  - Total request of ca 8000 DKK

Other info

- BREDA-RPV has the intention to come back with a new proposal for CfP2018
  - The work in 2017 has been focused on extracting material from the RPV at Barsebäck
  - More research focus is planned for next year

Summary

Overall the work in NKS-R is progressing according to plan

- Status for the 8 activities from CfP 2016:
  - 4 activities are completed
  - 1 activity partly completed (final reports from 2 out of 3 partners)
  - 3 activities remain not completed (one draft report received)

  - 9 NKS-R reports have been published
  - 1 seminar was held in 2017

- Status for the 7 activities from CfP 2017:
  - **All contracts signed!**

  - …, work basically on schedule
  - Fortum & TVO support agreements were submitted on May 24

NKS-B Status Report

Kasper G. Andersson

NKS-B Programme Manager

Summary

Overall the work in NKS-B is progressing well

- Since last NKS-B status report
  - *5 final reports published on website (from 3 activities)*
- Delayed activities (from before 2016)
  - *None*
- Activities commencing in 2016
  - *6 (of 9) completed, 3 nearing completion (EFMARE, MOMORC, NORCO)*
- Activites commencing in 2017
  - *All 8 contracts signed, work on schedule*

Final reports published on NKS website (since last Board Meeting):

- 3 reports on COASTEX

  Report 1: *"COASTEX Scenario Report: nine maritime accident scenarios"*,

  Report 2: *"COASTEX Exercise guide"*,

  Report 3: *"Final Report from the NKS-B Project COASTEX"*.

- 1 final report on MESO

  "MEteorological uncertainty of ShOrt-range dispersion (MESO)"

- 1 final report on Nordic ICP

  "An inter-comparison exercise on the application of ICP-MS techniques for measurement of long-lived radionuclides"

EFMARE

Activity leader – Per Roos (DTU)

- Final report was according to contract due by 31/12-2016.
- More time granted for further detailed analyses in relation to preliminary results.
- Will be finalised before NKS Board meeting in June.
- Budget 395 kDKK.

MOMORC

Activity leader – Christopher Rääf (Lund University)

- Report officially due on 31/12-2016, according to contract.
- Highly advanced draft report (ca. 120 pages) received in late April. However some small parts are still missing.
- The final report will be ready for the next Board meeting.
- Budget 525 kDKK.

NORCO

Activity leader – Tanya Hevrøy (NRPA)

- Report officially due on 31/12-16, according to contract.
- Due to scheduling conflicts with the FIGARO facility at the University of Life Sciences, Ås, Norway, some important work had to be postponed for nearly 6 months. The activity was thus already in December 2016 extended until the end of May 2017. Progress reported to be according to new schedule.
- The final report will be ready for the Board meeting.
- Budget 435 kDKK

NKS-B Seminars 2017

EPHSOGAM: Workshop on early phase source term estimation from gamma spectra. To be held in the autumn, probably in Oslo. Only open to specially invited participants nominated by the activity group.

GAMMASPEC: Two-day seminar on gamma spectrometry issues. To be held at Risø, 19-20 September 2017. Announcement made on NKS website / in NKS NewsFlash + NewsLetter. Further information has been posted on www.gr.is/wiki/GammaWiki/.

NEXUS: Nordic exercise for unmanned systems. To be held near Lund on 31 October – 2 November 2017. Observers (limited number) will be welcome. Announcement made on NKS website / in NKS NewsLetter.

NORDIC ICP: Two-day seminar plus one-day lab practice on inductively coupled plasma spectrometry. To be held at Risø, 25-27 September 2017. Announcement made on NKS website / in NKS NewsFlash + NewsLetter.

USER SEMINAR

Seminar Objectives:

The workshop aims to strengthen the education of MSc/PhD students and young scientists and to increase competence of staff involved to explore the application of ICP techniques for different purposes in nuclear and radiochemistry fields.

1) To provide the participants with an overview of state-of-the-art fundamental aspects and instrumental developments of ICP techniques, and the applications of these techniques in interdisciplinary contexts.

2) To provide an opportunity to the participants getting hands-on experience of ICP instrument operation, maintenance, data acquisition and software instruction by participating in practical training in the laboratory.

3) To provide a forum for knowledge and experience exchange on various aspects related to ICP techniques and stimulate international collaborations.

Getting there:

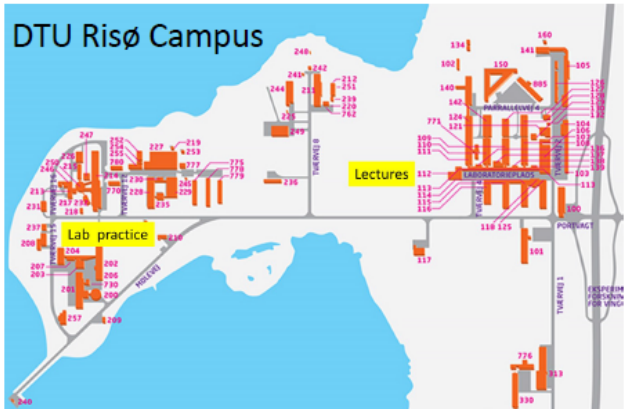
You can find all information you need about getting to the seminar venue at Risø near Roskilde from the following link: http://www.dtu.dk/english/about/campuses/dtu-risoe-campus.

Accommodation:

For accommodation in the Roskilde area, the following hotels can be recommended:
Zleep Hotel (https://www.zleephotels.com/da/hotel/roskilde/)
Scandic (https://www.scandichotels.dk/hoteller/danmark/roskilde)
Comwell (http://www.comwellroskilde.dk/)
Danhostel (http://www.danhostelroskilde.dk/)

Practical Information for Visitors:

You can find a lot practical information for your visit to Roskilde here: http://www.visitroskilde.com/ln-int/roskilde-lejre/tourist
If you would like to visit Copenhagen, you can find a lot practical information here: http://www.visitcopenhagen.com/copenhagen/transportation/practical-information



USER SEMINAR

Development and Exploration of Inductively Coupled Plasma Spectrometry

25-27 September 2017

DTU Risø Campus
Frederiksborgvej 399, Roskilde, Denmark

Welcome !

Dear colleagues,

I am delighted to welcome you to the NKS-B ICP User Seminar (ICP User 2017). It will take place during September 25-27, 2017 near the historic town of Roskilde, Denmark.

This is the first Nordic Nuclear Safety Research (NKS) supported seminar with focus on development and application of inductively coupled plasma (ICP) techniques. The seminar is organised by the Technical University of Denmark, in collaboration with Swedish Defence Research Agency; University of Helsinki; ALS Scandinavia AB; Swedish Radiation Safety Authority and Norwegian University of Life Sciences.

Over the past years, the inductively coupled plasma technique has become the technique of choice in nuclear industry, nuclear forensics, radioactive waste disposal and management, environmental monitoring, emergency preparedness and radioecology for providing accurate and precise measurements. Proficient application of different ICP techniques requires long-term dedicated effort and experiential learning. Facing the worldwide challenges related to nuclear safety, disposal of radioactive wastes, decontamination and decommissioning of closed nuclear facilities, we have seen increased demands for applying ICP techniques in various sectors for effective radiochemical analysis as an alternative to traditional radiometric measurements.

I hope that the ICP User Seminar will be successful in sharing knowledge, exchanging experience and further promoting international collaborations, while you also enjoy the lovely early autumn in Denmark!

With best regards,
Dr. Jixin Qiao
Technical University of Denmark
Chair, ICP User 2017 Organizing Committee

Seminar Venue:

The seminar will take place at DTU Risø Campus, located on the peninsula Risø in Roskilde Fjord 7 km north of the historic Cathedral town of Roskilde and 40 km west of Copenhagen.

Address: Technical University of Denmark
Risø Campus
Frederiksborgvej 399
DK-4000 Roskilde
Denmark

The seminar consists of two parts:

26th and 27th September: Invited lectures and presentations from participants at H.H. Koch, building 112, Risø. Prof. Frank Vanhaecke (Ghent University, Belgium) will give the opening lecture and several highly reputed experts will give invited talks.

28th September: Lab practice in room S15-17, building 204, Risø

Registration:

Please fill in the registration form for ICP User 2017 you will find at http://www.nks.org /en/seminars/upcoming_seminars/nks-b-nordic-icp.htm, and send to htho@dtu.dk. Registration deadline 15th August 2017.

Invitation for presentations:

If you wish to give an oral presentation, please supply a presentation title in the registration form. The presentations should relate to one or several of the following seminar topics:

Fundamental aspects and instrumental developments:

- ICP fundamentals and mechanisms
- sample preparation and matrix effect
- sample introduction and transport phenomena
- removal of interferences
- software and data analysis

Applications of ICP techniques in the analysis of:

- natural and anthropogenic radionuclides
- isotopic ratio of radioactive and stable elements
- environmental studies
- forensic analysis
- geological dating
- biological / clinical / pharmaceutical materials

NKS-B CfP 2018

44 selected potential activity leaders contacted (by telephone, mail or meeting in person) in May, urging them to send in proposals. A number of positive responses came promptly.

Will follow up on this systematically in the autumn when the CfP is announced.

May be useful to ask for Board members' assistance also this year.

Lobbying for CfP2018 will also be made at the GAMMASPEC and NORDIC ICP seminars in September 2017 (NEXUS seems too late).

Young scientist travel applications 2017

Joonas Tikkanen (STUK) for GAMMASPEC seminar

I have been informed that a further 2 STUK people will apply for the same seminar (all have accepted oral presentations):

- Ms. Sinikka Virtanen: Sample preparation for the intercomparison exercise and preliminary results (Phd. student)
- Ms. Tiina Torvela: Recent development of the STUK's whole body measurement system (Phd. thesis 2015)
- Mr. Joonas Tikkanen: Efficiency calibration of a well-type HPGe detector (MSc. student)

+ Mila Pelkonen, MSc Student, University of Helsinki - Laboratory of radiochemistry has applied for funding to go to Nordic ICP seminar.

NKS R & B journal paper writing

Kasper G. Andersson

NKS-B Programme Manager

NKS R&B journal paper(s)

A number of sections have been written on R and B matters for the paper, but integration has proved problematic.

Better to focus on making two articles:

- Better flexibility for journal selection (one half of the paper would be a problem to most journals)
- Length of article
- Diversity of purposes, structures of the two programmes
- Diversity in infrastructures, expertise, network and organization (too many common denominators would be needed in one paper)
- Main purposes of NKS work: collaboration or results
- Better focus on readership
- Should not be too technical but show some clear benefits of NKS – review like
- Cross over material can be presented with focus on both sides

The entire coordination group should co-author both papers (respective PCs as driving force)

How should we prioritise this task?

Preparation for joint NKS R and B seminar 2019

Kasper G. Andersson

NKS-B Programme Manager

Preparation for joint NKS R and B seminar 2019

Program Committee: Tuuli Pyy (Fortum), Astrid Liland (NRPA), Karin Andgren (Vattenfall), Gisli Jónsson (IRSA), Finn Physant (FRIT/NKS), Christian Linde (SSM/NKS), Kasper Andersson (DTU/NKS)

First planning meeting held 29/5-17 at NRPA (PCs and Finn supplied the program committee with background material including 4 ideas for overall themes and some questions for reflection before the meeting)

Seminar scheduled for January 2019. Will it be in Stockholm also this time? Need to decide venue and date with the Board. Could be around 150 participants. No fee for participants.

Allow more time for breaks and discussions. A better balance wrt. female speakers.

Broad seminar scope proposed - Suggested seminar title:

“Radiation protection and nuclear safety & security from philosophy to action”

Preparation for joint NKS R and B seminar 2019

Guidelines (template) should be given to presenters (key speakers, invited speakers and activity representatives) to make them philosophise about specific questions concerning the future rather than just report on work done. They should use plain language, avoiding too many technical details, and be aware of the diversity of the audience. Very strict instructions to be given about timing.

Both plenary and parallel sessions for R and B. Make room for workshopping on new proposals. Panel discussion and summary should focus on what might be beneficial for NKS to fund in the future. Aim at having a statement at the end on which research topics should be addressed by NKS the next 5 years.

Session presentations will be constructed from a mix of key speakers and activity representatives. Representatives will be identified from a list of activities funded in 2016 and 2017, trying to balance male and female. At least one key speaker should be female.

Preparation for joint NKS R and B seminar 2019

Include a poster session (guidelines and good advice to be given – template) for funded NKS projects. Promotes young scientists.

Questionnaires should be handed out at the seminar to assess satisfaction.

Suggested topics:

FIRST DAY:

- Science and values – incl. uncertainties, interaction with the society (inspired by the CRPPH workshop in 2018) (R and B)
- Parallel sessions
  Severe accidents and defence in depth (for reactors, repositories, during decommissioning; what are barriers?) (R)
  NORM (B)
- Severe accidents and emergency preparedness and response (mainly B, also R)
- Poster session

Preparation for joint NKS R and B seminar 2019

SECOND DAY:

- Decommissioning (R and B)
- Parallel sessions:
  EU BSS (the history of the EU BSS – why and how? When is the next? Experience from Nordic countries on the implementation) (R and B)
  Measurement capacities (R and B)
- The graded approach in nuclear safety (dialogue between licensee and public authority; reasonable requirements – cost-benefit analysis; nuclear safety vs money) (mainly R)
- Environmental radiation protection (how do we demonstrate that the environment is protected?) (mainly B)
- Nuclear security (philosophy, IAEA Design Basis Threat analysis, measurement equipment related to nuclear forensics, security culture, experience from other field) (R and B)

Preparation for joint NKS R and B seminar 2019

Time	Topic	Invited speaker
12:00-13:30	Topic 1	
30 min break	Coffee	
14:00-15:30	Topic 2	
30 min break	Coffee	
16:00-17:00	Topic 3	
17:00-17:30	NKS activities	R and B programme managers
17:30	Poster session & reception	
08:30-10:00	Topic 4	
30 min break	Coffee	
10:30-12:00	Topic 5	
1 hour break	Lunch	
13:00-14:00	Topic 6	
30 min break	Coffee	
14:30-16:00	Key speaker. Panel discussion and summary	

Kasper G. Andersson
NKS-B Programme Manager

Short note on status of the website, NewsLetters etc.

The Secretariat

Finn Physant

NKS Board Meeting, Copenhagen
8 June 2017

Website

- The present version of the website was opened in 2012 and still a state-of-the-art day-to-day working tool.
- We will keep an eye with this and – if needed – come back to you with possible update/upgrade proposals.
- For the present sites we started obtaining statistics from a Google site late 2012. Here you have some main monthly figures for the first 4 years:

Data 2013

nks.org user statistics

Date	Dec 12	Jan 13	Feb 13	Mar 13	Apr 13	May 13	Jun 13	Jul 13	Aug 13	Sep 13	Oct 13	Nov 13	Dec 13
Visitors	771	2110	841	727	1030	815	623	577	643	1249	967	742	578
Unique visitors	562	1342	642	550	718	562	459	415	481	803	628	546	459
New visitors	536	1226	539	474	584	448	374	348	406	648	511	461	397
Return visitors	235	884	302	253	446	367	249	229	237	601	456	281	181
Av. session time	2:54	2:36	2:25	2:32	2:40	3:20	2:50	2:32	2:26	3:33	3:20	2:49	3:35
Video 13 views					344	92	55	58	27	48	22	17	19

Data 2014

nks.org user statistics

Date	Jan 14	Feb 14	Mar 14	Apr 14	May 14	Jun 14	Jul 14	Aug 14	Sep 14	Oct 14	Nov 14	Dec 14
Visitors	878	1011	969	722	659	717	823	762	904	865	712	736
Unique visitors	672	763	771	581	471	499	696	620	680	625	536	578
New visitors	380	370	296	203	243	298	178	207	332	356	231	221
Return visitors	498	641	673	519	416	419	645	555	572	509	481	515
Av . session time	2:36	2:09	2:11	2:31	4:27	3:17	2:35	2:28	2:58	3:40	4:01	3:18
Video 13 views	15	11	11	12	5							

Data 2015

nks.org user statistics

Date	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	Oct 15	Nov 15	Dec 15
Visitors	1067	723	1046	848	864	877	673	869	1207	1037	923	822
Unique visitors	751	547	857	648	670	642	524	627	818	665	568	571
New visitors	431	244	249	272	279	551	481	553	680	524	459	440
Return visitors	636	479	797	576	585	326	192	316	527	513	464	382
Av . session time	3:40	3:05	2:17	2:55	2:37	2:30	2:29	2:20	3:00	3:03	2:46	2:45

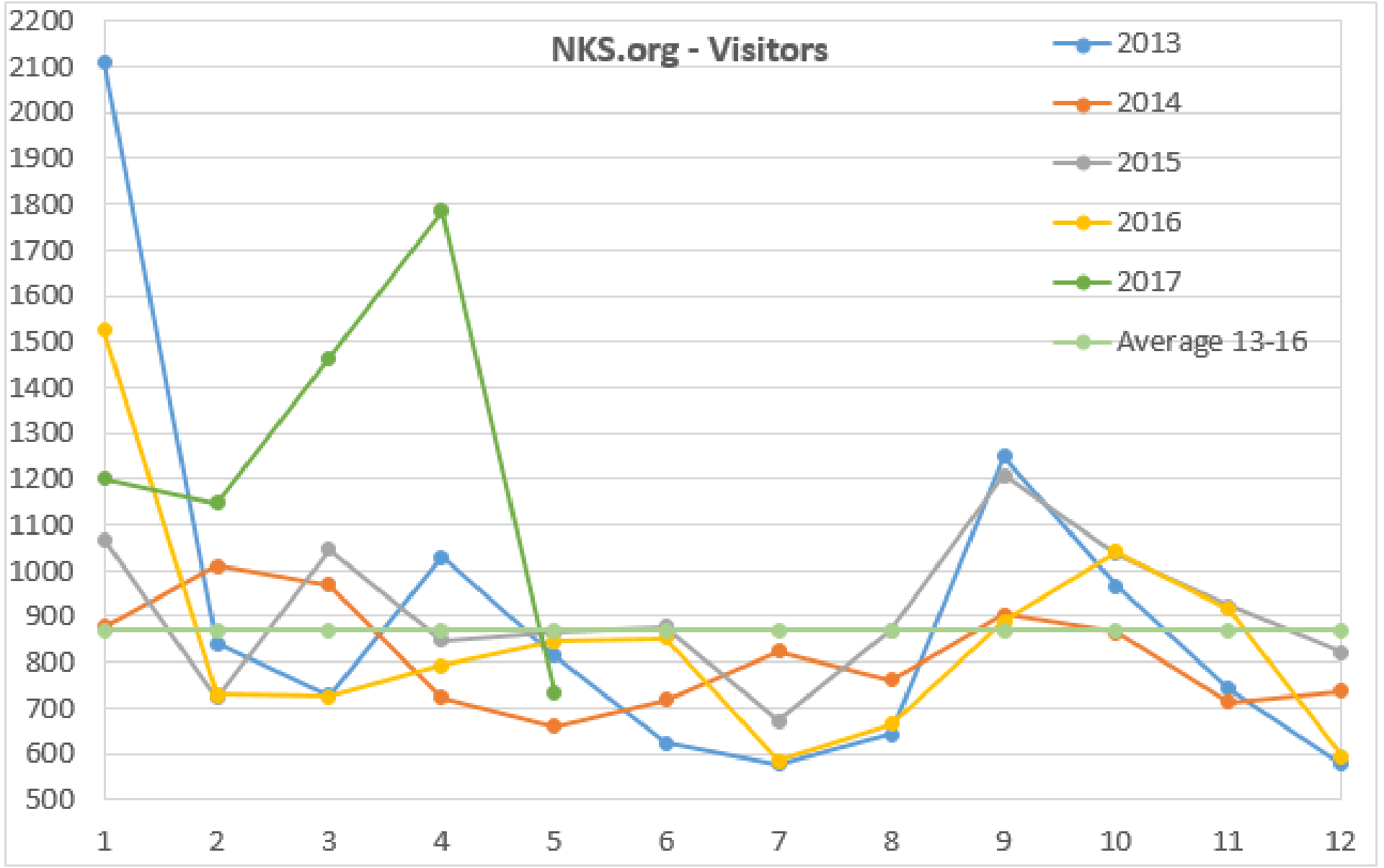
Data 2016

nks.org user statistics

Date	jan/16	feb/16	mar/16	apr/16	May 16	jun/16	jul/16	aug/16	sep/16	okt/16	nov/16	dec/16
Visitors	1523	730	724	792	845	854	584	664	890	1042	915	594
Unique visitors	903	522	536	579	670	589	459	513	621	705	555	420
New visitors	684	403	448	511	583	332	166	460	542	591	478	374
Return visitors	839	327	276	281	262	522	418	204	348	451	437	220
Av. session time	163	184	144	211	137	166	143	161	235	213	227	170
Video 16 views	151	167	23	18	32	16	10	20	25	15	38	21

Data 2017

2017												
Date	jan-17	feb-17	mar-17	apr-17	maj-17	jun-17	jul-17	aug-17	sep-17	okt-17	nov-17	dec-17
Visitors	1201	1147	1464	1785	731							
Unique visitors	703	685	932	931	507							
New visitors	613	582	799	719	432							
Return visitors	588	565	665	1066	299							
Av. session time	170	86	69	67	151							


NKS.org - Visitors
2013
2014
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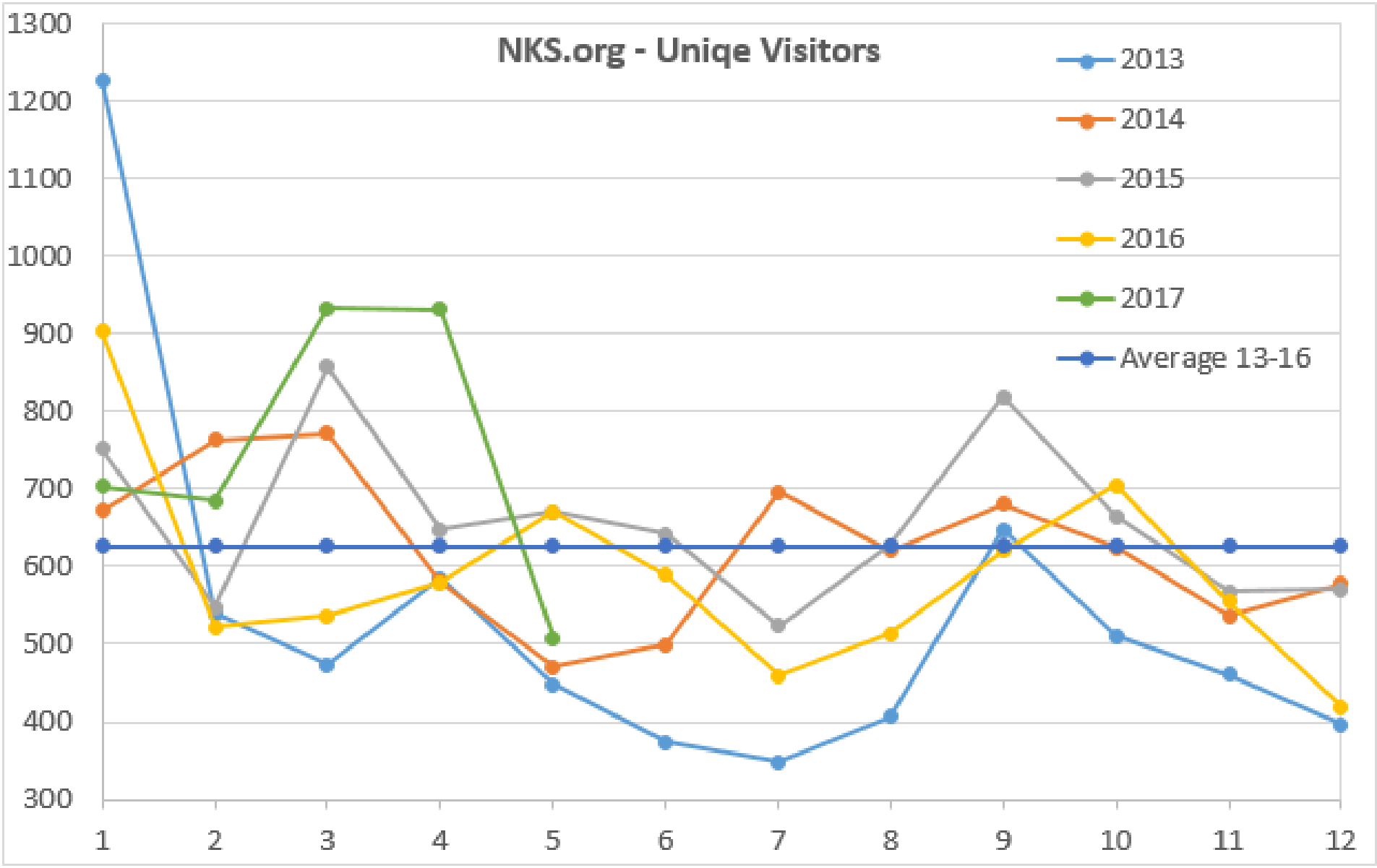
NKS.org - Uniqe Visitors
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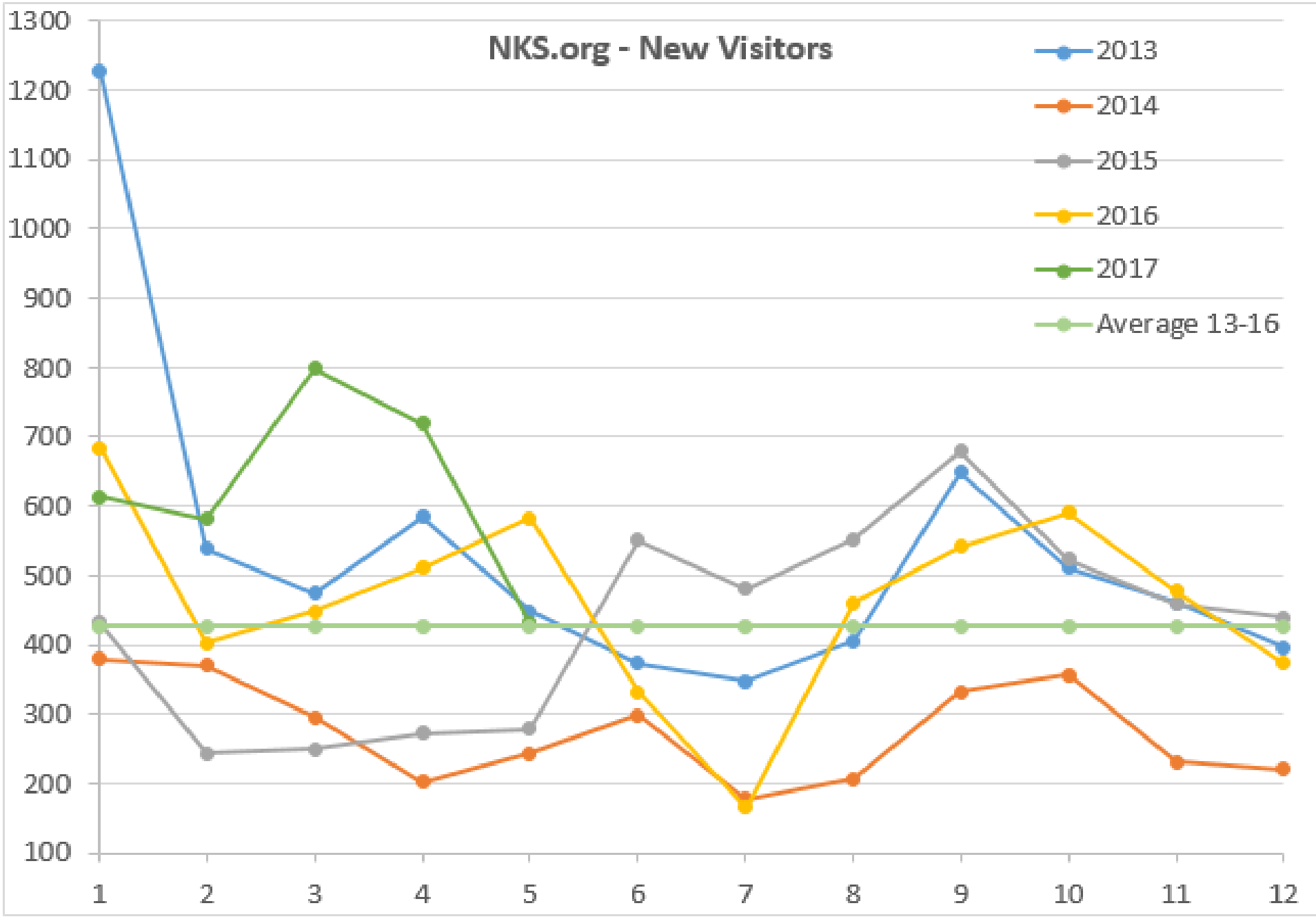
NKS.org - New Visitors
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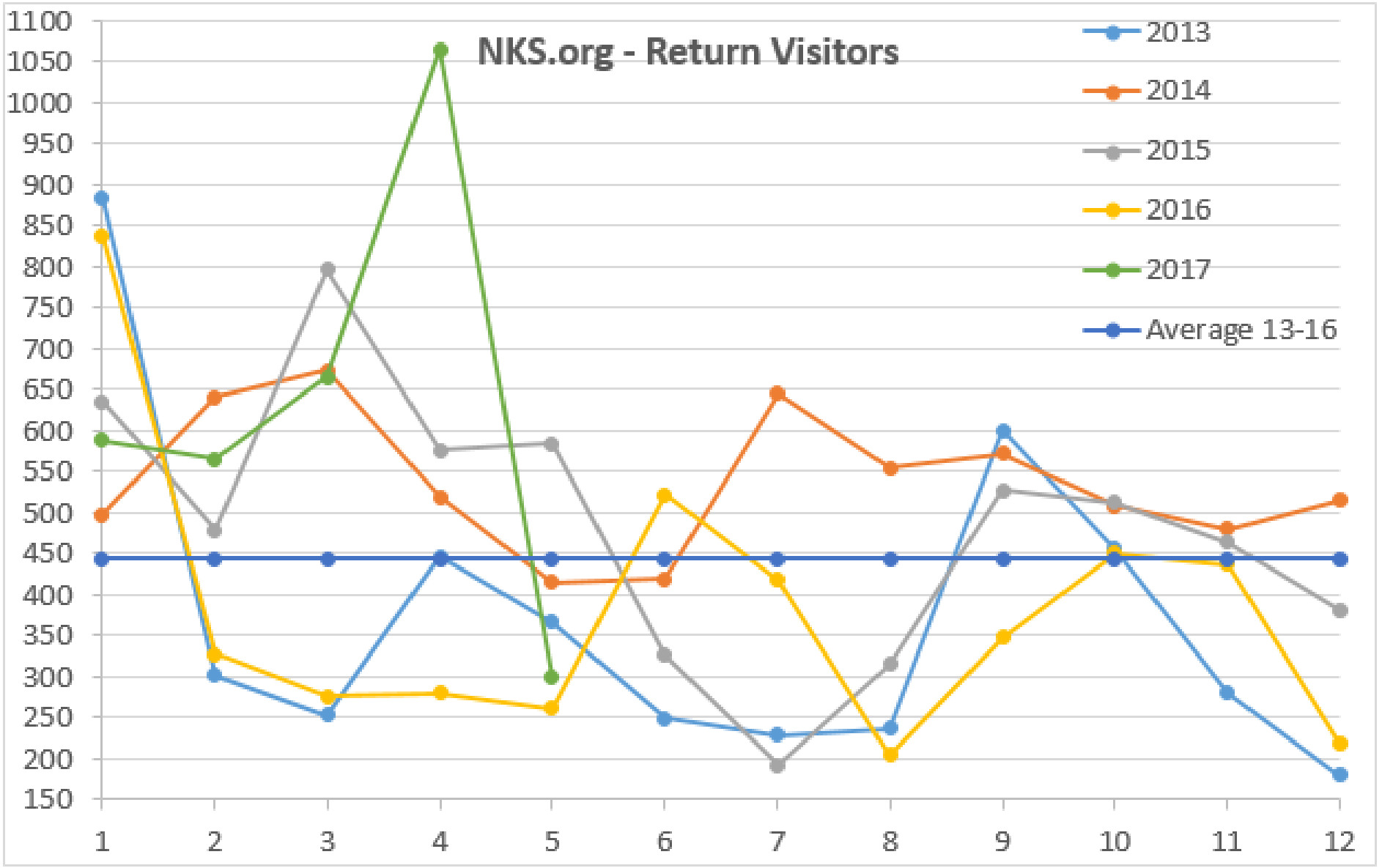
NKS.org - Return Visitors
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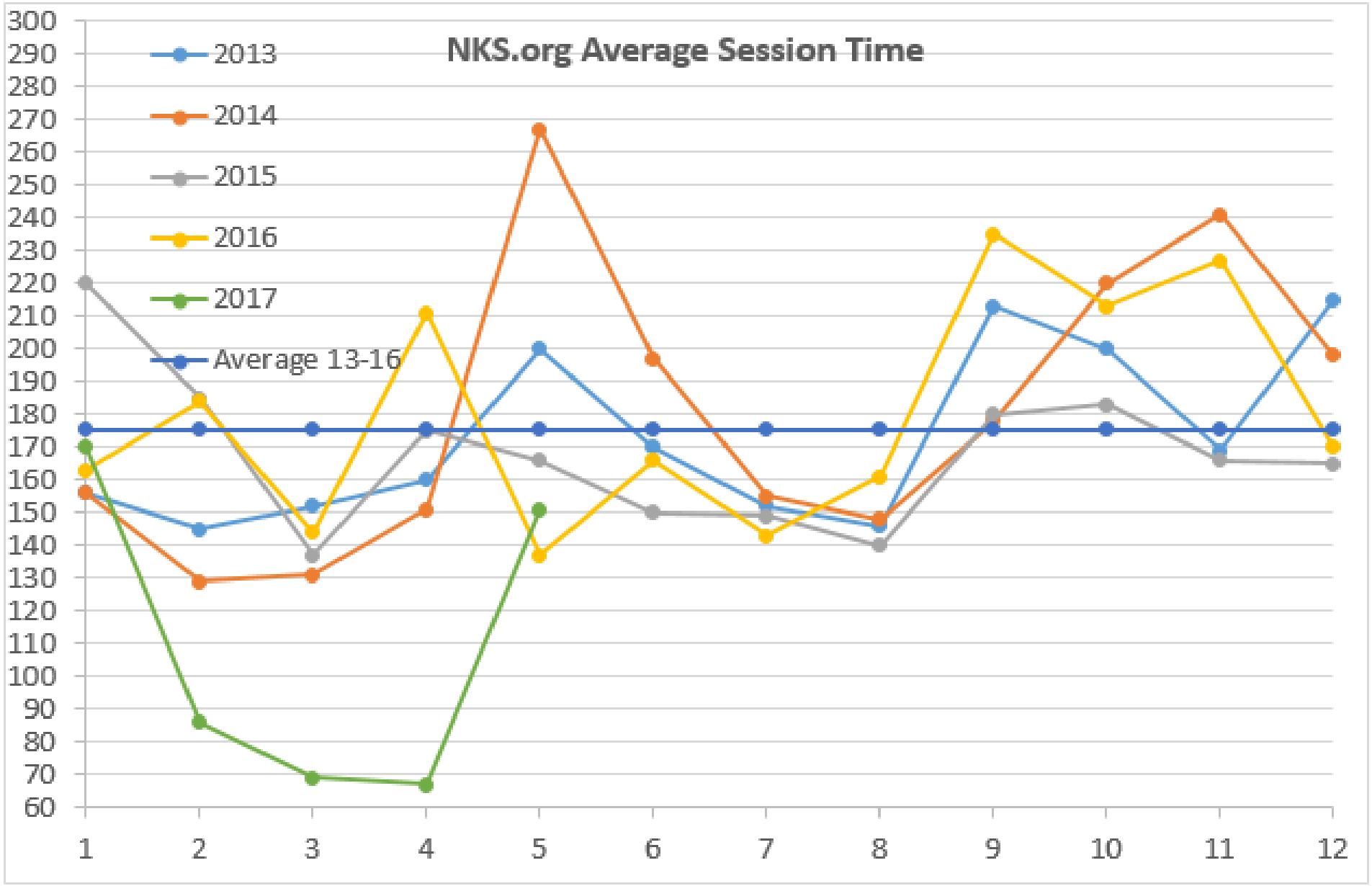
NKS.org Average Session Time
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Average 13-16
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NewsLetters and NewsFlashes

- Since the last board meeting two NewsFlashes have been distributed.
- January 25: summary report from the January board meeting.
- March 29: NKS on LinkedIn, upcoming seminars, new publications and young scientist travel assistance.
- A NewsLetter was distributed a week before this meeting.
- There is a list of more than 500 e-mail addresses, to which our electronic letters are forwarded.
- A NewsFlash will be prepared for distribution within a week after this meeting including a summary report from today's meeting.

Other kinds of info material –new pamphlet

- A new and updated version of the pamphlet "Nordic Nuclear Safety Research" has been published in 2017 (electronic version – not printed).

NKS and LinkedIn

May 2017

Christian Linde
NKS-R Programme Manager

NKS Board meeting, Copenhagen,
8th June 2017

NKS on LinkedIn

- The launch of the NKS LinkedIn page was presented in NewsFlash 76 on March 29.

NKS NewsFlash 76
March 29, 2017

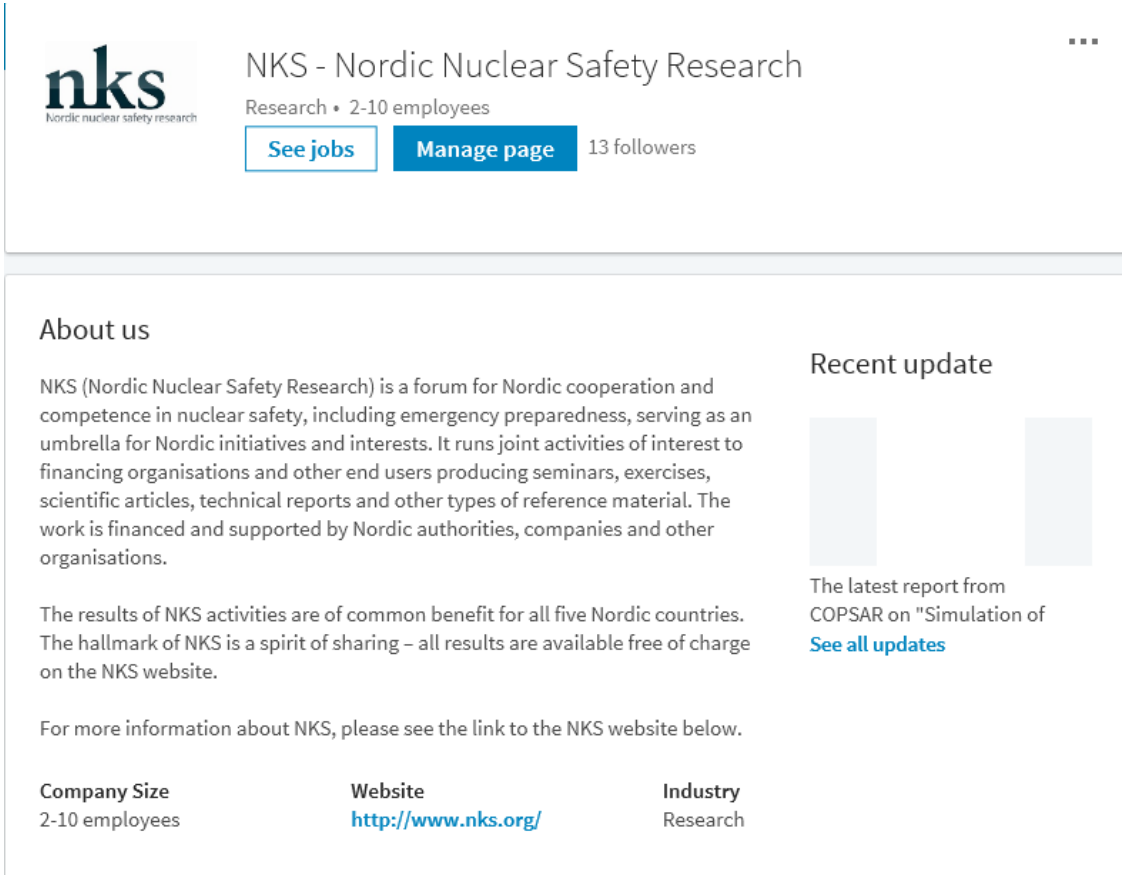
Nordic nuclear safety research

NKS on LinkedIn

Follow NKS on LinkedIn and connect with other followers from the NKS family! Please click on the link below.

https://www.linkedin.com/company-beta/16196099/

NKS on LinkedIn

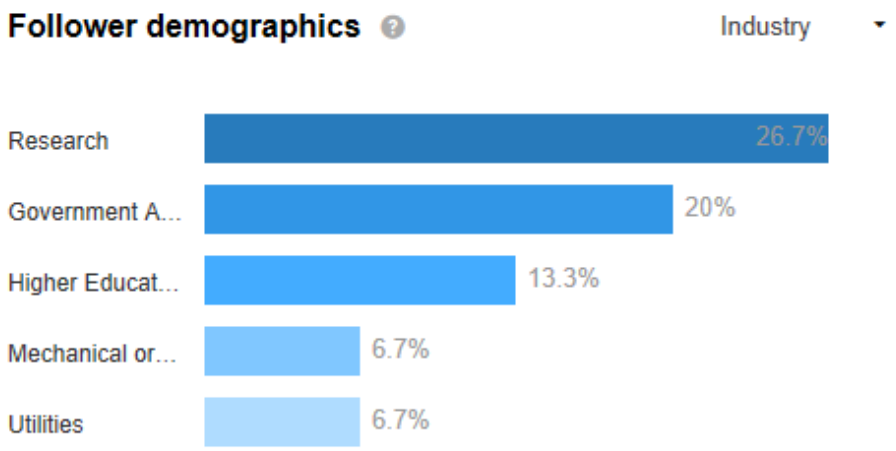


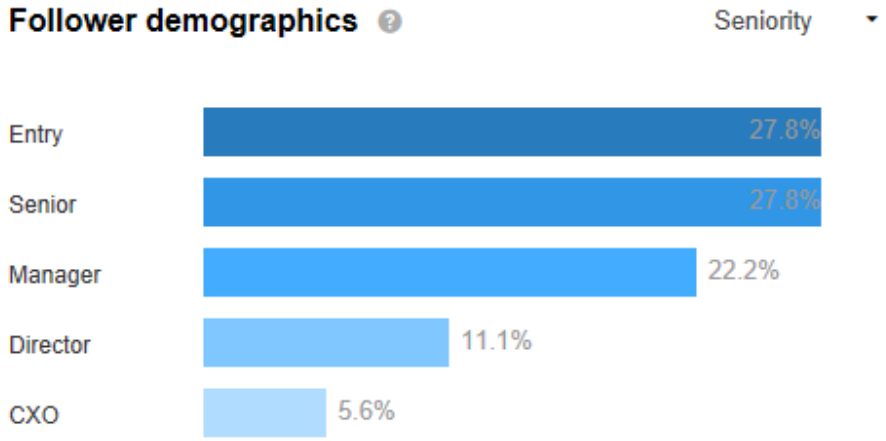
Christian Linde
NKS-R Programme Manager

NKS Board meeting, Copenhagen,
8th June 2017

Follower demographics

Currently 14 followers!

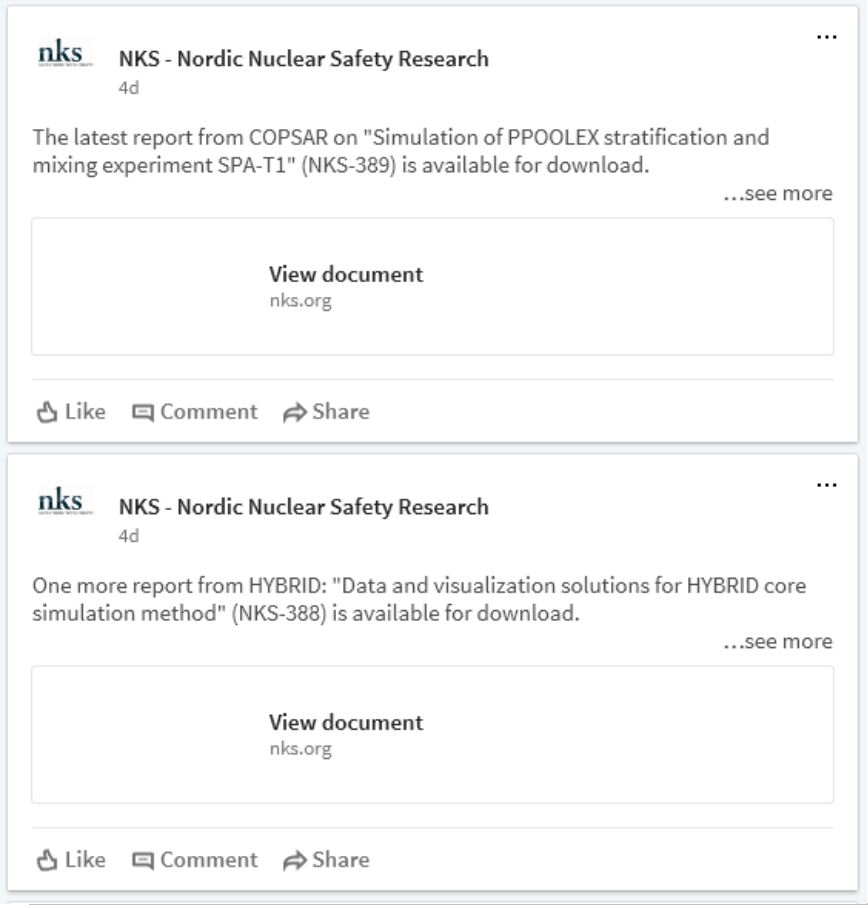


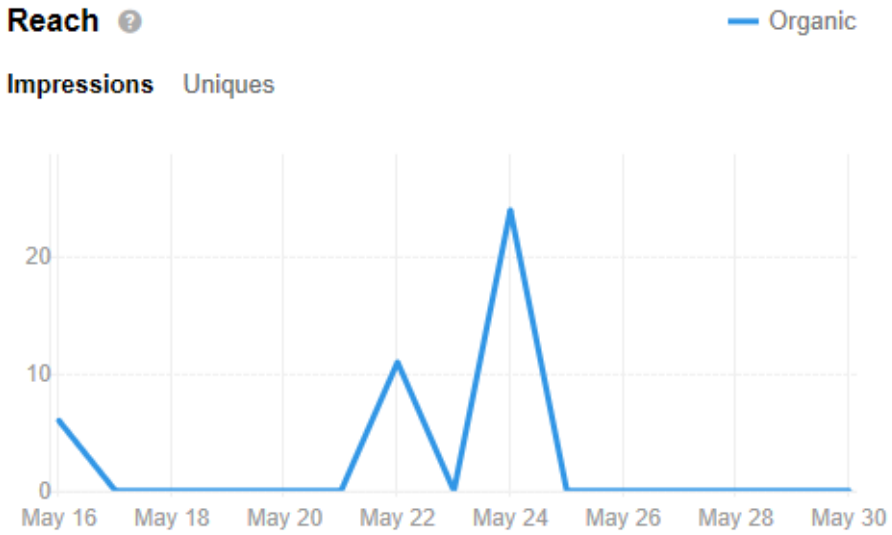


Christian Linde
NKS-R Programme Manager

NKS Board meeting, Copenhagen, 8th June 2017

NKS updates on LinkedIn





Christian Linde
NKS-R Programme Manager

NKS Board meeting, Copenhagen,
8th June 2017

Published updates

Updates

Hover over the title of each column to learn more.

Preview	Date	Audience	Sponsored	Impressions	Clicks	Interactions	Followers Acquired	Engagement
The latest report from COPSAR on "...	4/28/2017	All followers	Sponsor	19	0	0	-	0.00%
One more report from HYBRID: "Dat...	4/28/2017	All followers	Sponsor	20	0	0	-	0.00%
The report "Development of a hybrid...	4/27/2017	All followers	Sponsor	29	1	0	-	3.45%
Share the latest NewsFlash with you...	3/29/2017	All followers	Sponsor	55	2	0	-	3.64%

Christian Linde
NKS-R Programme Manager

Strål säkerhets myndigheten
Swedish Radiation Safety Authority

Authors: Hjalmar Eriksson
August Olsson

2017:09

Evaluation of the Swedish participation in the Nordic Nuclear Safety Research (NKS) collaboration

Report number: 2017:09 ISSN: 2000-0456
Available at www.stralsakerhetsmyndigheten.se

SSM perspective

Background

NKS is a Nordic collaboration promoting cooperation on nuclear safety and emergency preparedness research. The research program is primarily funded by Nordic radiation safety authorities and responsible ministries. The main purpose of NKS is to finance joint Nordic activities and initiatives, including seminars and workshops, technical reports, exercises and scientific articles. Both radiation safety authorities, industries and research actors are engaged in NKS projects

Objective

This is a report on the evaluation of the Swedish participation in the Nordic Nuclear Safety Research (NKS) collaboration during 2008-2015. The study has been com-missioned by the Swedish Radiation Safety Authority and completed by a team of evaluation consultants from Oxford Research. The evaluation has focused on the added value from Swedish participation in NKS and investigated the results and impacts of NKS and effects realised in Sweden.

Conclusions

This study concludes that the relative value of NKS for Sweden, as compared to funding of national research programs or activities, lies in NKS' function as a co-ordination program which supports collaboration of multiple Nordic actors in smaller R&D projects and pilot projects, rather than in its performance in terms of basic indicators of scientific output. Furthermore, the added value of NKS is greater with-in the NKS-B programme as compared to the NKS-R programme, partially due to the wider engagement in the NKS-B programme from multiple Nordic countries. The evaluation further concludes that NKS integrates Nordic knowledge systems, especially within areas covered by NKS-B, and strengthens the capacity for re-search and development within the Nordic emergency preparedness system. The programme promotes a Nordic knowledge base and enables and realises continuity of Nordic cooperation within nuclear safety, which is important for gathering critical mass and continued development in small specialised research groups and environments in Sweden.

The added value of participation in NKS can be strengthened further by promoting thematic focus on topics which relate to common Nordic questions where a broad representation of Nordic actors is possible and by clarifying the purpose and objec-tives of NKS within the owners group. Furthermore, we recommend investigating and working towards synergies with other Nordic research programmes. Promoting the inclusion of Swedish PhD-students could strengthen the impacts of the programme in Sweden.

Project information

Contact person SSM: Eva Simic
Reference: SSM 2016-747

Strål
säkerhets
myndigheten
Swedish Radiation Safety Authority

Authors: Hjalmar Eriksson, August Olsson
Oxford Research, Stockholm

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Evaluation of the Swedish participation in the Nordic Nuclear Safety Research (NKS) collaboration

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This report concerns a study which has been conducted for the Swedish Radiation Safety Authority, SSM. The conclusions and viewpoints presented in the report are those of the author/authors and do not necessarily coincide with those of the SSM.

SSM 2017:09

Content

Abbreviations

Abbreviations used in the report are listed below in alphabetical order

BWR – Boiling water reactor
DEMA – Beredskabsstyrelsen Eng. The Danish Emergency Management Agency
DKK – Danish crowns
DTU –Technical University of Denmark
IFE – Institutt for energiteknik, Eng. Institute for Energy Technology
IRSA – Geislavarnir Ríkisins Eng. The Icelandic Radiation Safety Authority
HRP – Halden Reactor Project
KTH – Kungliga Tekniska Högskolan Eng. Royal Institute of Technology
NCM – Nordic Council of Ministers
NKS – Nordisk kärnsäkerhetsforskning. Eng. Nordic Nuclear Safety Research
NRPA – Statens Strålevern Eng. The Norwegian Radiation Protection Authority
PWR – Pressurized water reactor
SSM – Strålsäkerhetsmyndigheten, Eng. Swedish Radiation Safety Authority
TEM – Eng. The Finnish Ministry of Employment and the Economy
TSO – Technical Support Organisation
VTT – Teknologian Tutkimuskeskus VTT Eng. VTT Technical Research Centre of Finland

Executive Summary

This is a report on the evaluation of the Swedish participation in the Nordic Nuclear Safety Research (NKS) collaboration during 2008-2015. The study has been commissioned by the Swedish Radiation Safety Authority and completed by a team of evaluation consultants from Oxford Research. The evaluation has focused on the added value from Swedish participation in NKS and investigated the results and impacts of NKS and effects realised in Sweden. The work has been carried out through document studies and database analysis of NKS projects, interviews with NKS participants and a workshop with SSM staff. Conceptually, the evaluation has been carried out as a limited programme evaluation including a comparative analysis regarding added values from funding NKS in relation to funding additional national nuclear safety research.

NKS is a Nordic collaboration promoting cooperation on nuclear safety and emergency preparedness research. The research programme is primarily funded by Nordic radiation safety authorities and responsible ministries. The main purpose of NKS is to finance joint Nordic activities and initiatives, including seminars and workshops, technical reports, exercises and scientific articles. Both radiation safety authorities, industries and research actors are engaged in NKS projects.

This study concludes that the relative value of NKS for Sweden, as compared to funding of national research programs or activities, lies in NKS' function as a coordination program which supports collaboration of multiple Nordic actors in smaller R&D projects and pilot projects, rather than in its performance in terms of basic indicators of scientific output. Furthermore, the added value of NKS is greater within the NKS-B programme as compared to the NKS-R programme, partially due to the wider engagement in the NKS-B programme from multiple Nordic countries. The evaluation further concludes that NKS integrates Nordic knowledge systems, especially within areas covered by NKS-B, and strengthens the capacity for research and development within the Nordic emergency preparedness system. The programme promotes a Nordic knowledge base and enables and realises continuity of Nordic cooperation within nuclear safety, which is important for gathering critical mass and continued development in small specialised research groups and environments in Sweden.

The added value of participation in NKS can be strengthened further by promoting thematic focus on topics which relate to common Nordic questions where a broad representation of Nordic actors is possible and by clarifying the purpose and objectives of NKS within the owners group. Furthermore, we recommend investigating and working towards synergies with other Nordic research programmes. Promoting the inclusion of Swedish PhD-students could strengthen the impacts of the programme in Sweden.

1. Introduction

This report presents an evaluation of the Swedish participation in the Nordic nuclear safety research (NKS) collaboration. The evaluation was conducted by Oxford Research during the autumn of 2016, on a commission from the Swedish Radiation Safety Authority.

1.1. What is NKS?

Nordic nuclear safety research (NKS) is a Nordic collaboration promoting cooperation on nuclear safety and emergency preparedness research. NKS comprises Nordic radiation safety authorities, companies and research organisations in the nuclear sector. The main purpose of NKS is to finance joint Nordic activities and initiatives, including seminars and workshops, technical reports, exercises and scientific articles. Results should be practically applicable for end-users within the sector, and made available in all Nordic countries publically and free of charge.

The aim of NKS, by financing Nordic knowledge activities, is to strengthen and maintain Nordic competence, develop close networks between relevant actors in the nuclear area and facilitate a common view and understanding of rules, practice and measures.

1.2. About the assignment

The Swedish Radiation Safety Authority (in this report referred to as SSM, in Swedish Strålsäkerhetsmyndigheten) has commissioned Oxford Research to conduct an evaluation of the Swedish added value from participating in NKS. The evaluation includes investigating the results and impacts of NKS and their effects in Sweden. The evaluation has adopted a broad interpretation of possible end-users and beneficiaries, and includes stakeholders from three institutional spheres: government, industry, and research.

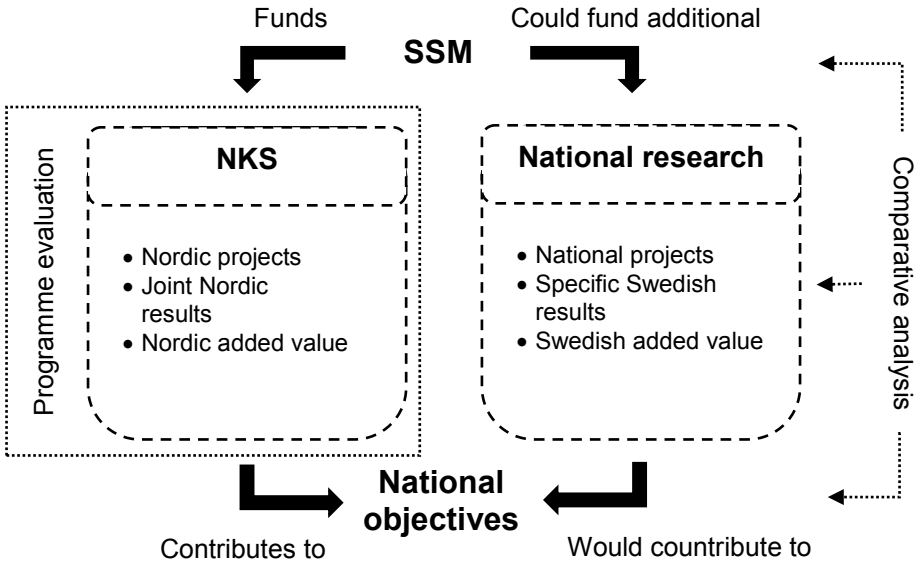
1.3. Framework and evaluation questions

Evaluating the effects of NKS in Sweden is complex. A conventional programme evaluation covers the effectiveness and efficiency of the programme, in relation to its specific purpose and objectives. The conventional evaluation generally includes a comparative or counterfactual component, either quantitatively, by some form of controlled study, or qualitatively, by reasoning based on credible assumptions, comparing with the outcomes of an alternative intervention. Since the aim of the NKS is Nordic added value, but the purpose of this evaluation is to determine the added value for Sweden specifically, there are additional layers of complexity in the evaluation: Sweden's control over NKS is partial and the impacts of NKS in Sweden are indirect and conditional upon the significance of the Nordic added value for Sweden in general, and for the advancement of knowledge within nuclear safety in Sweden. To manage this complexity, the evaluation is based on a robust framework for investigating the added value of NKS for the nuclear safety knowledge community in Sweden.

1.3.1. Framework

A direct comparison between NKS performance with comparable national research of a similar extent is not an adequate measure of the added value of NKS for Sweden. It is also necessary to assess how SSM manages its partial ownership of NKS, and how output from NKS and Nordic added value give indirect effects in Sweden. A priori, NKS could be justified from a Swedish perspective either through being an efficient measure to produce knowledge results, or through producing specific Nordic added value that is unique or especially significant also on the national level. SSM's management of NKS, from coordination with other funding measures to utilization of results and capitalization on added values, are fundamental components in assessing the utility of NKS for Sweden.

Figure 1. Illustration of the framework for the evaluation



We conduct a limited programme evaluation to assess the programme in and of itself. In addition, the management of NKS from Sweden, and the impacts of the programme, especially the indirect impacts in Sweden of Nordic added values, have been investigated. The comparative analysis has been conducted jointly by the evaluation team and the research unit at SSM, drawing upon previous evaluations and existing knowledge about the management of SSM's research funding and impacts of national research to qualitatively asses the role of NKS within the context of Swedish funding of nuclear safety research.

1.3.2. Evaluation questions

In line with the evaluation framework the following evaluation questions have been formulated to guide the investigations:

1. **SSM's management of NKS: How is NKS positioned as a component of SSM's research funding?**
    - What types of added value do the owners expect from the NKS?

- What national objectives should the NKS contribute to? Which systems and routines are used to ensure these objectives are met?
- Which Swedish stakeholders are included in NKS's target group (i.e. project participants and end-users)?
- How extensive nationally based funding does the NKS correspond to? What percentage of the NKS funding has been awarded Swedish actors? How extensive is the Swedish co-financing within the NKS?

2. **The performance of NKS: To what extent is NKS an efficient alternative for the financing of knowledge activities?**
    - What is the output of NKS?
    - How efficient is the production of results and outcomes? How much of the budget is spent on administration?
    - How is the quality ensured in NKS activities and results?
    - To what extent are relevant Swedish actors aware of the NKS? To what extent do Swedish actors participate in NKS activities?
3. **Impacts of NKS in Sweden: To what extent does NKS contribute with specific results and impacts in Sweden?**
    - To what extent is thematic content of NKS relevant for Sweden?
    - How are NKS results used in Sweden?
    - To what extent is Nordic added value realised in Sweden? What are the impacts of Nordic added value in Sweden?
    - How does Nordic added value compare alternative use of the Swedish funding to NKS?

It should be noted that the question of what types of added value are expected from NKS has been treated as an evaluation question to be answered. In the evaluation, we have investigated the logic of how the Nordic added value of NKS should be realised in the member countries, specifically in Sweden. This amounts to an investigation of the intended national added value resulting from Nordic added value.

Here, the concept of "Nordic added value" needs a short explanatory note, in part because it is a composite concept, and in part because it is a key concept for conceptualising the utility of NKS. NKS itself describes its objectives in terms of 'Nordic competence' and 'informal networks in the Nordics', and establishes that Nordic perspectives on research topics are especially relevant. We have used this conceptualisation of Nordic added value as a starting point for the evaluation, asking such questions as: In what respect is Nordic competence different from and additional to the sum of competencies in the Nordic countries? What is the added value of Nordic networks for Sweden? To what extent are there specific Nordic issues within nuclear safety which presupposes a Nordic perspective?

1.4. Methods and material

In this section, we describe the methods and material used in the study. The methodology has been developed based on the framework and evaluation questions above. In short, it consists of the following:

- Introductory exploratory interviews
- Document studies
- Analysis of the project portfolio

- Survey to project coordinators
- Interview study of participants and end users
- Workshop for analysis and interpretation

The introductory elements were conducted to inform the direction of research, especially for formulating hypotheses about Nordic added value, to be investigated in data collection through survey and interviews.

1.4.1. Exploratory interviews

Initially exploratory interviews were conducted with five board members, including the NKS chairman, with the NKS secretariat, and with one high ranking SSM official. The exploratory interviews lasted between 30 and 60 minutes and were mainly conducted by telephone. The topics for the interviews were expectations and objectives of participation in NKS, and understanding of Nordic added value. The results of exploratory interviews were compiled and shared with the NKS chairman and with SSM before survey and interview guides were designed, and is the basis for section 2.2.2 below. Exploratory interviews were followed by private communication via telephone and email, with initial respondents and with programme managers, to further inform the description and interpretation of the inner workings of NKS.

1.4.2. Document studies

Document studies, except studies of the project database, mainly consist of reviewing the historical background of NKS. This forms the main basis of section 2 below. The main sources are the following:

- Marcus (1997). *Half a century of Nordic nuclear co-operation. An insider's recollections.* Nordgraf, Copenhagen.
- Bennerstedt (2011). *Nordic Nuclear Safety Research 1994 – 2008: From standardized 4-year classics to customized R&B.*

1.4.3. Project database

A project database was constructed from successful applications and project contracts for NKS-R and NKS-B projects for the years 2008-2015. Information on the size and distribution of funding and co-funding among participating actors as well as the number and type of actors from each country participating was recorded for each project. The analysis of the project database is presented in section 3.2 below.

1.4.4. Survey

The survey was developed based on the initial investigations of the concept of Nordic added value in a nuclear safety context. It was distributed to all individuals who had been contact persons for an organisation participating in an NKS project during the time-period 2008-2015. In total 243 individuals were identified and the survey was submitted to the 220 individuals for whom function email-addresses could be identified. In total 125 respondents answered the survey which amounts to a response rate of 56,8%.

Overall the response group and non-response group are similar and the respondents can be viewed as a valid sample of the population of NKS project contact persons. However, the slight over-representation of research actors and underrepresentation of radiation safety authority actors should be noted when interpreting the survey results. For the full non-response analysis see Appendix A - Survey response analysis.

1.4.5. Interview study

An interview study was conducted to validate and explain survey results, triangulate results from the project database analysis and the survey study, and to investigate more complex reasoning not uncovered through the survey. The sample of interview subjects was drawn from the contact person population with additional end-user participants being interviewed as well. Swedish, Danish and Norwegian participants were interviewed to gain both a Swedish perspective on NKS, but also to uncover further information on the nature of the Nordic added value of the program from the perspective of countries without a commercial nuclear power industry. To the extent possible, one individual of each type of actor, from each programme, was interviewed in each country. Types of actors being the following:

- Industry
- Radiation safety authority
- Other authority
- Research institution

Individuals who had coordinated projects were prioritized over individuals who had been contact persons for non-coordinating organisations. When multiple coordinators from one country, program and type of actor were identified, the individual with the most project participations was targeted. If multiple individuals had the same amount of project participations the individual who had most recently participated in an NKS project was selected. In addition to project participants two Swedish end-users were interviewed. Chosen due to their engagement in the Nordic PSA group.

1.4.6. Workshop for analysis and interpretation

Preliminary results were presented at a workshop with the SSM research unit. Four SSM officials and two of the team members conducting the evaluation participated in the workshop. The purpose of the workshop was to develop the framework, determining alternative uses of the funding to function as a basis for counterfactual analysis. Preliminary results regarding the added value of NKS were also interpreted, informing the analysis which is presented in chapters 4 and 5 below.

1.5. Structure of the report

This report begins with a presentation of NKS, focusing on the history of the program, the expectations of the owners of NKS, the organisation of NKS and lastly the characteristics of NKS projects. The next chapter characterises the activities of NKS, first by describing the processes of the collaboration, then by a presentation of a project portfolio analysis. Last, a description of the Swedish participants engaged in NKS is presented. Chapter four contains a description of the impacts of NKS on a Nordic and Swedish level. The chapter is based on information from the survey and interview study, and results

are presented on the standing of NKS, the utilization of results from NKS, and the added value of the program. The following chapter shortly summarises the results presented in Chapter 3 and 4 and discussed the value of Swedish participation and the realisation of added values in Sweden. Finally, in Chapter 6, the central conclusions and recommendations of this evaluation are presented.

2. About NKS

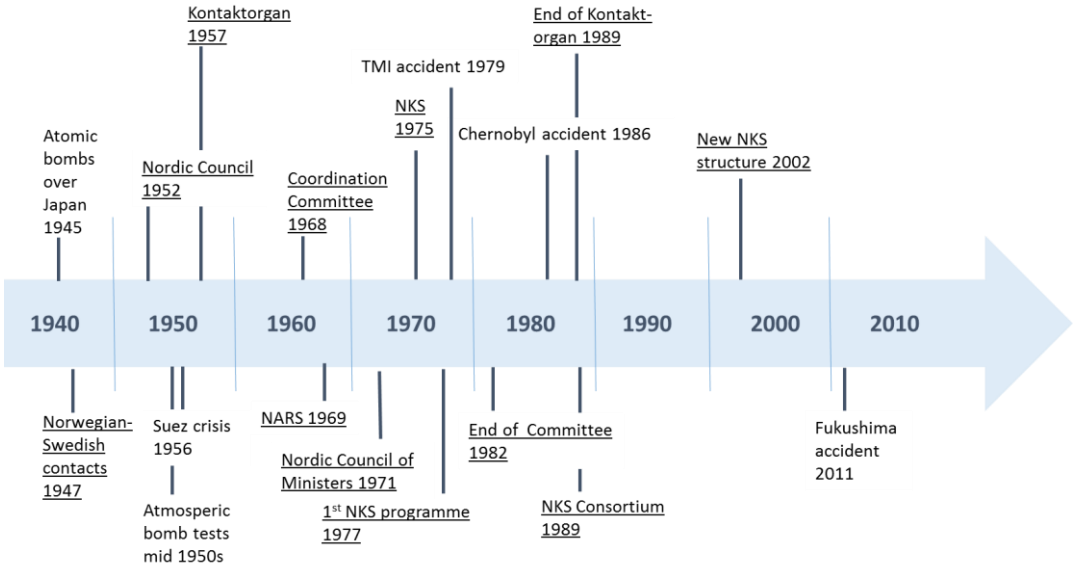
2.1. Background

NKS has a long history. Formal cooperation between senior public officials within the nuclear sector predates the formalisation of cooperation between Nordic government officials in the form of the Nordic Council of Ministers (NCM) in 1971. However, due to the, at times, contested political status of the nuclear sector, the collaboration on nuclear sector topics was never fully integrated into the general framework for Nordic cooperation under the NCM. This is necessary to consider to understand why NKS is organised in the way that it is and its position within Nordic cooperation in general.

2.1.1. A history of the Nordic nuclear cooperation[1]

To understand the development of NKS one must start off from the sensitive state of international security in the late 1940's, when the cooperation has its beginning. After the second world war, the state of national security varied between the Nordic countries and the nuclear technology field was influenced by a number of contemporary events in the world. See the timeline below for a summary of world events and Nordic collaboration within the nuclear sector.

Figure 2. Timeline over the evolution of Nordic collaboration (underlined) and contemporary significant events. After Marcus (1997) supplemented by Oxford Research.



[1] When not stated otherwise the section is based on Marcus (1997). *Half a century of Nordic nuclear co-operation. An insider's recollections.* Nordgraf, Copenhagen.

Communications between Sweden and Norway on nuclear safety research were already taking place in the 1940s, as they both had started to develop research reactors. In 1947 AB *Atomenergi* was created in Sweden. Norway was one of the first countries outside the pioneer countries[2] that developed a research reactor (the JEEP reactor) in 1951 and Sweden followed with its first research reactor located at the Royal Institute of Technology (KTH) in Stockholm in the mid-1950s.

In 1952 the Nordic Council[3] was established, which is a geo-political and inter-parliamentary forum that aims to strengthen Nordic cooperation in a wide range of issues, including social, security and defence issues. Between the 1950's and the 1960's the nuclear field was influenced by a range of occurrences, both international and in the Nordic countries. In 1953 Norway organised the first international nuclear conference and two years later the United Nations organised a conference on the Peaceful Uses of Atomic Energy[4]. The following year, the Suez crisis (and its effect on the imported oil) and the radioactive fallout observed in northern Scandinavia following the atmospheric bomb tests in the mid-1950s, lead to an increased interest in the nuclear field. In 1956 a group of ministers from the Nordic countries gathered to evaluate the prospects for joint actions for the Nordic Council. This lead to the creation of a joint institute for theoretical atomic physics research (NORDITA), a Liaison Committee (*Nordisk Kontaktorgan for Atomenergifrågor, NKA*) to follow technical aspects in the development of the nuclear field, and a Nordic group on radiation protection.

NKA held its first meeting in 1957 and worked as a useful forum for exchanging thoughts and ideas, both political and industrial, consisting of top executives from ministries and other authorities. With the establishment of the international Halden Research Project in Norway, the co-operation between research institutes in the Nordic countries became more practical. The NKA also spearheaded the agreement of the Nordic countries taking turns to occupy one seat in the Governing Board of the International Atomic Energy Agency (IAEA), securing a continuous Nordic presence in that assembly.

In the sixties, the public opinion was in favour of nuclear as the new energy source. This lead to a rise of new joint actions among research institutes. Following a recommendation from NKA to increase collaboration among the Nordic research institutions the Nordic Co-ordination Committee for Atomic Energy, focused on research and development, was established (*the Committee*). Four of the countries also agreed to establish a Nordic working group on reactor safety (NARS), with the task to specify what should be documented in a licence application for a nuclear power plant. Other areas of actions for NARS were safety criteria and emergency provisions within nuclear sites. In parallel constructive cooperation between the Nordic authorities resulted in the publication of Nordic "Flagbooks", which intended to give recommendations on radiation protection in a Nordic context.

2.1.2. The foundation of NKS[5]

Nordic cooperation found a new shape in 1971 when the inter-governmental Nordic Council of Ministers (NCM) was established. The NCM was organised with a secretariat

[2] USA, UK, Soviet Union and France.
[3] The Nordic Council, also referred to as the Nordisk råd
[4] Also known as the Geneva conference in 1955.
[5] When not stated otherwise the section is based on Marcus (1997). *Half a century of Nordic nuclear co-operation. An insider's recollections.* Nordgraf, Copenhagen. And Bennerstedt (2011). *Nordic Nuclear Safety Research 1994 – 2008: From standardized 4-year classics to customized R&B.*

and committees of senior officials in various sectors. The work of NARS was finalised in 1974, resulting in recommendations for bilateral collaboration if a nuclear reactor was to be placed near the border of another Nordic country, as with Barsebäck. An attempt to transform the NKA into an NCM committee failed. However, given that there was now a Nordic project budget, in 1975, NKA established an ad hoc committee on Nuclear Safety Research (NKS) to prepare a research programme which would include contemporary nuclear safety issues. The aim of NKS was to assure the safety of the growing nuclear program in all the Nordic countries. Securing funding from NCM, NKS started its first programme in 1977. A formalised structure was laid down for the NKS programme where the programme was carried out in four-year terms. Since the question of management of radioactive waste had receive increased interest amongst the public during the late 70's, the subject was incorporated in first the program, along with quality assurance in reactor construction, and radioecology. The second and third programmes were also financed by the NCM and required an annual approval of budgets.

In 1980 the second NKS programme was launched. An evaluation of the first programme showed that the projects should either provide a broad increase of competence, or be aimed at clearly defined technical results. The evaluation also showed that the results had not been as widely disseminated as desired, leading to the introduction of final reports. In the second programme safety became a larger issue, much due to the Three Mile Island accident and the programme thus got the name *Safety Research in the Energy Production Field.* In 1985 the second programme ended with the recommendations that future work should concentrate on fewer topics where a firm basis could be provided by national institutions to ensure their actual interest.

For the NCM it was important that NKS' results could be used in non-nuclear fields. When the third NKS programme started in 1985 the programme focused on risk analysis and safety philosophy, radioactive releases from a reactor core and their dispersion and environmental impact. When the Chernobyl accident occurred in 1986, these research areas turned out most relevant. The NKA was however not designed to address security issues and emergency provisions caused by accidents like the Chernobyl, resistance against its activities in anti-nuclear circles increased, saying that NKA was too pro nuclear power, and by now there was competition with other policy areas for NCM project funds and policy development on the Nordic level. The political anti-nuclear climate in especially Denmark lead to conflict regarding future funding of NKS programme and Sweden's withdrawal from the NKA.

With Sweden withdrawing from the NKA, the NKA was effectively dissolved and NKS evolved instead as an important forum for Nordic cooperation. The NKS became independent from the Nordic Council and instead converted into a consortium consisting of the responsible authorities except in Finland, that was represented by the Finnish Ministry of Trade and Industry. The Fourth NKS programme lasted from 1990 to 1994 and included a programme on emergency provisions, which together with radioecology, public information and countermeasures included many of the problems raised after the Chernobyl accident.

2.1.3. NKS 1994-2008[6]

Since the 90's, the NKS has evolved and become a platform for Nordic cooperation and competence in nuclear safety and related safety issues, including emergency preparedness, waste management and radioecology. In the 1990's, the NKS programmes still worked in 4-year terms, however, in 2002, the structure of NKS was changed in order to improve cost-effectiveness and increase flexibility. A new program structure was implemented, consisting of two areas – NKS-R (reactor safety) and NKS-B (emergency preparedness). Projects within the two areas were to receive equal funding. An application procedure was established in which external organisations suggested activities, specified work plans and applied for NKS funding. Activities were no longer automatically prolonged for several years, as in the old 4-year programs and all activity proposals were assessed against a set of criteria established by the Board.

Today NKS is a forum, which serves as an umbrella for activities for Nordic nuclear safety research. Special efforts are made to encourage young scientists and to ensure the Nordic perspectives in the research area. Bennerstedt writes in *Nordic Nuclear Safety Research 1994 – 2008: From Standardized 4-Year Classics To Customized R&B* that

> "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."[7]

2.2. What is NKS expected to contribute?

The overall aim of the NKS is to facilitate a common Nordic view on nuclear safety and radiation protection, which includes emergency preparedness. The Nordic view requires common understanding of rules, practice and measures. More specifically the main objectives of both the NKS-R and NKS-B programmes are set out to be:[8]

- Maintain and strengthen Nordic competence in the areas of nuclear safety and research
- Develop close informal networks between scientists, workers and end users from the relevant Nordic authorities, organisations, industries and university departments that are concerned with the various aspects of nuclear safety and research.

2.2.1. Strategy and themes

NKS funds different types of work related to nuclear safety. This includes emergency preparedness, radioecology, measurement strategies and waste management, areas that are considered to be of importance to the Nordic community. All the projects should be of interest to the owners and financing organisations of NKS and the results must be of relevance, e.g., practical and directly applicable. The proposal for NKS activities can be submitted by either Nordic companies, authorities, organizations and researchers. At

[6] When not stated otherwise the section is based on Bennerstedt (2011). *Nordic Nuclear Safety Research 1994 – 2008: From standardized 4-year classics to customized R&B.*
[7] Bennerstedt (2011). *Nordic Nuclear Safety Research 1994 – 2008: From standardized 4-year classics to customized R&B.* P. 2.
[8] NKS (2016). *NKS-B Framework./NKS-R Framework.* Avaliable at http://www.nks.org/en/nksr/call_for_proposals/ respectively http://www.nks.org/en/nksb/call_for_proposals/ accessed on 2016-11-21.

least three of the five countries should participate[9], however non-Nordic participation in NKS activities are possible, but the activity leader must be from a Nordic country.[10]

The proposals are submitted during annual Calls for Proposal and are addressed according to criteria important to the objectives of NKS, with final funding decisions made by the board of NKS. The activities funded by NKS falls either under the NKS-R programme or NKS-B programme[11], which covers the following research areas:

- NKS-R
    - Thermal hydraulics
    - Severe accidents
    - Reactor physics
    - Risk analysis & probabilistic methods
    - Organisational issues and safety culture
    - Decommissioning, including decommissioning waste
    - Plant life management and extension
- NKS-B
    - Emergency preparedness
    - Measurement strategy, technology and quality assurance
    - Radioecology and environmental assessments
    - Waste and discharges

When evaluating the proposals submitted during the annual calls, focus is both on whether the two main objectives are addressed or not, and on the technical, scientific and/or pedagogic merits of the project and its participants. The proposal should also describe that the output from the activity will be of use to at least one relevant end user group. To ensure a high level of Nordic competence and qualification in the areas of nuclear safety and emergency preparedness in the future, the involvement of young scientists and workers in the projects are encouraged.

2.2.2. Nordic added value

The objectives of the research programmes and selection criteria for projects indicate towards what NKS projects are expected to contribute. We have supplemented these sources with exploratory interviews with board members and representatives of SSM and NKS to further characterise the expected added value of Nordic collaboration within nuclear safety research and knowledge activities.

The greater purpose of the collaboration is that by maintaining sufficient levels of common and up to date knowledge across countries, it contributes to macro-regional resilience, improving the emergency preparedness of joint Nordic society, and the informed understanding of the safety of nuclear installations in the Nordics. Based on a thematic analysis of the interviews we find that there are assumed to be specific circumstances that operate in the Nordic context which contribute to specific Nordic additionalities, realising this purpose. The circumstances have been organised in enablers and commonalities. Enablers are general circumstances in the Nordics while commonalities are spe-

[9] Involvement of only two Nordic countries, in relevant cases: Sweden and Finland, has been accepted in the NKS-R programme.
[10] NKS (2016). *Handbook for NKS applicants*.
[11] Projects may contain elements of both NKS-R and NKS-B and will then be treated as a “cross-over” activity. These activities are most often funded by the NKS-R budget and categorised as NKS-R projects.

cific to the context of nuclear safety. These commonalities are both possible topics for investigation and grounds for common understanding and comparative perspectives. The list of enablers and commonalities are as follows

- Enablers
  - Common language
  - Similar professional and organisational cultures
  - Similar values and views on final political ends
  - Similar institutions and a common Nordic institutional framework (NCM)
- Commonalities within nuclear safety
  - Geographical (sharing risks from accidents)
  - Geological (important for spent fuel repositories)
  - Ecological (similar impacts from accidents)
  - Institutional (similar regulatory environments, similar institutions)
  - Cultural (similar safety cultures, including in operative contexts)
  - Technological (similar (BWR) reactors in Sweden and Finland, similar solutions for spent fuels repositories)

Additionalities from knowledge activities in the Nordics in comparison with activities in another geographical context are, by definition, based on the circumstances listed above. Below, the designation **Nordic** should be taken to mean that the phenomenon offers synergies with the specified Nordic circumstances, that is, that the result is assumed to be boosted by the specific Nordic circumstances and that the impacts manifest and reproduce these circumstances. Impacts are organised by direct and indirect impacts, where indirect impacts are assumed to result over time from aggregate direct impacts, within the two general categories of ‘networks’ and ‘competence’.

Direct impacts have been expected to consist in the following:

- Networks
  - Support to vulnerable knowledge areas through professional exchange contributing to **Nordic** critical mass within a field
  - **Nordic** platform for wider international research collaboration
  - Better research results by illumination from separate **Nordic** perspectives on the common issues
  - Access to independent, but still insightful, **Nordic** third party assessments
  - A **Nordic** forum for concrete scientific topics for high ranking officials
- Competence
  - **Nordic** collaboration to combine supplementary expertise and infrastructure
  - Training of and access to **Nordic** employees
  - Access to **Nordic** employers

Indirect impacts have been expected to consist in the following:

- Networks
  - Trust and familiarity between **Nordic** experts with similar expertise
  - Reserve of specialist expertise contributing to redundancy of **Nordic** expertise for any one country
  - **Nordic** interface for reliable information/news on novel developments

- **Nordic** economy of scale advantages through rational collaboration on commonalities lowering total costs for research and development
- Common **Nordic** ground for policy dialogue

- Competence
  - **Nordic** specialisation of national knowledge systems which is cost efficient
  - **Nordic** understanding of quality and contents of nuclear safety competence: 'Nordic (nuclear safety) competence'
  - Regrowth of experts with **Nordic** competence
  - A **Nordic** labour market

2.3. Organisation

The NKS is mainly financed by Nordic authorities responsible for nuclear and/or radiation safety, with additional contributions from Nordic organizations (co-financiers) that have an interest in nuclear safety. The Nordic authorities constitute the owner of NKS.

The owner and main financiers of NKS are the following:

- 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)

The budget for NKS was in 2016 about 9 million DKK. Participating organisations are also asked to provide a similar amount of in-kind contributions.

Co-financiers of NKS are the following:

- Fennovoima Oy, Finland
- Fortum Power and heat Ltd, Finland
- TVO, Finland
- Institute for Energy Technology (IFE), Norway
- Forsmark Kraftgrupp AB, Sweden
- OKG AB, Sweden
- Ringhals AB, Sweden

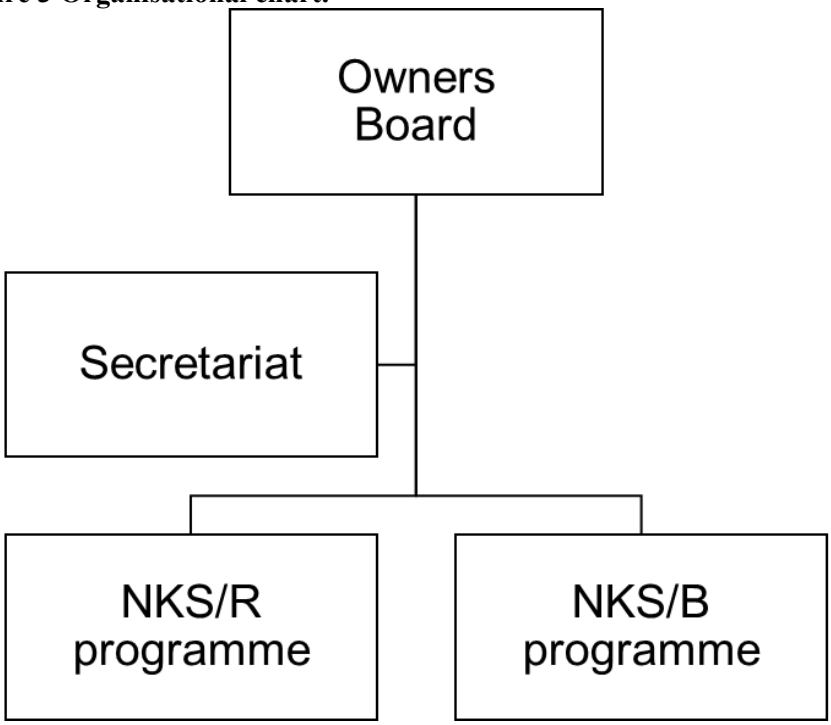
Previous co-financers during the relevant time frame are:

- KSU AB, Sweden (until 2013)
- Nordic council of ministers (procured a report in 2015)

The owners together with experts (appointed by the owners) constitute the NKS Board. The owners decide on matters regarding funding, policy, structure, Board chairmanship, quality assurance and other relevant issues. The Board handles questions regarding priorities, budgets, program plans and activity related issues.

The Secretariat of NKS is appointed by the owners and keeps track of all administrative matters, such as finances, bookkeeping, audits, publication of reports, assisting project leaders, while the programme managers coordinate the NKS-R and NKS-B programme.

Figure 3 Organisational chart.



2.4. Project characteristics

The NKS projects may be of different forms, such as scientific research, including experimental work, or joint activities, test exercises, producing seminars, workshops, courses, exercises, scientific articles, technical reports and other types of reference material. Commonly, all the projects shall be beneficial and made available in all Nordic countries in the form of an end-report published on NKS's webpage. The funding is granted one year at a time and generally runs from January to December.

To receive funding from NKS, the proposal shall fulfil the following requirements:[12]

- Must demonstrate compatibility with the current framework program
- The activities must consist of participation of organisations in at least three Nordic countries in all major parts (see above text for exceptions)
- Results of NKS activities must be publicly available for free
- 50 % of the funding must come from own contributions

In general, an activity will not receive more than 600 000 DKK per year from NKS. The first 50% of the contribution is paid when an activity is started and the remaining 50% when the results of one year's work are available and approved by the programme manager. When applying for funding by NKS, the activity is evaluated by the following criteria:

- If the activity will bring added Nordic value (i.e. increase the Nordic competence and/or build new relevant networks for the NKS.)

[12] NKS (2016). *Handbook for NKS applicants.*

- If the activity demonstrates relevant technical and/or scientific standard
- If the proposed activity has distinct and measurable goals
- If the activity is relevant to the NKS end-users
- If the activity includes the participation of young scientists (i.e. those studying towards a master degree or a PhD, or completed their PhD not more than 5 years ago)
- If the proposed activity has links to other national/international programmes

3. Activities of NKS

3.1. System and routines of NKS

NKS is operated by a coordination group consisting of the NKS chairman, the NKS secretariat and the two programme managers. In this section, we present a summary of the routines and practices involved in managing and administering the collaboration, with a special attention to how quality of funded projects is assured and cost efficiency of the operations.

3.1.1. Quality assurance

In his historical review of NKS 1994-2008, Bennerstedt lists six measures through which quality of the work funded by NKS is monitored and assured. The processes listed are the following:

- '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'[13]

In practice, respondents state that the quality assurance mainly takes place in the assessment of applications, which is the responsibility of the board, the first point on the list above. Programme managers also review reports, for compliance with publication standards, rather than for a full peer review of technical or scientific quality of set up and execution of the project. We elaborate on these procedures below.

In addition to the quality assurance procedures of NKS some respondents point out that quality assurance is performed by other agents as well. On the one hand, participating organisations tend to have their own quality assurance procedures, and NKS reports undergo a regular, internal review. On the other hand, NKS projects are never funded in full by NKS. When funding is supplemented by other funding programmes, the projects and results are monitored by these other programmes as well. In the case of Sweden, Swedish participants are frequently financed by SSM as well as NKS, and the funding from SSM is monitored by an official at SSM.

Another point raised by interviewees regarding quality assurance of NKS projects and reports is that review procedures need to be proportional to the scope of the programme.

[13] Bennerstedt (2011). *Nordic Nuclear Safety Research 1994 – 2008: From standardized 4-year classics to customized R&B*.

Current NKS projects are limited in turnover and time, in a way that does not justify a cumbersome peer review procedure. It could be argued that the timely release of results is an added value that is more appropriate to projects of this scope, rather than the value of greater assurance of quality through independent peer review.

Awarding funding

Funding for proposals is awarded based on a ranking system. Each application is rated on a scale from 1-7 for each of the following criteria: [14]

1. Added Nordic value
2. Technical and/or scientific standard
3. Distinct and measurable goals
4. Relevance to NKS end-users
5. Participation of young scientists
6. Links to other national/international programmes

Assessments of applications are made independently by the board members themselves, within their fields of expertise, which is evenly split between the two programme areas. Some board members supply assessments of all applications using the assistance of experts in each home organisation, as designated by the respective board members. The assessments form the basis for ranking an application. Some respondents report that the policies for this process are not sufficiently elaborated. In a situation when a board member is not familiar with a topic, he or she may designate an expert, in his or her own organisation, to assess the proposal. However, this person may or may not be sufficiently familiar with the topic either, or may in exceptional cases be themselves part of the consortium that submitted the proposal. Since the review procedure for applications is not formally regulated or monitored with respect to these issues their gravity and potential impacts are not established.

In addition to the six criteria given above, activities are ranked by general priority based on an overall assessment. This ranking need not overlap with the rating on criteria such as technical/scientific standard, since the priority ranking includes national priorities. The general overall assessment is the most important criterion. The rankings from the different board members are merged and projects are given a green, yellow or red 'light'. The results of the evaluations are then sent to the programme managers who create a balanced proposal of projects to be awarded funding, usually adjusting funding to green lighted projects to accommodate more projects given a yellow light.

Reporting

Each project funded by NKS is required to submit a final report to be published in the public NKS report database on the NKS website. The reports are screened by the programme managers, to ensure compliance with the publication standards. That is, the programme managers oversee such things as content, reasoning, completeness and readability through a careful reading of the report, but do not, other than in exceptional cases, conduct a full peer review of the technical/scientific standard of methodology and execution of the project. It should be noted that the programme managers are experts in their field and in some cases have returned to the grantee with comments on methodology and scientific content if they find it lacking. At the same time, one person cannot be expected to be a leading expert on all issues within a programme area.

[14] NKS (2016). *Handbook for NKS applicants.*

It may also be that results of NKS projects are published in journals with peer-review. This is encouraged, especially for research activities performed by academic researchers, but is not mandatory. Our survey indicates that some 40 % of participants have publish peer-review articles based on results from NKS projects, with an average of 3 articles published per respondent giving an affirmative answer.[15] This indicates that a sizeable fraction of NKS projects result in academic publications, suggesting that potential discrepancies in quality are at least not generally distributed among NKS projects and participants.

3.1.2. Cost efficiency

Contributions to the NKS varies between the Nordic countries as can be seen in Table 1 and Table 2. No specific algorithm for deciding each country's contribution to NKS exists. Instead, the contributions are determined in negotiations based on previously contributed amounts.[16]

Table 1. 2015 contributions to the NKS budget by country (kDKK)

Country	Contributions by national authority/ministry	Industry contributions	In total
Sweden	3574	280	3854
Denmark	427	0	427
Norway	1050	89	1139
Finland	2531	437	2968
Iceland	179	0	179
Total	7761	807	8567

In addition to contributions presented in Table 1, the Nordic council of ministers (NCM) financed an investigation on the possibilities and needs for Nordic cooperation regarding nuclear waste with 100 kDKK. Interest rates as well as currency gains amounted to 96 kDKK, meaning the total NKS budget for 2015 amounted to 8764 kDKK. Of the total budget, 6801 kDKK was awarded as project funding, 100kDKK was commissioned research for NCM and 100 kDKK was budgeted as travel grants in the annual call for proposals, which means that the overhead costs amounted to 1763 kDKK, or 20 % of the budget. The main overhead costs are the fees for the secretariat, chairman and programme managers. Minor costs include auxiliary activities such as support to funded activities, the 2016 NKS seminar and funding to the Nordic Society for Radiation Protection (NSFS) in 2015, in addition to purely administrative costs such as web hosting, equipment and auditing.

Overhead costs of NKS are high compared to research councils: for the Swedish national research councils it is common to carry less than 10 % overhead. Another relevant comparison is with the Nordic Institute for Advanced Training in Occupational Health (NIVA). NIVA is an institute under the Nordic Council of Ministers promoting the dissemination of research results and advanced knowledge within occupational health and safety

[15] Publication is more common in the countries without nuclear industry, however, this effect is driven by the fact that industry actors are under-represented among participants publishing in peer-reviewed articles and industry actors come from Sweden and Finland as can be seen in Figure 6 and Figure 7 in chapter 4 below.

[16] This can be contrasted with the Halden Reactor Project, for which a formula for calculating fees, based on GDP, GDP/capita and installed nuclear power, has been developed. See Oxford Research (2016). *Evaluation of the Swedish participation in the Halden Reactor Project 2006–2014.* Report 2016:29, Swedish Radiation Safety Authority.

in the Nordics, through different dissemination activities. In 2012, NIVA's staff costs amounted to 54 % of the total budget of 542 kEUR. The costs relating directly to activities amounted to 63 % of total costs. The type of activities arranged by NIVA are similar to a subset of NKS activities, such as seminars, training and exercises.[17] A comparison with Nordic research programmes such as Nordforsk or Nordic Energy Research could also be illuminating.

According to survey results, Swedish respondents took part in 64 peer-review publications during the time period. If the same level of academic publication is presumed for Swedish contact persons who did not answer the survey, Swedish participants can be estimated to have co-authored a little more than 100 peer-reviewed publications based on NKS results during the time period. Note that multiple Swedish actors could have partaken in the same publication why the total number of articles is most probably lower than the estimate. The estimate can be compared with 120 publications resulting from the three professorships in radiation safety funded by SSM 2008-2013, receiving almost an equal amount of funding during this period as what SSM contributed to NKS during the time frame under consideration. The contribution from these leading researchers also considerably strengthened the research environments at their host institutions in two of three cases.[18] The relative effect of funding NKS over national programmes, that is its additionality, on the basic viability of Swedish research environments, as measured by rate of peer-reviewed publication and capacity building, is then assessed as slightly negative.

Considering cost efficiency of operations and output, one should take into account that NKS is a small funding programme providing a highly specialised funding opportunity. The overhead costs are higher than for a major research council, but are not high in comparison with similar Nordic institutions, suggesting that the costs of 'staffing' the operations are adapted to the character of the programme. We can conclude that NKS contributes to knowledge creation in Sweden, as measured by peer-reviews publications, is on par with national support to leading researchers. This suggests that it is the more elusive and indirect Nordic added value, rather than superior performance in knowledge production, that justifies NKS, but also that the performance on knowledge production is comparable to national programmes, and that the efficiency of the programme is not cause for criticism.

National distribution of NKS grants

Below is a presentation of the total contributions from the Nordic countries to NKS and the amount of funding received by actors in the Nordic countries. There is a moderate connection between each country's contributions to NKS and the funding received by actors separated by country.

[17] Oxford Research (2013). *Evaluation of NIVA. An evaluation of The Nordic Institute for Advanced Training in Occupational Health's activities 2003-2012*. Available at: http://oxfordresearch.se/media/279078/Evaluation%20of%20NIVA_Final%20report.pdf

[18] For further discussion on the additionality of SSM:s funding of senior research positions in Sweden see Oxford Research (2016:07). *Utvärdering av tre seniora forskartjänster inom strålskyddsområdet.* SSM

Table 2 Total contributions to NKS, 2008-2015, by country compared to received project funding from NKS. Amounts are presented in kDKK.

Country	Contributions by national authority/ministry	Industry contributions	In total	Funding received from NKS	Return on contributions
Sweden	29137	2526	31663	16192	51%
Denmark	3852	0	3852	6035	157%
Norway	8912	655	9567	9862	103%
Finland	19848	3064	22912	16030	70%
Iceland	1396	0	1396	2637	189%
In Total	63145	6245	69390	50756	73%

Note that in addition to project funding awarded to country participants a small portion of project funding is often non-country specific as seen in Figure 11 (for example to cover administrative costs for a seminar). Moreover, each year 100 kDKK of NKS' budget is budgeted to travel grants which are not included in the compilation in Table 2.

Nordic cooperation within the Nordic Council of Ministers is generally governed by the principle that the funding received by actors in each country over time should correspond to the country's share of contributions. This is clearly not the case for NKS. However, within matters of nuclear safety research, one could argue that countries with nuclear industry should contribute more in relation to funding received. Furthermore, Swedish actors participate in almost all projects and activities. Even though a corresponding amount of funding is not awarded to Swedish actors, Swedish actors extract knowledge and information through participation in projects. If one views the funding from NKS as funding for coordination of Nordic research activities, Swedish actors are promoted not only by being awarded funding but also by being a part of the Nordic knowledge community, and extracting knowledge as well as building professional relations with experts in other countries. In addition, strong knowledge communities in neighbouring countries is itself important for emergency preparedness in the region neighbouring Swedish territory, which is clearly relevant also for the Swedish emergency preparedness system, why the gains for Sweden in participating in NKS cannot simply be evaluated based on funding contributed to Swedish actors, but is a matter of assigning value to auxiliary benefits, which is a strategic question within broader nuclear safety policy.

3.2. Project portfolio

During the time-period 2008-2015, NKS has awarded funding to a total of 145 projects. 73 of these projects have been awarded funding from the NKS-B program and 70 projects from the NKS-R program. In addition, two projects have been awarded funding from both the NKS-R and the NKS-B program.[19] A few projects solely funded by NKS-R have been recorded as covering both the areas of NKS-R and NKS-B. These 'R and B' projects cover areas such as PSA (probabilistic safety assessments) level 3, Safety assessments through CFD (Computational fluid dynamics) and decommissioning.

Below is a presentation on how participation in NKS-R and NKS-B projects is split between countries and actors, and the allocation project funding by program and country.

[19] The RASTEP-project received funding from both NKS-R and NKS-B in both 2011 and 2012.

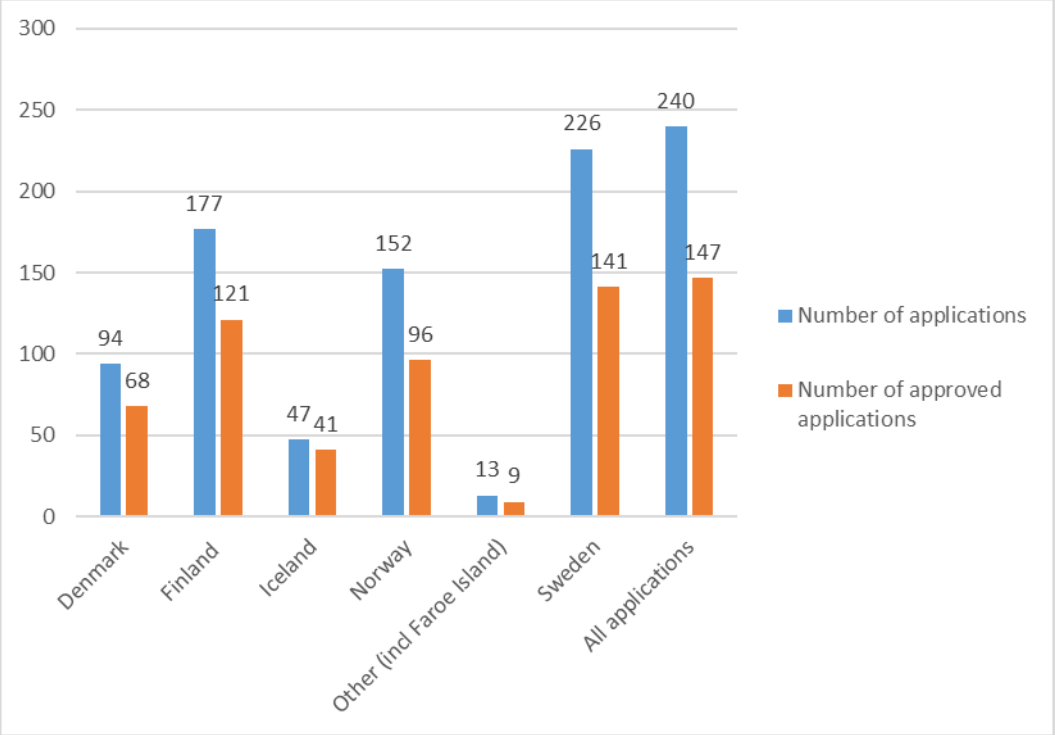
3.2.1. Participation by country

In this segment project portfolio data on the project participation of actors from the Nordic countries will be presented and discussed. Sweden is the most active country in NKS, having participated in almost every proposal to NKS, and therefore in nearly all projects that have been financed during 2008-2015. As can be seen in Figure 4, a total of 240 applications were submitted to NKS during the investigated time period, and at least one Swedish actor was a partner in 226 of those applications. A Swedish actor was suggested as a coordinator for 96 of the submitted applications, and a Swedish actor coordinated 45 of the approved activities during the time period.

The average application success rate for each country is given by comparing the number of applications and the number of approved applications for each country as presented in Figure 4. The success rate ranges between 50-100% depending on year, country and program. On average the success rate for applications is around 60%. There are only small differences in success rates by program. However, countries participating in fewer applications (such as Denmark and Iceland) generally have a higher rate of success for applications they are a part of, compared to countries that are active in almost all applications, such as Sweden. Since Swedish actors have been participating in almost all applications, the success rate for applications with Swedish actors is 62.4%. This can be compared to applications with Danish partners, which have a success rate of 72.3%. It should be noted that actors from Denmark, Iceland and Finland have a higher success rate for applications where they are coordinating the activity, in comparison to when they are project members. For Norway, the success rate is close to equal. Swedish actors on the other hand have a success rate of 46.9% for applications where the Swedish actor is coordinating the activity, compared to 73,8% when the Swedish actor is a project member. One explanation for the low performance for applications with Swedish coordinators could be that each year Swedish actors submit at least one application with participation from only Swedish actors. Since the rules of NKS stipulate that at least three Nordic countries should be involved in a project, projects with participation form only one country are very seldom approved.[20]

[20] On occasion applications with only Swedish actors have been approved, such as the INCOSE-project 2009-2010.

Figure 4 Number of submitted and approved project proposals during 2008-2015 grouped by involvement of actors from the Nordic countries.



Many NKS projects have more than one participating actor from each country as shown by comparing the following three graphs (Figure 5 - Figure 7) with Figure 4 above. During the time period a total of 203 Swedish actors took part in 141 projects. Note that the graphs below describe the number of project participations from actors in each country. That is, if two Swedish organisations have both been active in two projects during the time period, a total of four participations have been noted.

Figure 5. Number of project participations by actors divided by country and program for 2008-2015.

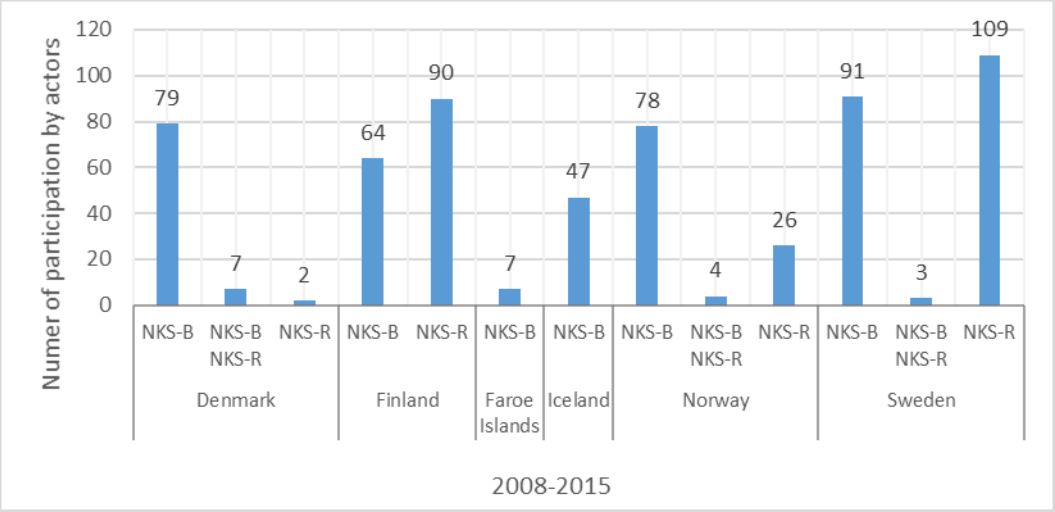
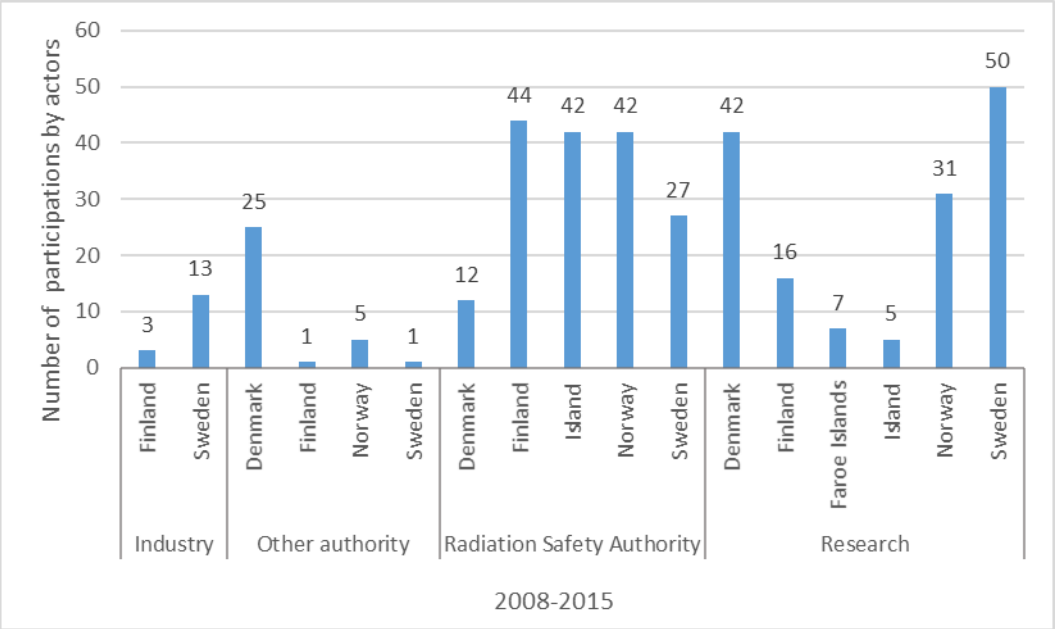


Figure 6 and Figure 7 describe the number of project participations from actors in each of the Nordic countries divided by type of actor for the NKS-B program and NKS-R program separately. It is important to note that the graphs do not provide information on the number of unique actors active within NKS, but the number of participations from actors in each country. For example, only two different research actors from Denmark were active within NKS-B during the time period. Participants from the Danish Technological University (DTU) stood for 40 of the 42 project participations by Danish research actors. To compare a total of eight research actors from Sweden were active within NKS-B during the time period with an average of 6.25 project participations per actor.[21]

Figure 6. Number of project participations by actors in NKS-B projects, divided by type of actor and country.

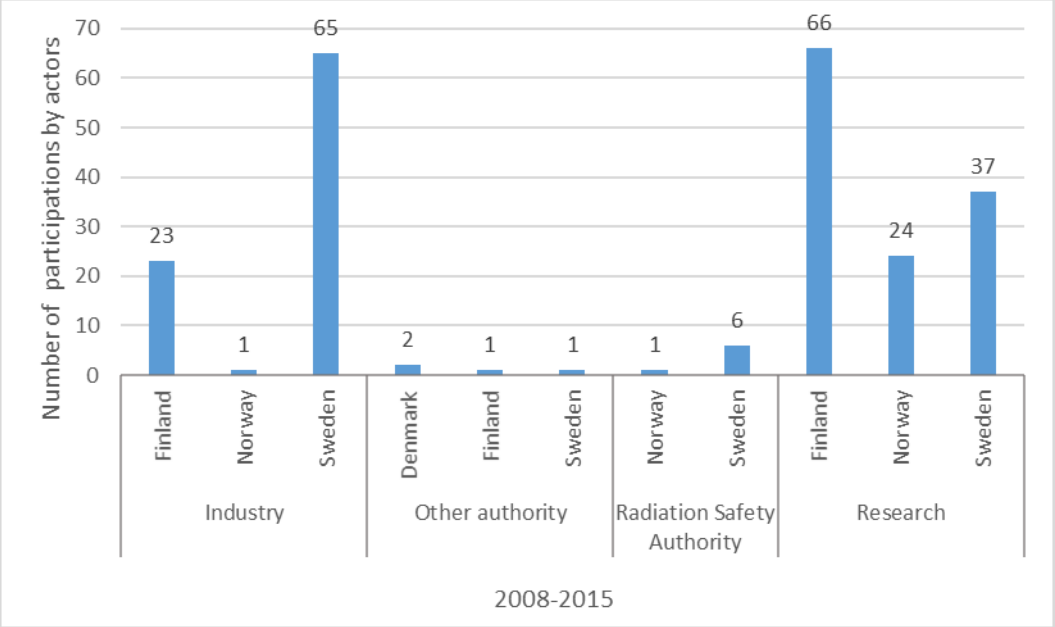


Note that the high number of participations from "Other authorities" in Denmark is due to the Danish Emergency Management Agency, DEMA (Beredskabsstyrelsen) being categorised as "Other authority".

Mainly actors from Finland and Sweden are active in the NKS-R program, as can been seen in Figure 7. Norwegian participation in NKS-R is almost exclusively made up of participations from IFE, either by individuals working with the Halden Reactor Project or at the Kjeller research reactor. Swedish industry, often in form of technical consultants, and Finnish research actors, predominantly VTT, are the main actors within the NKS-R program.

[21] For a full list of unique Swedish actors, see segment 3.3.

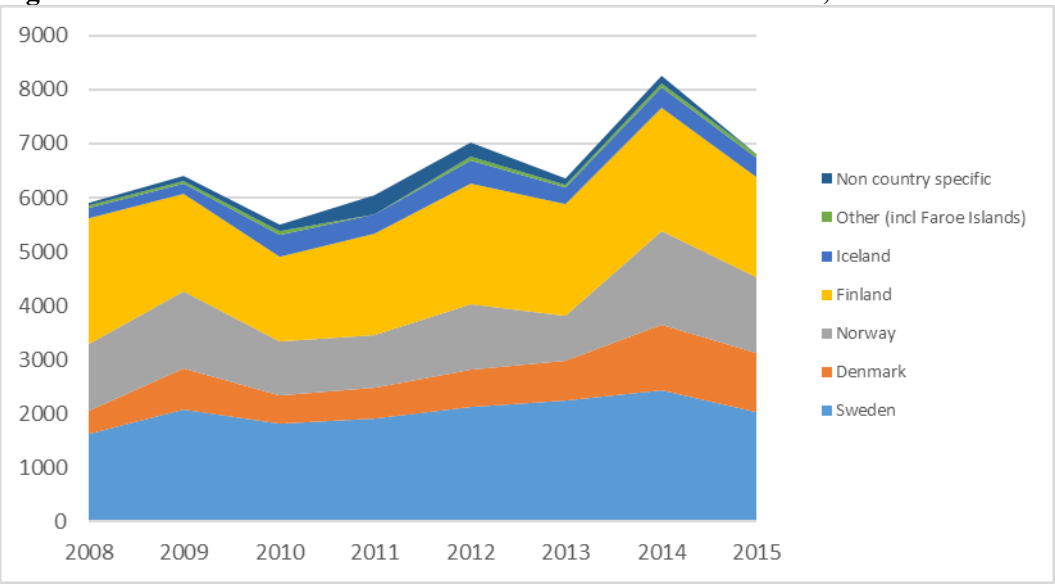
Figure 7. Number of project participations by actors in NKS-R projects, divided by type of actor and country.



3.2.2. Project funding and co-funding

Below the distribution of NKS project funding and the distribution of project co-funding is presented. The information is presented separately for NKS-B and NKS-R to highlight the differences regarding proportion of project co-funding and Nordic participation.

Figure 8. Distribution of NKS funds between the Nordic countries, 2008-2015



NKS R

As previously noted, actors from Sweden and Finland are the primary participants in NKS-R projects. This can be seen in the distribution of NKS funds presented in Figure 9. Finland and Sweden receive most of the funding within the program. NKS-R projects are

heavily co-funded which can be seen in Figure 10. NKS demands that project participants provide co-funding equal to the amount of funding from NKS. However, within the NKS-R program project co-funding equals to more than twice as much as the NKS funding as can be seen by comparing Figure 9 and Figure 10. The high amount of co-funding of NKS-R projects indicate lower additionality of the NKS-R program in relation to the NKS-B program. The project portfolio data indicates that NKS-R projects, to a higher degree than NKS-B projects, would have been realized if NKS funding had not been granted.

Figure 9. Distribution of NKS-R funds between the Nordic countries, 2008-2015. [22]

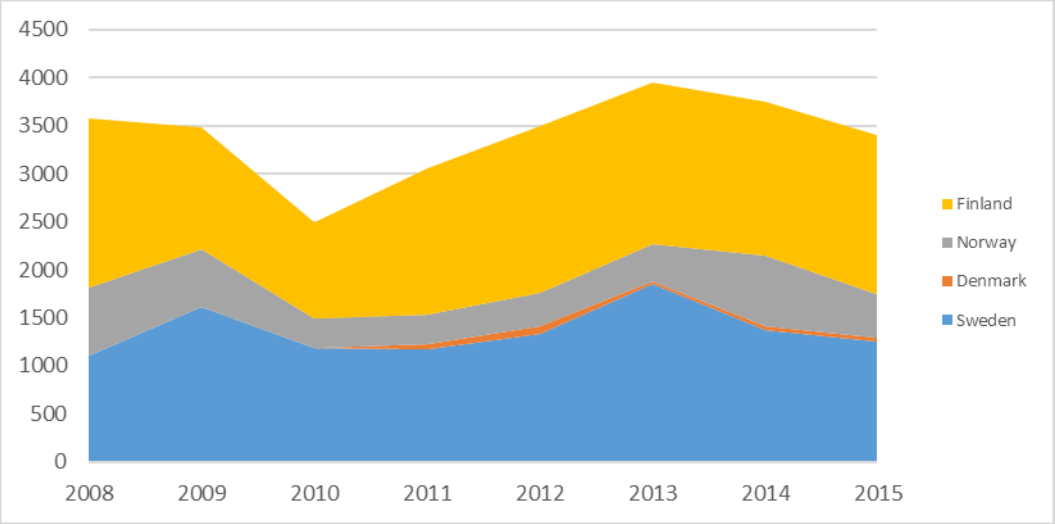
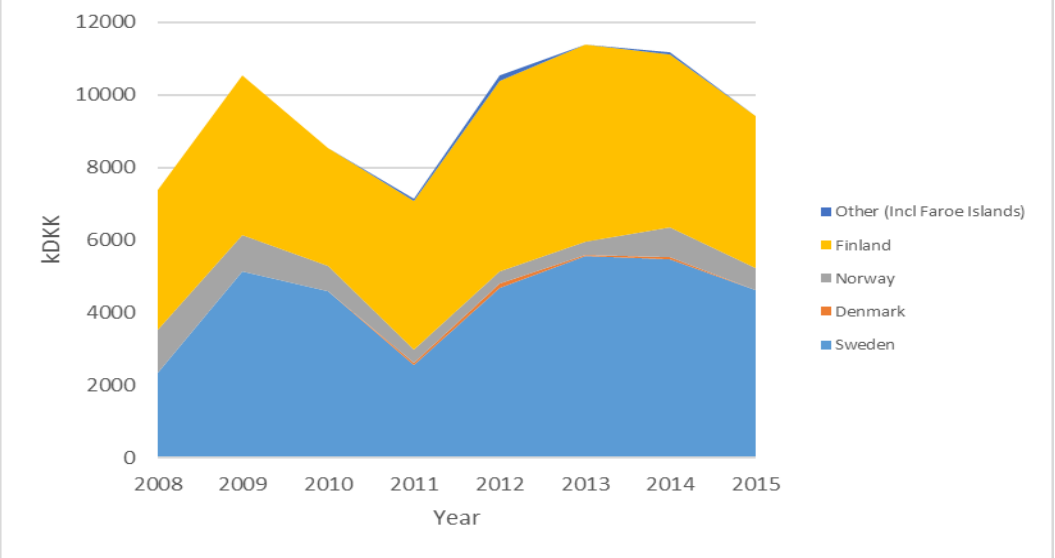


Figure 10. Distribution of expected co-funding of NKS-R projects between the Nordic countries, 2008-2015. [23]



[22] Note that records for 2008-2009 are not as specific as records for later years. For these years the distribution of project funds between project members are not avaliable. For 2009 the distribution presented in applications has been used to allocate funds to different country participants. For 2008 the distribution from subsequent projects has been used. In cases where no subsequent project exist all funding has been attributed to the coordinating organisation.
[23] Applications for the NKS-R program for 2008 are not available why information on co-funding is generally missing. For projects spanning several years the level of co-funding for later years has been assumed for 2008 as well. For remaining projects co-funding equal to the amount of NKS funding has been assumed (in accordance with NKS rules).

NKS B

The distribution of NKS funds and project co-funding for the NKS-B program, grouped by country, is presented below. All Nordic countries are active within the NKS-B program, and actors from Denmark, Norway and Sweden, have generally received the largest amount of funding. Project co-funding is generally in proportion to the NKS funding.

Figure 11. Distribution of NKS-B funds between the Nordic countries, 2008-2015.

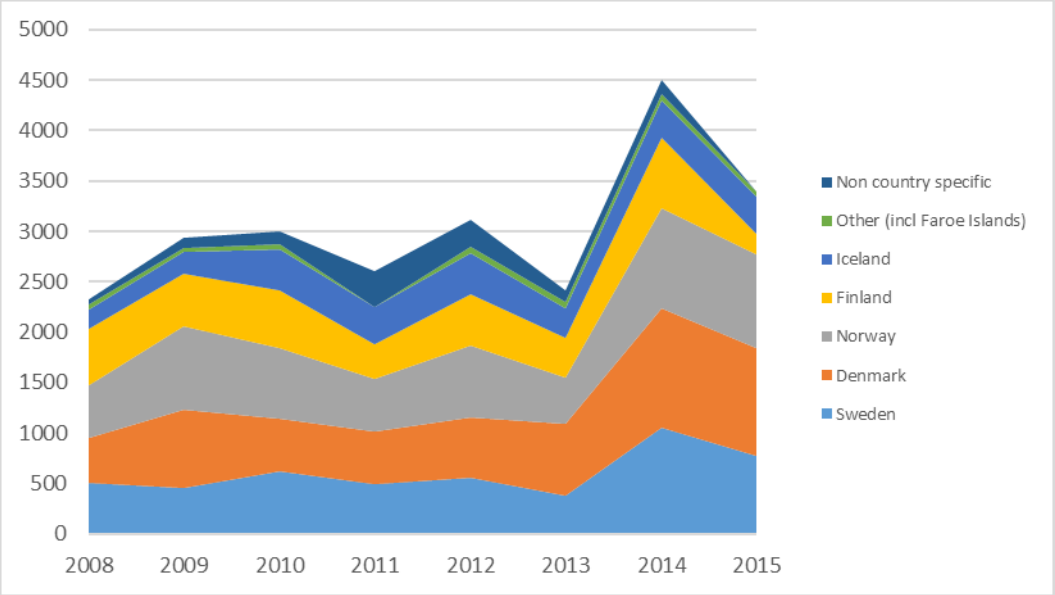
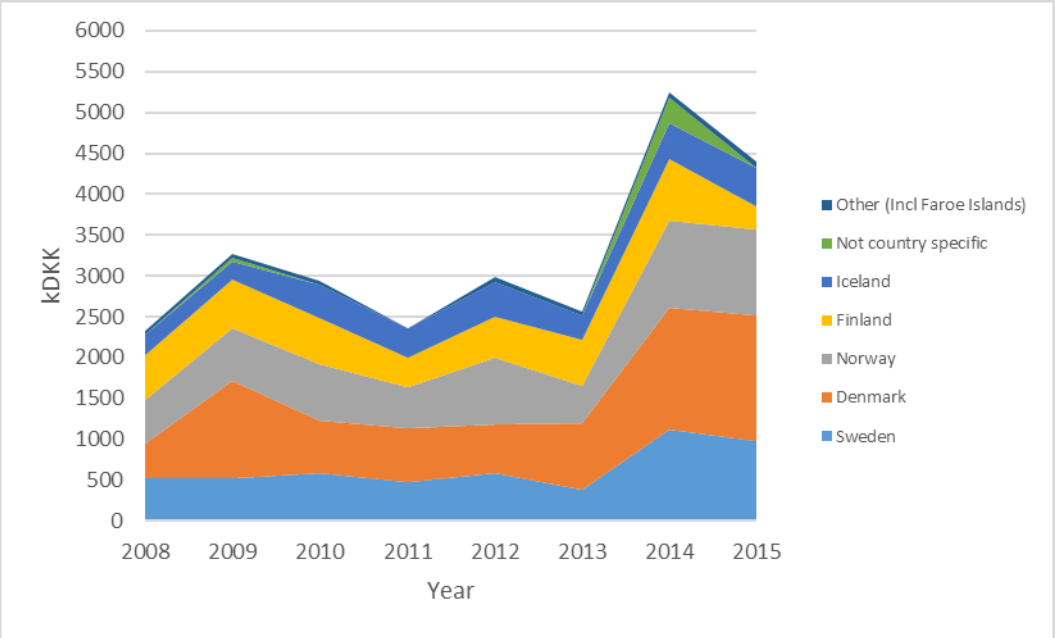


Figure 12. Distribution of expected co-funding of NKS-B projects between the Nordic countries, 2008-2015[24]



[24] Co-funding data is missing in some applications for 2008. In those cases, co-funding has been assumed to be equal to NKS-funding (in accordance with NKS rules).

3.3. Swedish participants in NKS

In this section, Swedish actors who have participated in either NKS-R or NKS-B projects are listed. An actor who has participated in both NKS-R and NKS-B projects is presented twice. The total number of participations by Swedish actors in NKS projects during the relevant time period is presented in Figure 13. Most of the relevant actors within the Swedish nuclear safety knowledge community have participated in NKS during the investigated time frame. This conclusion is based on SSM's and Oxford Research's experience of the Swedish nuclear safety knowledge system. Hence, reach of the target group appears to be satisfactory and accurate.

Table 3. Swedish actors who have participated in either NKS-B and/or NKS-R projects during 2008-2015.

Actor (NKS-B)	Type of Actor	Actor (NKS-R)	Type of Actor
Barsebäck kraft AB	Industry	Chalmers University of Technology	Research
Swedish Defence Research Agency (FOI)	Research	ES konsult	Industry
Forsmark Kraftgrupp AB	Industry	Forsmark Kraftgrupp AB	Industry
The University of Gothenburg	Research	Inspecta Sweden	Industry
KTH Royal Institute of Technology	Research	KTH Royal Institute of Technology	Research
Linköping University	Research	Kärnkraftsäkerhet och Utbildning AB	Industry
Lund University	Research	Lloyds Register Consulting Energy AB	Industry
Oskarshamnsverkets Kraftgrupp OKG	Industry	Luleå University of Technology	Research
Ringhals AB	Industry	Lund University	Research
Geological survey of Sweden (SGU)	Other authority	Ndcon	Industry
Swedish University of Agricultural Sciences (SLU)	Research	Oskarshamnsverkets Kraftgrupp OKG	Industry
Swedish Radiation Safety Authority (SSM)	Radiation Safety Authority	Ringhals AB	Industry
Studsvik Nuclear Ab	Industry	Risk Pilot AB	Industry
Stockholm University	Research	Scandpower	Industry
Uppsala University	Research	Swedish Meteorological and Hydrological Institute (SMHI)	Other authority
Vattenfall	Industry	Solvina AB	Industry

		Swedish Radiation Safety Authority (SSM)	Radiation Safety Authority
		Studsvik Nuclear AB	Industry
		Swedish Nuclear Fuel and Waste Management Company (SKB)	Industry
		Uppsala University	Research
		Vattenfall	Industry
		ÅF Consult	Industry

Figure 13. Participations by Swedish actors in NKS during 2008-2015 divided by type of actor.

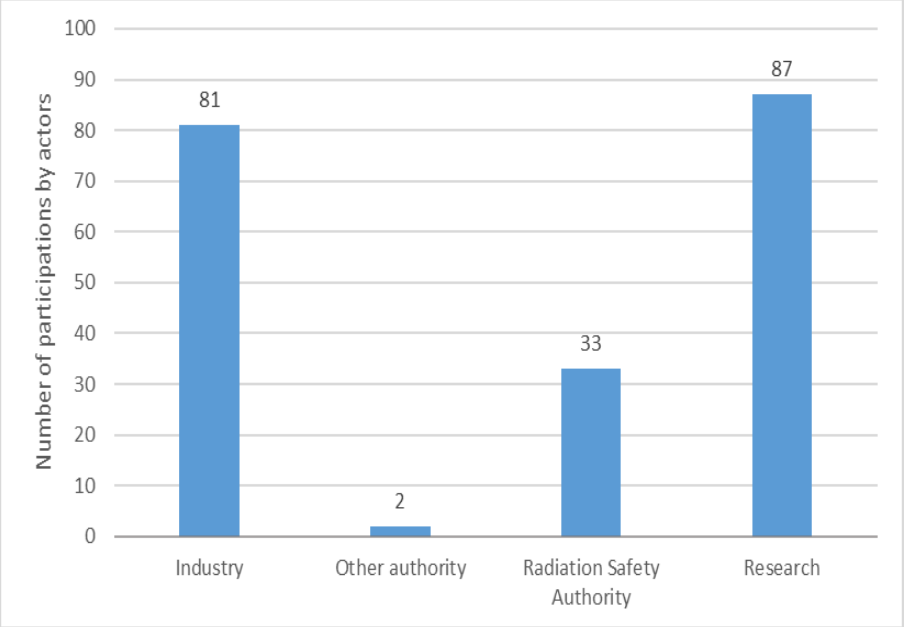
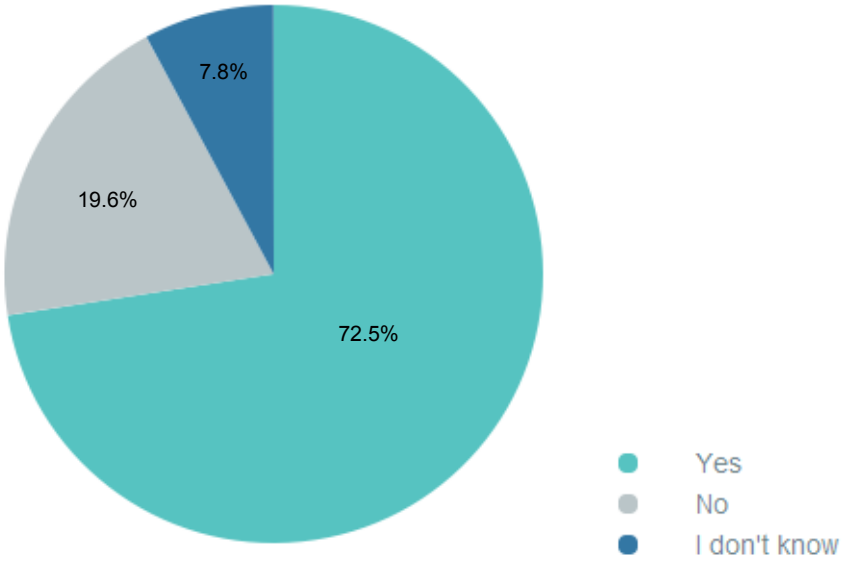


Figure 14. Answers from Swedish survey respondents to the question: 'Did you, at the time when you were active in NKS, consider yourself to belong to the main target group for participating in NKS?'



4. The impacts of Swedish participation in NKS

4.1. The relevance and standing of NKS

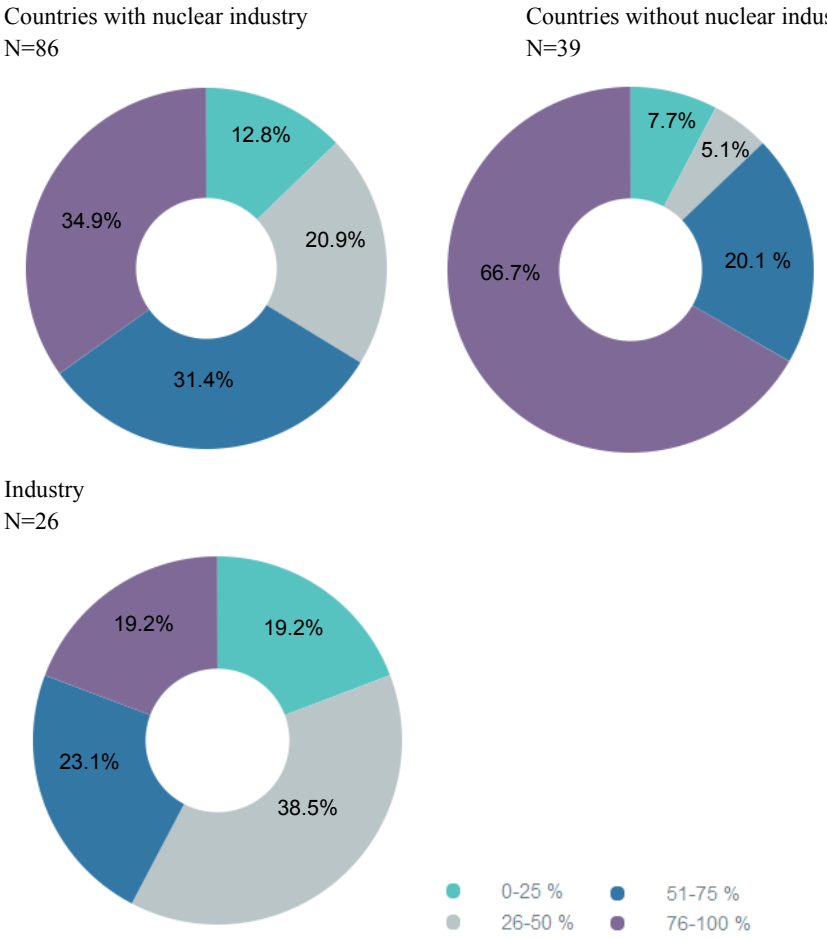
Below we address the standing of NKS through presenting results on how well known NKS is and on the function of NKS as compared to other funding opportunities. NKS is generally well known and funding is considered relatively easy to receive. The granted amounts are considered to be low or negligible by around 40%, of the respondents which partially explains the relatively low competition for funds.

4.1.1. Who knows of NKS?

NKS is considered well known among survey respondents and interview subjects. It should be noted that the selection of interview subjects and survey respondents has been based on individuals who have been active in NKS why a certain amount of selection bias can be expected. However, overall the institutions and organisations which could be anticipated to be engaged in NKS have been part of the interview and survey population sample. Knowledge of NKS within relevant populations is estimated to be higher in the countries without a nuclear industry than in countries with nuclear industry as can be seen in Figure 13. Note that 12 out of 13 Danish respondents have estimated that 76-100% of colleagues within Nuclear Safety are aware that NKS exists.

Between-country effects as presented in Figure 15 are mainly driven by low estimations by actors within industry. All but one industry actor come from Sweden and Finland, as can be seen in Figure 6 and Figure 7, why the lower estimations on knowledge of NKS from countries with nuclear industry can be expected to be driven by industry actors. Significant differences based on NKS program exist as well, with higher knowledge of NKS among NKS-B participants in comparison to NKS-R participants. Due to the skewed participation of industry actors, with more prevalent participation in NKS-R projects compared to NKS-B projects, this difference can be expected to be an effect of the views of industry actors as well.

Figure 15. Survey respondents' estimations of the percentage of colleagues within Nuclear Safety that are aware that NKS exists



Some interview respondents note that fewer young researchers have knowledge of NKS compared to older researchers. The reason is that young researchers are often introduced to NKS by older peers. Overall 35% of survey respondents got information on NKS from a radiation safety authority (either through official of private information) which indicates an important role of the radiation safety authorities as well, since only 23% of the respondents were associated with a radiation safety authority. 13% of respondents got information on NKS directly from NKS.

4.1.2. NKS as a funding opportunity

The NKS application procedure is generally considered appropriate. Figure 16 shows that respondents consider it to be easier to receive funding from NKS compared to national or international funding opportunities within nuclear safety research. Figure 18 shows that project participants in general consider project administration to be less taxing in NKS projects in relation to national and international ones. The results in both Figure 16 and Figure 18 are mainly driven by research actors. They have responded in higher frequencies, which is explained by the fact that they have more experience of applying for funding.

A comparison between respondents from countries with nuclear industry (Sweden and Finland) and countries without nuclear industry (Denmark, Norway, Iceland and Faroe Islands) show statistically significant differences regarding the difficulties in receiving funds compared to national and international options. Actors from countries with nuclear industry are more inclined to agree that it is more difficult to receive funds from NKS, although differences are small and a majority of respondents disagree with the statement as can be seen in Figure 16.

NKS-R participants and industry actors to a significantly higher degree than NKS-B participants and non-industry actors agree with the statement that it is more difficult to receive funding from NKS in comparison to national funding as can be seen in Figure 17**.** A majority still find NKS funding easier to receive than national or international funding though. Because most NKS-R participants and industry actors are from Sweden or Finland this difference based on program participation and type of actor affects differences based on country.

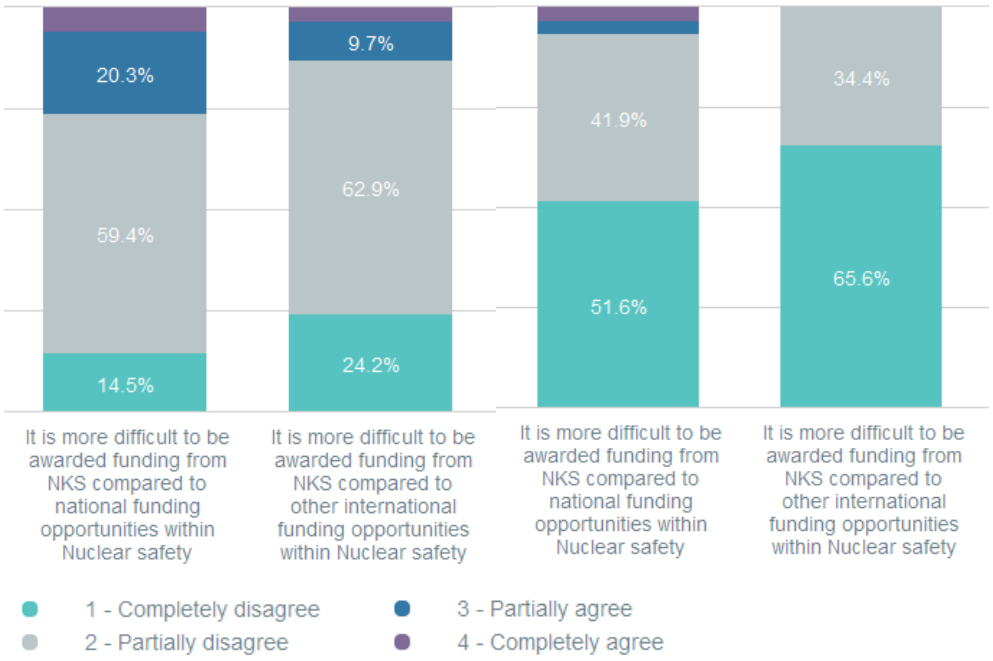
Interview results show that Swedish and Finnish participants in NKS-R projects, of whom many are industry actors, find the NKS rule on including a minimum of 3 Nordic countries difficult to live up to[25]. The reason is that many NKS-R projects are more relevant for countries with a nuclear industry. This fact partly explains perceived differences regarding the difficulties in receiving NKS funding compared to national funding based on country and program. The rate of success for NKS-B and R programs is equal though, why one could suspect that there is more national funding easily available for NKS-R than NKS-B projects. Another explanation for the perceived differences between countries is the availability of funding from SSM and SAFIR in Sweden and Finland. Additionally, interviews indicate that specific funding for some of the areas covered by NKS-R are available to a higher degree than funding for research within the thematic areas covered by NKS-B. An example on alternative national and/or Nordic funding for NKS-R projects is funding from the Nordic PSA group which consists of utilities, radiation safety authorities and research actors from Finland and Sweden. The group finance research on probabilistic safety assessments (PSA). Regarding difficulties in receiving NKS funding it should be noted that Swedish applications have a lower success rate than other countries, as shown in Figure 4. This difference in the actual success rate of applications also explains difference in perceived difficulty of receiving funding based on the country of origin of respondents.

[25] As previously noted many NKS-R projects contain only participation from Swedish and Finnish actors as evident from Figure 7 and Figure 9

Figure 16. Percentage of respondents from countries with and without nuclear industry agreeing or disagreeing with statements on the difficulties to receive NKS funding.

Countries with nuclear industry
N= 62-69

Countries without nuclear industry
N= 31-32

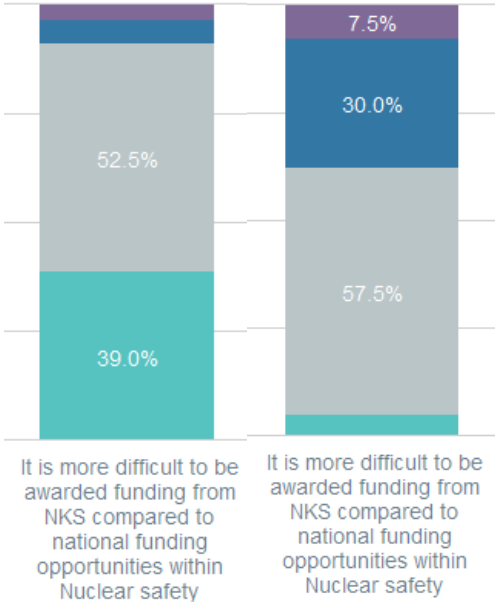


Note: "I don't know"-answers have been removed.

Figure 17. Participants in NKS-B and NKS-R agreeing or disagreeing with the statement below on the difficulties in receiving NKS funding as compared to national funding.

NKS-B
N=59

NKS-R
N=40

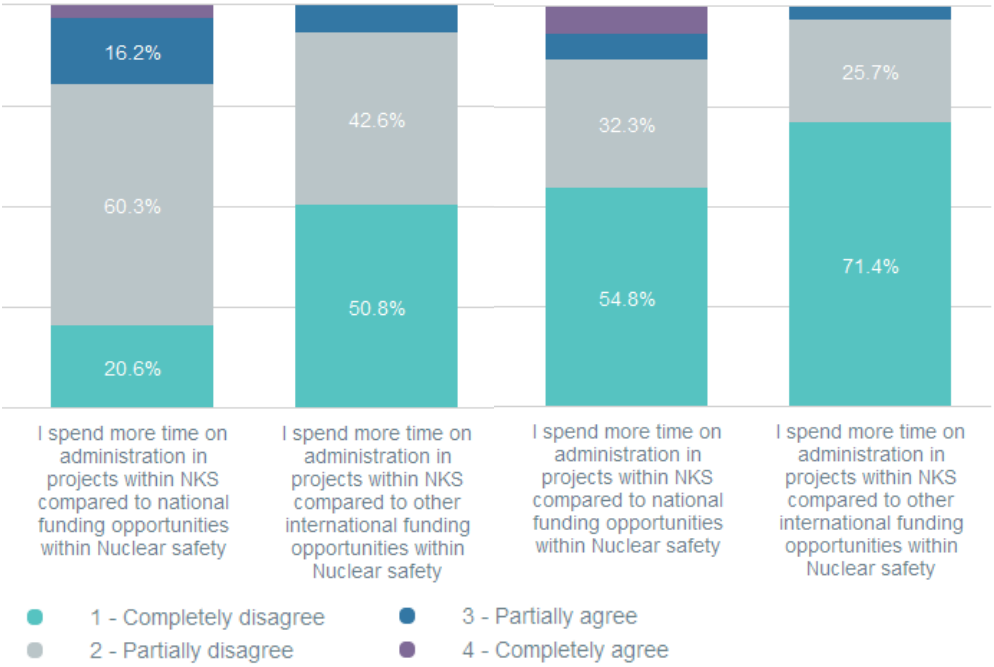


There are significant differences based on the survey respondent's country of origin regarding time spent on administration of NKS projects in relation to other national or international projects as can be seen in Figure 18 below. These differences based on country are partly driven by industry actors in Sweden and Finland who find the administration more time consuming than other actors. A majority of industry actors find the administrative burden of NKS less taxing than the administrative burden in other national and international projects though.

Figure 18. Percentage of respondents from countries with and without nuclear industry agreeing or disagreeing with statements on the administrative burden of NKS.

Countries with nuclear industry
N= 61-68

Countries without nuclear industry
N= 31-35

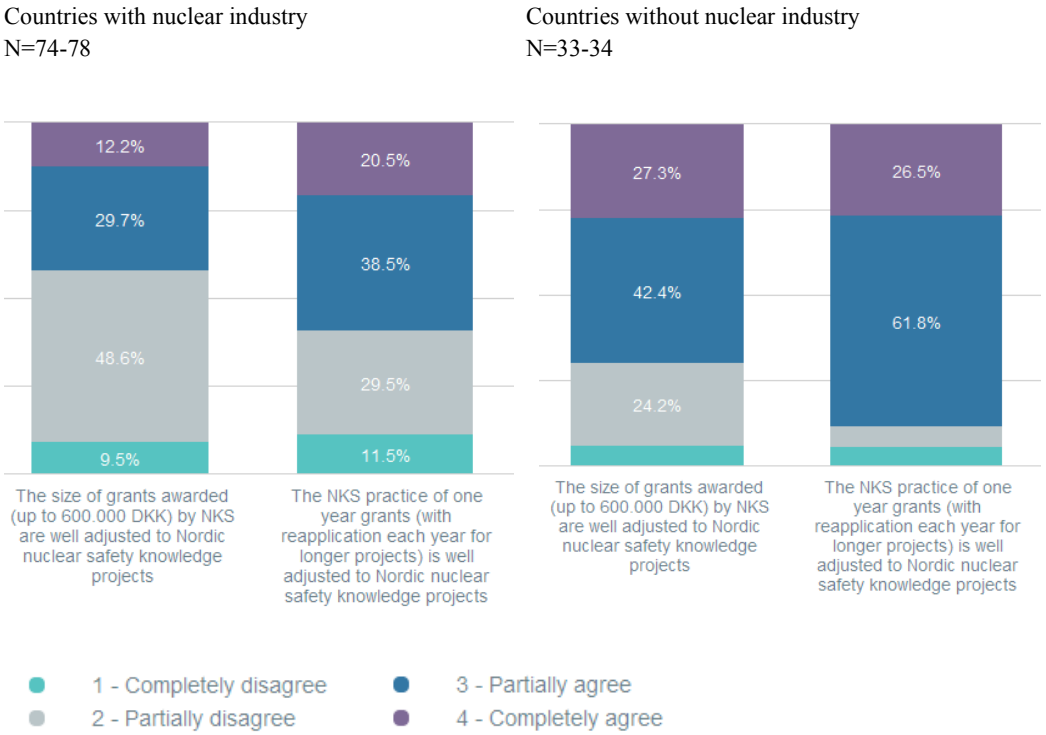


Note: "I don't know"-answers have been removed.

4.1.3. The relevance of NKS funding

Survey results show significant differences between countries with and without nuclear industry regarding the appropriateness of the amount of project funding provided by NKS (maximum 600k DKK) and the length of the project grants (1 year). These differences are presented in Figure 19 below. No significant differences based on type of actor or program have been identified. Overall there is no consensus in the survey data on the appropriateness of the size of grants.

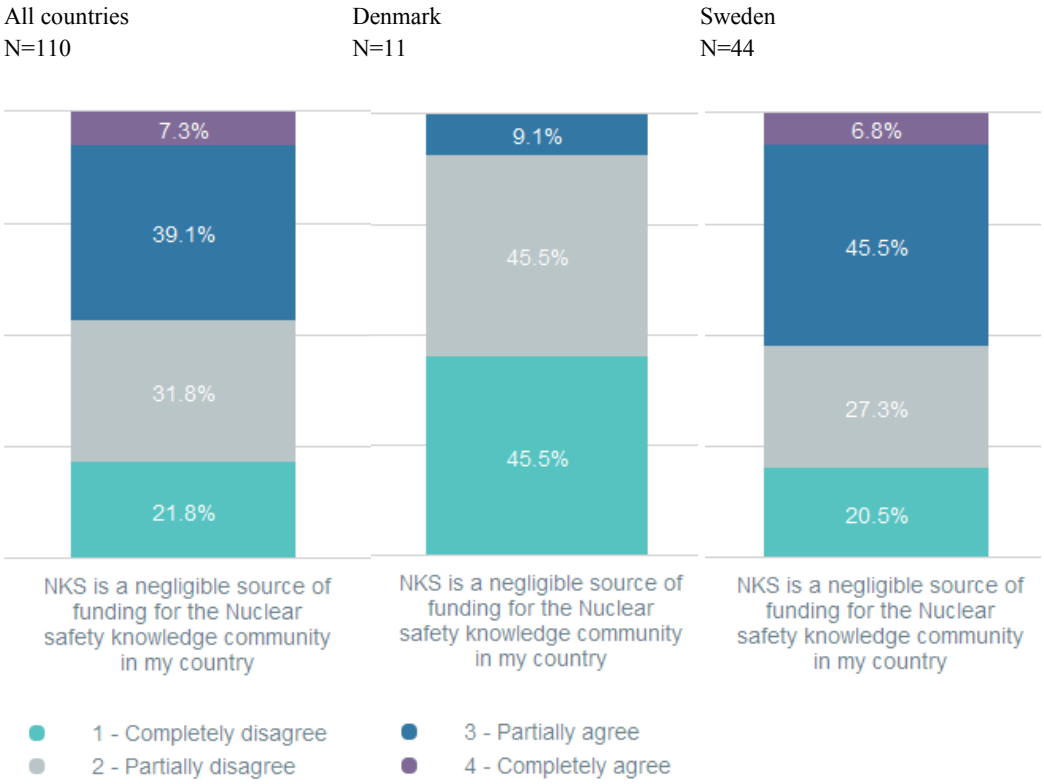
Figure 19. Percentage of respondents from countries with and without nuclear industry agreeing or disagreeing with the two statements presented below.



Note that "I don't know" answers have been removed

The view on the importance of NKS-funding, if it's a negligible source or not, is split evenly between survey respondents. However, no significant differences based on if respondents are from a country with or without nuclear industry, based on type of actor or based on which program the respondent has participated in have been identified. Danish respondents view the funding as more important than both Swedish respondents and the general survey population though, as can be seen in Figure 20. Overall, survey respondents express that NKS functions as a way of distributing knowledge, building competences and financing small projects which would otherwise be difficult to finance.

Figure 20. Percentage of respondents from all countries and from Denmark and Sweden agreeing or disagreeing with the statement below.



Note that the difference between Denmark, Sweden and the other countries has not been statistically tested due to the low number of Danish respondents. "I don't know" answers have been removed

In general, there are few alternatives to NKS funding. Specifically, few options exist aimed at Nordic cooperation and small projects including funding for knowledge dissemination activities. Alternative funding for Nuclear safety research overall is primarily funding from EU (Euratom/H2020), national research councils, radiation safety authorities or other authorities (such as Tekes in Finland and MSB in Sweden), and in some cases industry actors. Barely half of the Danish survey respondents see no alternative to NKS funding at all, which explains why almost all Danish respondents disagree with the statement that NKS is a negligible source of funding.

As can be seen in Figure 20 a bit less than half of the survey respondents view NKS' funding as negligible. Interview results make clear that the main justification for participating in NKS is the opportunity to build Nordic networks and work with experts from other Nordic countries, something that is true for both NKS-B and NKS-R projects. The funding from NKS primarily funds pilot projects or provides an extra source of funding for a project. For example, for Swedish actors within radioecology, NKS-B projects facilitate Nordic professional networks and help maintain the competence needed to uphold development capacity within the field. The function of NKS as a base for building professional relationships is especially apparent for radiation safety authority actors, although a consensus exists among all types of actors as expressed through interviews and open survey answers. The funding is important as funding of the Nordic coordination of research activities rather than as funding for the basic research activities themselves. This discrepancy partly explains survey results presented in Figure 19 and Figure 20.

The additionality of NKS funding is lower for NKS-R projects as compared to NKS-B projects. Interview results show that especially NKS-R participants often view NKS as a source of extra funding rather than as the primary funding of a project. NKS-R projects are usually not dependent on the funding from NKS and would be executed with or without the NKS funding. The additionality of NKS funding is greater in NKS-B as shown in Chapter 3, and interview results reveal that participants within NKS-B depend on NKS to execute collaborative projects on a Nordic level to a higher degree than participants in NKS-R. However, the funding itself does not justify participation in the program, and if there was more competition and lower success rates, some actors would lose interest in the program. Several actors, both active in NKS-B and NKS-R, state that funding up to 600k DKK is in itself not a negligible amount for nuclear safety research, however when funds need to be split between three or more actors, the funding for each actor usually only covers a minor part of the funding needed for a research or development project. The additionality of the funding as pure research funding could therefore be suspected to be fairly low, however the funding is important when regarded as research coordination funding, especially for NKS-B projects.

4.2. Utilization of results from NKS

Below, we describe the utilization of NKS by Swedish and Nordic actors. Results are presented based on country, type of actor and based on which NKS program the respondent has been active in.

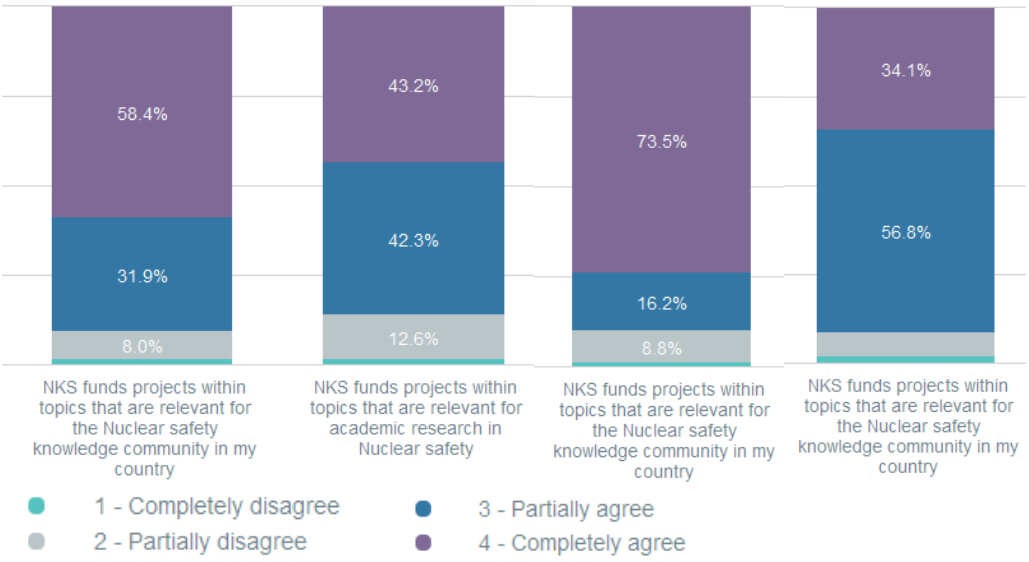
4.2.1. Relevance of NKS' themes

NKS generally funds projects relevant for respondents in all countries. Participants in NKS-B to a statistically higher degree than participants in NKS-R agree that NKS funds projects which are relevant for the national nuclear safety knowledge community.

Below, the general view on the relevance of the projects NKS funds, along with the difference based on program, is presented. Note that all participants agree that NKS funds relevant projects, the difference between NKS-R and NKS-B participants regard whether participants agree *completely* or *partially* with the statement. Interview results validate the survey data. Researchers applying for funding from NKS-B find that the program contains all relevant thematic areas for their research since their research is focused on nuclear safety and emergency preparedness. Researchers who apply for NKS-R funds on the other hand are also active within fields that are not encompassed by the NKS-R program. For example, research on the development of new nuclear fuels or other types of research and development which is not primarily focused on nuclear safety.

Figure 21 Percentage of participants agreeing or disagreeing with each of the two statements below.

All participants N=111-113 | NKS-B N=68 | NKS-R N=44

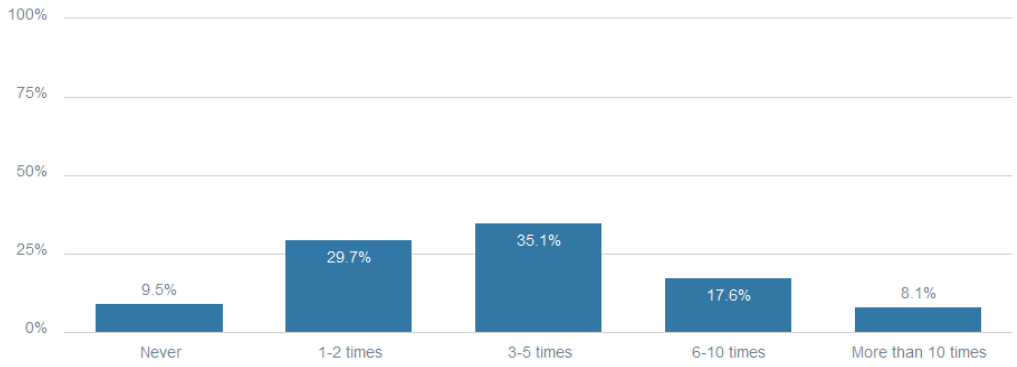


4.2.2. Use of NKS results and reports

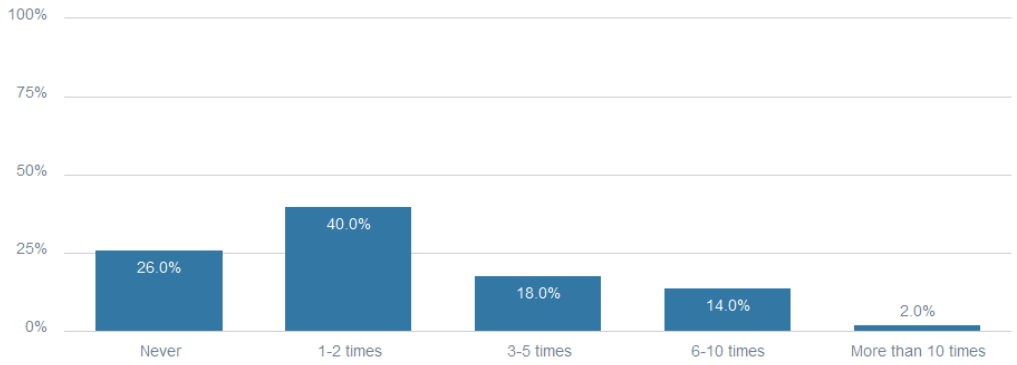
Non-parametric statistical testing shows no significant difference between countries with or without a nuclear industry regarding taking interest in results from NKS projects the respondent has not participated in. Danish respondents stand out though, taking interest in results to a higher degree than participants from the other Nordic countries. There are significant differences based on program, where participants in the NKS-B program to a higher degree than participants in the NKS-R program take interest in general NKS results as can be seen in Figure 22. Significant differences are also prevalent based on type of actor where research actors most commonly take interest in NKS results and industry actors take interest in results more seldom. An interaction exists between program and actor where research actors and respondents from other authorities active in NKS-B programs take interest in results to a higher degree than research actors and respondents from other authorities active in NKS-R projects.

Figure 22. Respondents' answers to the question 'How many times during the past three years have you taken interest in results from NKS projects, excluding projects which you yourself participated in?' grouped by which program respondents have participated in.

NKS-B, N=74



NKS-R, N=50



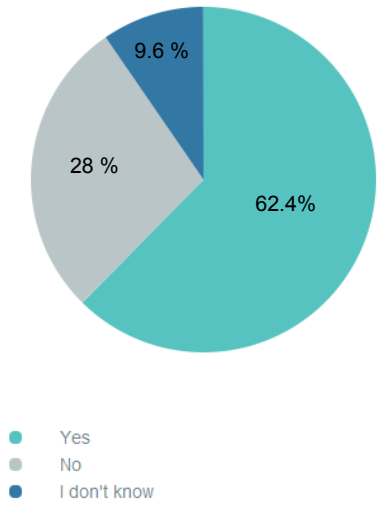
Overall interview results indicate that 'generalists' and NKS-B project participants are interested in NKS results in general, to a higher degree than 'specialists' and NKS-R participants, who are often themselves participants in all relevant projects.[26] NKS material is used in a number of ways, such as background for future research, competence-building and general orientation, validation of methods, development of regulation, for education/teaching purposes to name few.

Generally, the interview respondents are positive to NKS' free structure of reporting in comparison to the strict structure of peer-reviewed journals. The quality of NKS reports (and projects) is overall high, however a handful of interview respondents note that there is no obvious system that upholds a high minimum quality standard of projects, and note that at times there have been cases of reports with low or varying quality. These cases may partially be explained by the character of quality assurance procedures, and challenges for generalists to evaluate specific project proposals in fields not within the evaluator's area of competence.

[26] 'Generalists' and 'specialists' are not objectively defined terms, rather the view of respondents as 'generalists' or 'specialists' has been established through the interviews.

NKS project participants and end-users of NKS project results overlap to a high degree, as can be seen in Figure 23. In addition, most projects include end-users in some way and NKS projects generally focus on applied research and development, why results in most situations are directly applicable. End users are primarily industry actors and radiation safety authorities, why the percentage of respondents who consider themselves end-users is higher among participants of NKS-R projects than NKS-B projects, due to the skewed participation of industry actors.

Figure 23. Percentage of survey respondents who consider themselves end users of NKS results
All respondents, n=125



An example of the applied nature of NKS research and how results can be used is illustrated in the quote below

"[…] I was working with the regulatory framework connected to emissions from laboratories and hospitals. In connection to the regulatory work I had to conduct measurements on the level of radioactive exposure for the individuals working with the sewage. I found out that there was not much data available on the exposure of radiation for the individuals working with the sewage waste. We therefore had to conduct measurements and applied for a quite large NKS project in which all Nordic countries were involved. The results were very important for the regulatory framework regarding emissions from hospitals and laboratories. The results were for example relevant for making recommendations to use or not to use septic tanks for sewage from hospitals." - Radiation safety authority

4.2.3. Nordic dimensions of Nuclear safety issues

Common Nordic issues exist in a broad range of nuclear safety areas, such as within emergency preparedness, methods for training control room operators, environmental effects of radiological waste, methods for radiochemical analysis, methodology for atmospheric dispersion of radionuclides, and more. Common Nordic issues can to a higher degree be found within the NKS-B program than the NKS-R program due to the focus on reactor safety in NKS-R. Specific Nordic dimensions of radioecology, emergency pre-

paredness and waste management are connected to a shared climate and similar regulatory culture and policies in all Nordic countries. To give an example: radioecology at higher latitudes (above 55 degrees) is different from radioecology at lower latitudes, and possible issues are therefore specific for the Nordics. Common issues within NKS-R relate to the use of BWR (Boiling water reactors) and the regulatory culture and structure of radiation safety authorities in the Nordics. Those common issues are though mainly common for Sweden and Finland. In addition, research questions within NKS-R are often general and not unique for the Nordic context. Interview results show that common Nordic issues generally justify specific projects, but the general Nordic cooperation within nuclear safety research and NKS is based on common networks and common history, as well as similar regulatory cultures and views on nuclear safety research. There seems however to be little support for the sentiment that there are discernible similarities in safety culture on an operative level.

Nordic collaboration within nuclear safety research is important within small specialised areas where specific national knowledge based on different national conditions can be pooled together on a Nordic level. One such area is emergency preparedness within meteorology. Through Nordic collaboration the Nordic radiation safety and meteorological institutions have shared data and information and developed models for calculation atmospheric dispersion of radionuclides. Both increasing the quality of the models as well as establishing a collaboration for sharing of data which increases resilience in cases of atmospheric dispersion of radionuclides.

4.3. Added value of NKS

This section describes the specific Nordic added value of NKS relevant for Sweden and Swedish actors. Results are divided based on country, the type of actor and which NKS program the respondents have been active in. Results are grouped in accordance to the hypotheses on direct and indirect added values from participation in NKS as presented under 2.2.2. The most prominent added values as identified through the survey and interview studies are the opportunities for Nordic cooperation through NKS and the programme's function, especially for NKS-B participants, as an interface for building professional relations. Relations are important for receiving second opinions on professional issues and building collaborations for international projects.

The role of Nordic nuclear safety research and its added value is different for actors in different countries and sectors. Scientists and researchers, especially within the areas covered by NKS-B, use Nordic networks for development of measurement strategies and of modelling, and to discuss detailed questions regarding nuclear safety research and development. Nordic networks are useful for all types of actors due to the familiarity and informality of the Nordic context. Within the Nordic context there is a common view of the preconditions for nuclear safety and nuclear industry, and actors share a common regulatory and scientific context. Expertise in other Nordic countries is easily identified through common networks and specific issues and applied research problems are easily solved due to the common context and the informality of networks.

Norwegian and Danish respondents to a great degree interact directly on the Nordic level while Swedish actors and experts, especially within NKS-R areas, such as reactor safety, have the possibility to interact with peers within Sweden before turning to experts on the Nordic level. The presence of a nuclear industry has resulted in a larger research community in Sweden compared to the Nordic countries without a nuclear industry. Howev-

er, within NKS-B areas such as radioecology and emergency preparedness, the greater Nordic networks are important for Swedish research activities as well.

4.3.1. National knowledge systems

The main experts within NKS-R and NKS-B are spread out through the Nordic countries. A few key actors have been identified through interviews with stakeholders in Sweden, Denmark and Norway.

In general, main actors within the NKS-B area are the Nordic radiation safety authorities including the Danish emergency management agency (DEMA), the Centre for Environmental radioactivity (Cerad) at the Norwegian university of life sciences (NMBU) and Institute for Energy Technology (IFE) in Norway, DTU-Nutech in Denmark, Swedish universities in Gothenburg, Lund, Umeå and Linköping, the Swedish Defence Research Agency (FOI), the Swedish university of agricultural studies (SLU) and for matters concerning atmospheric modelling the Nordic meteorological institutes.

Within NKS-R, main actors are the Swedish radiation safety authority (SSM), The Finish radiation safety authority (STUK), VTT, Helsinki University, the Swedish universities in Uppsala and Lund, Chalmers technical university, KTH, consultancies such as Riskpilot, Lloyds register and ÅF, and the Nuclear power plants of Sweden and Finland along with Vattenfall and Fortum.

Somewhat surprisingly the consultancy Studsvik, the fuel vendor Westinghouse and SKB (Swedish nuclear fuel and waste management) have not been mentioned as key actors within the national knowledge systems. Studsvik and SKB have each participated in one or a few NKS projects but neither actor is prevalent in NKS projects. An individual at SKB explains that the company recently submitted an application to NKS, which was not approved.[27]

These major actors in the national knowledge systems mainly consist of small research environments focused on specific research questions. Some environments are therefore dependent on networks to reach critical mass. The importance of NKS in creating such networks is described in the 4.3.2 segment below and the value of collaboration between these Nordic actors and NKS' role in facilitating professional relations is describe in the 4.3.3 segment.

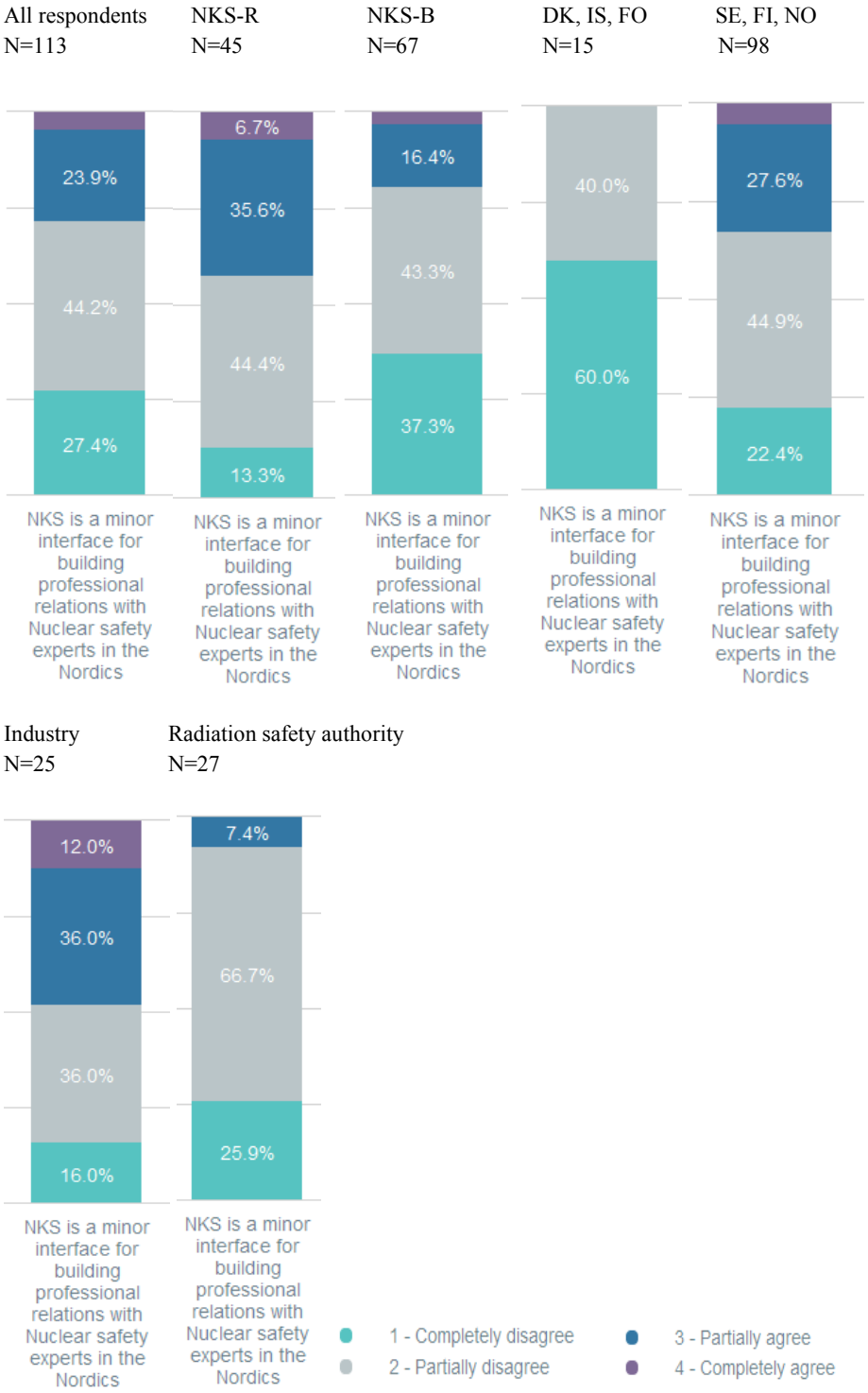
4.3.2. The importance of NKS for Nordic networks

Results from interviews show that NKS has an important and significant role in supporting professional relations and networks among Nordic experts within nuclear safety research. There is a clear consensus that: *'the fact that NKS offers opportunities for Nordic cooperation is an advantage compared to other funding opportunities'*, with 92.5% of the survey respondents either partly or completely agreeing with the statement. The opportunity for Nordic cooperation is the most prominent added value regarding NKS importance for Nordic networks. The direct connection between more specific Nordic nuclear safety networks and NKS are more apparent within the areas covered by NKS-B than the areas covered by NKS-R.

[27] Private communication.

The respondents' views on the importance of NKS to build professional relations within the Nordics differs depending on country of origin, NKS-program and type of actor. These three dimensions interact with each other and actors within NKS-R, where Swedish and Finish as well as industry actors are prevalent, to a higher degree see NKS as a minor interface compared with respondents from Denmark, respondents who are associated with radiation safety authorities and respondents who have been active within NKS-B. Norwegian respondents have similar views as Swedish and Finnish respondents rather than, as in most other cases, as Danish and Icelandic respondents. Statistically significant differences have been detected based on country, program and actor as illustrated in Figure 24.

Figure 24 Percentage of respondents agreeing or disagreeing with the below statement on the importance of NKS for building professional relations.



Note that differences were tested on group level and the specific actor or country causing the significant differences has been determined on a qualitative basis rather than through ad-hoc testing.

On a national level one general program usually funds either the areas covered by NKS-R or NKS-B, why the interaction between the areas covered by the program is generally low. The fact that NKS funds research activities within both the areas covered by NKS-B and NKS-R have therefore at times contributed to interactions between national actors who would not have worked together if not for NKS. For example, research conducted within PSA level three[28] has a close relationship to research within radio ecology. Within a national context PSA research and research on radioecology is seldom combined, although, through NKS, participants in PSA projects have cooperated with radioecologist usually active in NKS-B projects.

Most respondents are in contact with peers they built relationships with through NKS on a monthly or yearly basis. Non-parametric statistical testing shows no significant difference based on country, program or actor. However, interview results indicate that NKS has a more significant role in establishing professional relationships on a Nordic level within NKS-B than in NKS-R. Within the thematic areas covered by the NKS-R program, other networks such as the HAMBO-group connected to the Halden Reactor Project, the Nordic PSA group and connections between Finnish VTT and Swedish universities and utilities exist in parallel and independent of NKS. Within the thematic areas of NKS-B results indicate that NKS has a central and significant role in establishing Nordic networks. Many of the participants in NKS-B projects that have been interviewed view NKS as the main channel for establishing professional networks in the Nordics.

One example of NKS' role in creating and facilitating Nordic collaboration is the meteorological network MetNet. Within MetNet the Nordic meteorological agencies work with emergency preparedness connected to atmospheric dispersion of radionuclides and collaborate closely with national radiation safety authorities. The network was created as an NKS-project and has since then been institutionalized as described in the quote below.

"Later we had a three-year project called MetNet which involved all Nordic meteorological institutes. The idea was to create a network for dispersion modelling in case of a nuclear accident. MetNet had a two-fold objective: to create a Nordic forum, and to develop a back-up system enabling any Nordic country to look at the model results by all Nordic meteorological services. The project was successful since after completion, MetNet was institutionalised in an agreement between the Nordic meteorological services (Nordmet). The network is maintained; we collaborate closely with the national nuclear authorities, we share information, we have discussions which sometimes generate new ideas for projects and development, we maintain our backup systems, and we organise exercises." - Other authority

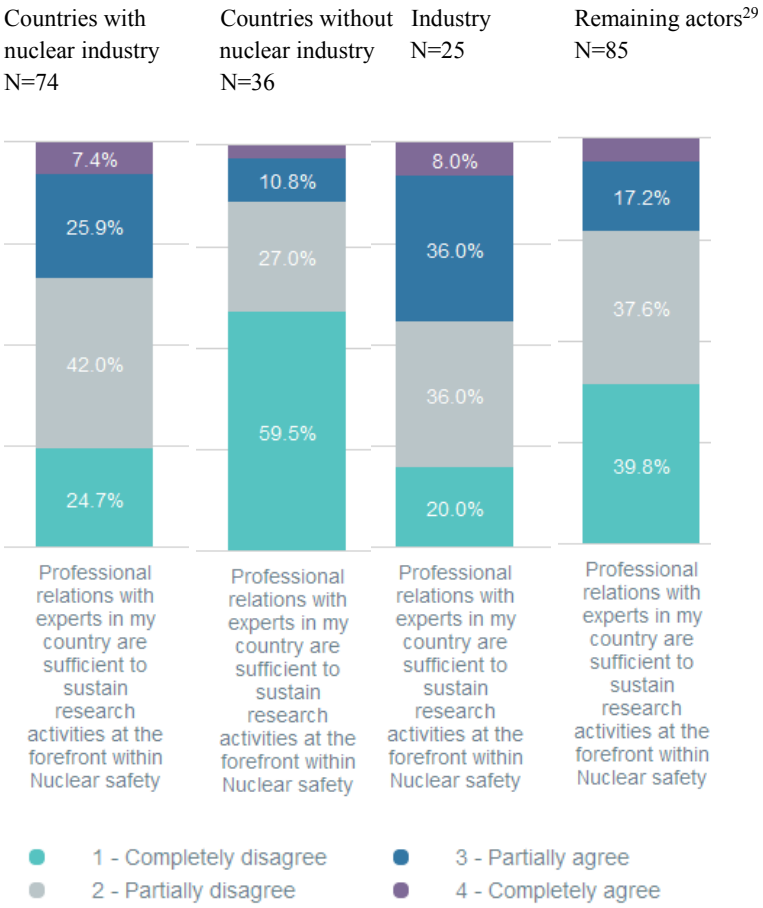
4.3.3. The importance of Nordic collaboration in Nuclear safety

There is a wide consensus that research in Nuclear safety is improved by combining perspectives from the Nordic countries, but the percentage of respondents completely agreeing, as compared to partially agreeing, with the statement is significantly higher within countries without a nuclear industry and among respondents who have been active in the NKS-B program as compared to respondents from countries with a nuclear industry or who have been active in the NKS-R program.

[28] probabilistic safety assessments regarding emergency planning and the environmental effects of nuclear accidents outside of the nuclear power plants

In general respondents do not agree with the statements that relations with professional experts within the country is enough to sustain research activities at the forefront within Nuclear safety. Significant differences have been detected based on type of actor and country as presented in Figure 25. Industry actors are generally Finnish or Swedish which highly affects results based on country.

Figure 25. Percentage of participants agreeing or disagreeing that relations with professional experts within the participant's country of residence is enough to sustain research activities at the forefront of Nuclear safety.



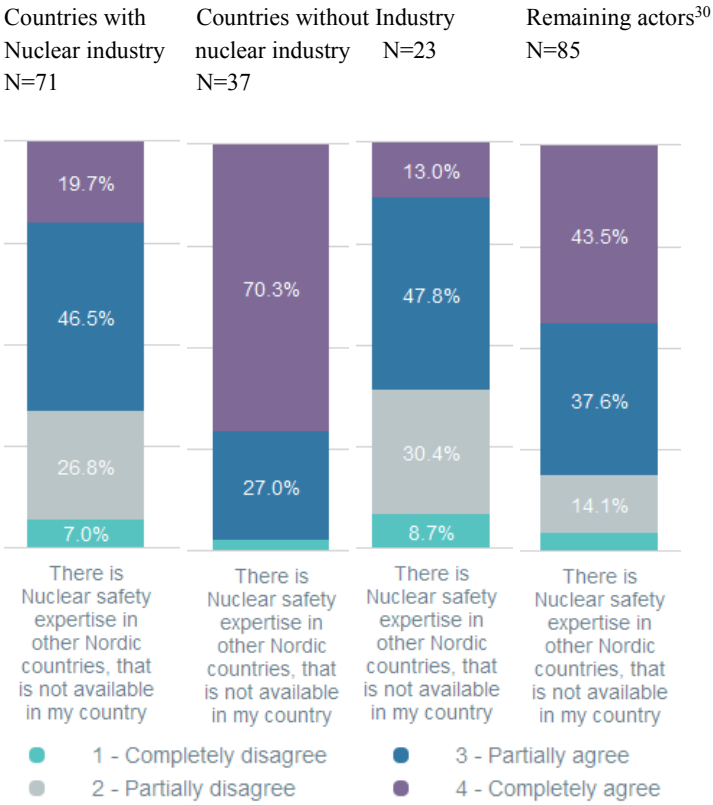
Interview results show that the opportunity to access expertise in other Nordic countries is a significant added value of participating in NKS. Expertise in other Nordic countries contribute with new perspectives and sometimes unique knowledge connected to specific national conditions. Survey results show general agreement with the statement that there is Nordic safety expertise available in other Nordic countries, not available in the respondents' own country. Each Nordic country has a national obligation concerning nuclear safety. For example, all Nordic countries and radiation safety authorities need to uphold national emergency preparedness and competence regarding modelling of the dispersion of radionuclides. Responsibility for competence within nuclear safety and operative emergency preparedness is generally centred on a few key actors and groups within and connected to the national radiation safety authorities. Nordic knowledge dissemination networks and common development capacity with the emergency readiness system is therefore important in order to uphold a high level of Nordic nuclear safety

[29] Research, Radiation safety authority and Other authorities.

emergency readiness. As is evident from survey and interview answers the Nordic countries have different specialities depending on the unique ecological conditions of each country, these unique national competencies are shared among the Nordic countries through a common knowledge system.

The percentage of respondents completely agreeing with the statement that there is expertise in other Nordic countries not available in the respondent's country of residence significantly differs based on country and type of actor. Furthermore, there is a tendency towards higher level of agreement from respondents active in NKS-B compared to NKS-R. Results are illustrated in Figure 26 below.

Figure 26. Percentage of individuals agreeing or disagreeing that there is Nuclear safety expertise in other Nordic countries not available in the respondent's country of residence.



NKS as a platform for reliable information and wider international collaboration.

In total, 53% of respondents agreed with the following statement '*I have used my professional relations from NKS in building collaborations for international projects beyond the Nordics'*. There is a tendency towards a significant difference between countries with and without nuclear industry driven by the Danish respondents, of which 77% indicate that they have used professional relations from NKS to build collaborations compared to 43% of Swedish respondents.

Relations established through NKS are also used to receive second opinions on professional issues. In total 55% of survey respondents agreed with the statement *'I have used*

[30] Research, Radiation safety authority and Other authorities.

my professional relations from NKS to receive a second opinion on a professional issue'
Interview results suggest that Nordic networks are often used due to the informality of the relations. Through Nordic networks individuals who can be trusted to supply correct and operatively useful information are easily found. Results from interviews indicate that Nordic networks are viewed as more important among actors active in NKS-B projects as compared to actors active in NKS-R projects. Within NKS-R national contacts and bi-lateral contacts are used to a higher degree than within NKS-B. For Swedish actors, relevant Nordic bi-lateral contacts are mainly VTT (Finland) and the Halden Reactor Project, HRP (Norway).

NKS as a platform for access to important infrastructure

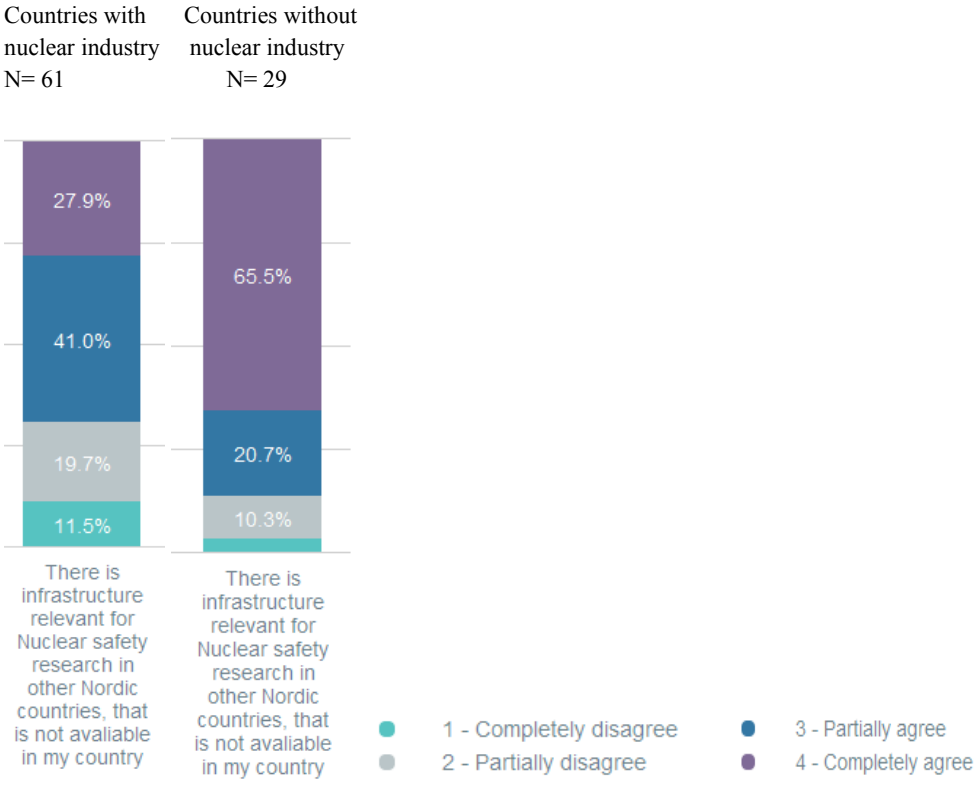
37% of respondents indicate that they through NKS have accessed infrastructure not available in their own country. Examples of relevant infrastructures made accessible through NKS are for example labs and neutron sources. The possibilities to use infrastructure in other Nordic countries and collaborate is used both for running tests and for education purposes. For example, Swedish radio-ecologists and radiation physicists have used lab infrastructure at DTU in Denmark through NKS networks. There are large differences based on country of origin regarding accessing infrastructure in other Nordic countries through as can be seen in Table 3 below.

Table 3. Percentage of respondents who through NKs have accessed infrastructure not available in their own country	
Denmark	62%
Sweden	41%
Finland	14%
Norway	36%
NKS-B	42%
NKS-R	28%

In general, NKS is more important for establishing professional relations, building collaborations for international projects and receiving advice on professional issues than for accessing infrastructure. Effects on the accessibility of infrastructure should be seen as a secondary added value of NKS.

The view on the availability of unique infrastructure relevant for Nuclear safety research differs between countries with or without a nuclear industry, which can be seen in Figure 27 below. In total 28% of respondents answered "I don't know" to the statement presented in Figure 27, why results should be conservatively interpreted.

Figure 27. Percentage of respondents agreeing and disagreeing with the statement below.



4.3.4. A Nordic labour market within nuclear safety

A common Nordic labour market within nuclear safety research is not a major added value from NKS. Most interview subjects, especially respondents active in NKS-R, would mainly look for a new job within their own country. Other Nordic countries would be relevant for a number of respondents if the respondents' current country of residence was not an option. In general, a majority of survey respondents state that they would use their professional relations from NKS for finding a new job, but most survey respondents would not use the network for recruitment of employees.

For young researchers[31] NKS can function as a first step towards building and taking part in international research networks. The extent to which young researchers are included and the level of strategy behind inviting young researchers to take part in projects differs from actor to actor and project to project. Some actors have a clear structure for including PhD-students and use NKS as a sort of training ground for working on an international arena while others might include a young researcher if one happens to turn up with the specific skill needed. Furthermore, through NKS young researchers and new staff can gain training and valuable knowledge on advanced infrastructure available through the Nordic network.

[31] In the NKS handbook "young researcher " is a broadly defined term, from master students to individuals who completed their Phd not longer than 5 years ago.

4.3.5. Summary

In summary, the Nordic added value of NKS primarily entails the creation of networks and professional relationships which contribute to a shared knowledge and emergency preparedness. Individuals in different Nordic countries gain knowledge on the specific situation in neighbouring countries through NKS, which increases their abilities to monitor risk and make correct statements on the nuclear safety and the potential risks of accidents, if they would occur. The harmonization of data between the Nordic countries is another relevant added value of NKS which contributes both to further possibilities for the Nordic countries to assist each other but also to increased competence and knowledge within Nuclear safety in the Nordics.

5. The value of Swedish participation in NKS

5.1. Summarised interpretation of results

Below is a condensed summary of the results from the project database analysis, the survey and the interview study. In Chapter 4 the results on the standing, utilization and added value of NKS was described based on the interview and survey study. In this chapter the relevance of the added value of NKS and the realisation of added values in Sweden will be discussed. The value of NKS for Sweden should be determined not only by analysing Swedish participation in NKS but also by accounting for the impacts of NKS in other Nordic countries as well.

5.1.1. NKS' function

The research activities funded by NKS has direct relevance for Swedish stakeholders. The applied nature of the activities make them relevant for regulation and licensing, and provides information both on the validity of methods and data, and on the availability of competence and data in neighbouring Nordic countries. The main value of NKS is the integration of Nordic knowledge systems and the establishment of professional relations within the Nordic nuclear safety research community. NKS funding may be likened to funding of coordination and support actions (CSA) within the EU framework program Horizon 2020. The CSA funding within Horizon 2020 is not as substantial as funding for research and/or innovation actions, and the aim of the funding is to promote cooperation between a number of European actors in pilot projects and other types of limited investigations, much in the same way as NKS. NKS' function as a program for coordination and a base for creating professional relations and networks is highly relevant for Swedish actors. Especially actors active in small specialised fields where important research environments exist in neighbouring Nordic countries have much to gain from participating in NKS.

NKS does not function as a significant financial contribution for research environments, and if evaluated only as a means to provide basic funding to national research communities within nuclear safety, the program would be assessed poorly. NKS is not the most effective way to finance major national research projects or researcher positions within nuclear safety, but as described above the program is highly relevant as an interface and facilitator for coordination of Nordic research activities. Small one-year grants, divided on a number of actors are not adjusted to sustain research environments and positions, but are relevant to enable Nordic cooperation within pilot projects or limited investigations. It should be noted that Swedish participants are estimated to have taken part in approximately one hundred peer-review publications based on NKS projects during the investigated time-period. Hence NKS projects do contribute to develop the research frontier in nuclear safety, even if the additionality of the funding in comparison to basic funding to national research communities is slightly negative, as regards direct impacts. The

programme's relative strength lies in its function as a means of establishing well-functioning and important networks.

5.1.1. Relevance of thematic areas

Both the project data base analysis and the interview and survey results point towards a higher relevance of NKS-B compared to NKS-R. NKS-B projects are to a higher degree dependent on NKS funding, indicating higher additionality in funding to NKS-B projects as compared to NKS-R projects, and NKS-B projects more often include actors from at least three Nordic countries. The NKS-B program is thereby more important for integrating the Nordic knowledge systems than NKS-R is. Although both programs hold merit, a wider range of actors and countries are active within NKS-B.

The thematic content in both NKS-B and NKS-R are highly relevant for Swedish actors, but a broader participation can be seen in NKS-B, where actors from industry, the research sector, and SSM are active, as compared to NKS-R, where Swedish participation is dominated by industry and some research actors.

5.1.2. Integration of knowledge systems

The main value of participation in NKS is integration of the Nordic knowledge communities within Nuclear safety, especially in the areas covered by NKS-B. Swedish actors are, relatively speaking, the least successful in attracting NKS funds. However, knowledge and capacity building activities in neighbouring Nordic countries are important both for Swedish emergency preparedness and for the Swedish knowledge communities. Swedish actors active in NKS-B are through NKS able to build professional relations with actors such as DTU-Nutech and together with other Nordic actors develop Nordic nuclear safety research. Swedish actors do to a higher degree than Danish and Norwegian actors contact colleagues within the national context when looking for advice on professional issues. Contact with Nordic actors is however still highly relevant for Swedish actors, in particular for actors active in the areas covered by NKS-B. There is an institutional value in the integration of Nordic knowledge systems within Nuclear safety as well. The cooperation as manifested in NKS contributes to predictability and continuity within the knowledge system and facilitates the knowledge activities of Nordic actors. Individual actors can predict that there will be possibilities for future knowledge activities within the Nordic intuitional framework, which reproduces continued activity and integration

5.2. Added values from NKS in Sweden

This evaluation stipulated a number of possible added values of NKS under the headline 2.2.2 Nordic added values. Here we will discussion and interpret the importance of the Nordic added values for Sweden. Before a discussion on the importance of the Nordic added values for Sweden can be conducted, a discussion on additional Nordic added values will be presented

5.2.1. Additional identified Nordic added values

Additional added values which were not anticipated have been identified throughout this study. The main unexpected added value is NKS' function in creating common Nordic development capacity within the emergency preparedness system. This shared emergency preparedness is established through professional relations and networks spanning authorities and/or universities. Shared data, information on models and methodology used, common networks for sharing information and common R&D activities are examples of shared development capacity in the emergency preparedness system.

The assumed direct effects on competence presented in the segment 2.2.2 do not constitute the primary added value of NKS. Instead effects on competence are indirect, through the established professional relations. The availability of information and data creates the possibility of enhanced operative knowledge and competence throughout the Nordics. Furthermore, through working on a Nordic level with colleagues in the Nordic countries competence in Sweden and the Nordics within Nuclear safety is improved. This effect should be seen as an indirect effect of NKS' direct effects on the formation of networks and professional relations.

5.2.2. Purpose of SSM' funding

The funding contributed to NKS by SSM is a part of SSM funding to support and uphold Swedish competence in nuclear safety research. SSM currently funds specific research positions, provides base funding to institutions at universities and funds projects through calls for proposals within nuclear safety research. These different types of funding maintain national competence, make sure that there is technical support capacity within the national context and ensures that Sweden lives up to the standards set forward by IAEA.

As this evaluation shows the main direct effects and added values of NKS are integration of knowledge systems through formation of networks and the establishment of professional relations. The relative direct effect on knowledge production and competence building is assessed as slightly negative when compared to SSM's other funding opportunities and the output of NKS therefore does not correspond directly to the primary goal of SSM's funding. However, as will be described in the next segment, the purposes of SSM's funding are met indirectly through the establishment of professional relations among Nordic nuclear safety experts and relevant high quality research is produced by NKS funded projects. Furthermore, NKS plays an important role in fulfilling more general goals on Nordic integration and cooperation, and has significant auxiliary effects on the integration of Nordic knowledge systems and emergency preparedness systems.

5.2.3. Impact of Nordic added values in Sweden

NKS plays a vital part in integrating the Nordic knowledge systems within nuclear safety, building Nordic professional networks and establishing contacts between industry, research and radiation safety authority actors in the Nordic countries, especially within areas covered by the NKS-B program. NKS' effects on competence and knowledge are mainly indirect where competence, and technical support capacity, is created and enhanced through Nordic professional relations and networks.

Furthermore, NKS contributes to dissemination of knowledge in the Nordic community. Research funded by SSM should be applied and have direct effects on the competence

within the nuclear safety community. Relatively speaking NKS is not the most efficient way to directly fund national competence building activities, although NKS has absolute effects on the Swedish competence in Nuclear safety. NKS supports common emergency preparedness and strengthened Nordic relations and networks within nuclear safety, which can be considered a general objective for SSM, if not an immediate objective of SSM's research funding. One example of how NKS promotes competence building through professional networks is the activity of research actors within the NKS-B program. In total eight different Swedish research actors have through NKS had the possibility to cooperated with DTU-Nutech in Denmark and form collaborations.

An additional added value of NKS for Sweden is improved knowledge of the nuclear industry in Sweden and Swedish nuclear safety in countries without nuclear industry such as Denmark and Norway. Through NKS the capacity of Danish and Norwegian actors to conduct analyses and make accurate judgements on the risks associated with an accident at a Swedish nuclear power plant is improved. The Swedish funding of NKS is based on taxation of the nuclear industry, where each nuclear power plant contributes to the research budget of SSM based on installed capacity at the power plant. It is relevant for the nuclear industry actors that there is competence in neighbouring countries to make accurate judgements on risks at Swedish nuclear power plants why the added value of increase knowledge in Denmark and Norway may also be considered relevant for Sweden.

5.2.4. NKS program logic

One could argue that there are a number of institutional objectives imbedded in NKS that are the actual objectives towards which NKS aims. Historically speaking, Nordic cooperation within nuclear safety, and previously nuclear development, has focused on creating a common Nordic base for actions on an international level. One example were the activities in NKA, for which one objective was to always have a Nordic participant in IAEA Board of Governors. In addition, cooperation has strived towards coordinating Nordic resources to increase the effectiveness in research and development. NKS is a program solely focused on nuclear safety research, but the institutional heritage of building common Nordic knowledge systems and harmonizing Nordic systems, in this case within emergency preparedness, can be seen in the output of today's NKS as well. If the program logic of NKS is judged according to the goal of integrating Nordic knowledge and improving the resilience of emergency preparedness systems, the focus on cooperation through coordination funding and the funding of activities aimed at areas such as harmonization of measurement strategies and modules is very reasonable. This evaluation has not focused on the program logic of NKS though and further analysis and discussions on the goals and purposes of NKS should be investigated on another occasion.

6. Conclusions and recommendations

This chapter contains conclusions and recommendations based on the presented data and the conducted analysis. Furthermore, Oxford Research has based recommendations on previous knowledge of research cooperation on a Nordic level, both in general and within nuclear safety.

6.1. Conclusions

6.1.1. Steering and justification of NKS

- NKS is motivated by a common Nordic context involving similar regulatory cultures, similar environmental conditions and a continuity of Nordic cooperation within nuclear safety. This justification of the NKS program is similar to the justification of other Nordic programs funded by the Nordic Council of Ministers.
- There is a weak connection between the contributions from the Nordic countries and the funding allocated by NKS to different projects. Nuclear safety is however not solely a national issue, and it is important for Sweden that there is an advanced and accurate understanding of nuclear safety in all Nordic countries, why the skewed allocation of funding is not necessarily problematic. With that said, there appears to be room for increase in the level of funding allocated to Swedish actors.

6.1.2. Operation of NKS

- The relative value of NKS as compared to funding of national research programs or activities lies in NKS' function as a coordination program which supports coordination of multiple Nordic actors in smaller R&D projects and pilot projects. NKS funds relevant research activities which contribute to the development of research within Nuclear safety, but the additionality of the funding, if viewed as basic funding for national research environments, is low. Instead NKS' grants of maximum 600kDKK spanning one year are suitable and have a high additionality as funding for Nordic coordination and collaboration within Nuclear safety research.
- NKS has a similar set up as other research institutions on the Nordic level.
- The quality of research and reports produced by projects funded by NKS are generally high, but NKS lacks routines for sufficient safeguarding against occasional deficiencies in the quality and/or scientific relevance of projects.
- NKS is a relevant program for both actors active within NKS-B and NKS-R, however NKS is more relevant for NKS-B participants as compared to NKS-R participants. Both the thematic areas and NKS' function as an interface for building professional relations are more relevant for participants active in NKS-B than

in NKS-R. Furthermore, NKS-B provides more added value than NKS-R primarily since there is a wider spread of both actors and countries among NKS-B project participants.

- NKS is more relevant and provides greater added value concerning the possibilities to build professional relations and networks for non-industry actors compared to industry actors. This is not surprising since nuclear industry actors in Finland and Sweden mainly interact with each other and at times with IFE. In addition, research actors are more interested in research activities than industry actors.

6.1.3. The impact of NKS' added values in Sweden.

- NKS integrates Nordic knowledge systems, especially within areas covered by NKS-B, and strengthens the capacity for research and development within the Nordic emergency preparedness system. This corresponds to overall goals for the activities of SSM, although not directly to the goals of the research department. The integration of Nordic knowledge systems includes access to information, shared data and shared knowledge on modules and models used in the Nordic countries within various fields of nuclear safety research.
- NKS promotes a Nordic knowledge base which strengthens the possibility of especially Danish and Norwegian actors to conduct valid judgements of risks associated with possible nuclear industry in Sweden. Danish and Norwegian information on Swedish nuclear industry and knowledge of Swedish emergency preparedness and the Swedish regulatory system is important to enable correct and valid interpretations and analysis among experts in neighbouring countries.
- NKS enables and realises continuity of Nordic cooperation within nuclear safety, which is important for gathering critical mass and continued development in small specialised research groups and environments in Sweden. Through NKS small research groups can coordinate common projects and build professional networks which can expand outside of NKS. NKS provides an area for networking and creating professional relations. Through NKS activities which ensure further integration of knowledge systems and possible future collaborations can be executed.

6.2. Recommendations

6.2.1. SSM's intentions with NKS

- SSM should initiate a discussion on the purpose and objectives of NKS within the NKS' owners group, considering the appropriateness of the size of grants and the length of project funding. The discussion should clarify the expectations on NKS as a funding programme for coordination and dissemination actions or for funding major new research projects and agendas.
- SSM should promote a thematic focus on topics which relate to common Nordic questions where a broad representation of Nordic actors is possible. One possible development is a shift towards only an NKS-B programme, which incorporates relevant Nordic topics within NKS-R.

6.2.2. Development of NKS' routines

- SSM should promote an effort to investigate synergies and lessons to be learned from other Nordic research programmes such as Nordforsk and Nordic Energy Research, in order to elaborate and increase the added value of NKS, and achieve synergies between the programmes.
- SSM should initiate a discussion on development of the quality assurance procedures of NKS, to be conducted in order to ensure consistent high quality and relevance of projects. A more detailed policy of, for example, the evaluation of project proposals, would also reduce sensitivity to staff turnover within NKS' board and ensure similar evaluation procedures in all Nordic countries.
- SSM should advocate that NKS establishes a structured database for recording project data, such as funding, co-funding, participation, dissemination etc., in order to facilitate monitoring and future evaluation.

6.2.3. Strengthening the impacts of NKS in Sweden

- SSM should promote increased inclusion of Swedish PhD students in NKS projects in order to capitalize on the networking aspects of the program.
- The value of the impacts from NKS' for SSM, and Sweden, should be assessed at management level in SSM, considering the auxiliary benefits to emergency preparedness on the Nordic level. Depending on which objectives are to be met by the collaboration, there may be different set ups for the allocation of funds to NKS within the authority's budget. This includes addressing expectations on the national distribution of NKS grants.

7. References

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7.2. Interviews

7.2.1. Explorative interviews

Name		Country	Actor	Role in NKS
Jourma	Aurela	Finland	Minstry of Enterprise	NKS board member and member of-NKS owners group.

Fredrik	Hassel	Sweden	SSM	-
Annelie	Bergman	Sweden	SSM	NKS board member.
Finn	Physant Christensen	Denmark	NKS Secretariat	NKS administrator
Olga	German	Sweden	Vattenfall	NKS board member
Sigurður	M. Magnússon	Iceland	Icelandic Radiation Safety Authority (IRSA)	Chairman of the board of NKS
Emma	Palm	Sweden	SSM	NKS-R Programme manager
Kasper	G Andersson	Denmark	DTU	NKS-B programme manager

7.2.2. Interview study

Name		Country	Actor	NKS-program	Type of actor
Charlotte	Nielsen	Denmark	Strålebeskyttelse (SIS)	NKS-B	Radiation Safety Authority
Xiaolin	Hou	Denmark	DTU-Nutech	NKS-B	Research
Jens	Havskov Sørensen	Denmark	Danish materological institute (DMI)	NKS-B	Other Authority
Bent	Lauritzen	Denmark	DTU-Nutech	NKS-B and NKS-R	Research
Peter H.	Voss	Denmark	Geological Survey of Denmark and Greenland	NKS-B	Other Authority
Lindis	Skipperud	Norway	Norwegian University of Life Science (NMBU)	NKS-B	Research
Mark	Dowdall	Norway	Norwegian radiation protection agency (NRPA)	NKS-B	Radiation Safety Authority
Arnfinn	Tveit	Norway	Wirescan	NKS-R	Industry
Naeem	Ul Syed	Norway	Norwegian radiation protection agency (NRPA)	NKS-R	Radiation Safety Authority
Heiko	Klein	Norway	Norwegian meterological institute (Met)	NKS-B	Other Authority
Lilián	del Risco	Sweden	Swedish radiation	NKS-B	Radiation Safety

	Norrlid		safety authority (SSM)		Authority
Mats	Isaksson	Sweden	Gothenburg University/Sahlgrenska university hospital	NKS-B	Research
Andrew	Wallin Caldwell	Sweden	Lloyd´s Register Consulting - Energy AB	NKS-R	Industry
Mathias	Franzon	Sweden	Swedish radiation safety authority (SSM)	NKS-R	Radiation Safety Authority
Synnöve	Sundell-Bergman	Sweden	Vattenfall	NKS-B	Industry
Stefan	Eriksson	Sweden	Ringhals AB	NKS-R	Industry
Jonas	Lindgren	Sweden	Swedish radiation safety authority (SSM)	NKS-B	Radiation Safety Authority
Maren H.	Rø Eitrheim	Norway	Institute for energy technology (IFE)	NKS-R	Research
Christian	Ekberg	Sweden	Chalmers university of technology	NKS-R	Research
Anders	Karlsson	Sweden	Forsmark Kraftgrupp AB	NKS-R	Industry

7.3. Workshop participants

Eva Simic, Swedish Radiation Safety Authority (SSM)
Kåre Axell, Swedish Radiation Safety Authority (SSM)
Andreas Kjellin, Swedish Radiation Safety Authority (SSM)
Anna Alvestav, Swedish Radiation Safety Authority (SSM)
Hjalmar Eriksson, Oxford Research
August Olsson, Oxford Research

Appendix A - Survey response analysis

A non-response analysis of the survey shows non-respondents are similar to respondents, Norwegian and Icelandic respondents are a few percentage points more common in the non-response group compared to the response group, and Swedish respondents are a couple of percentage point more uncommon in the non-response group compared to the response group.

A comparison based on the affiliation of respondents show that respondents affiliated with research actors are more common in the response group than in the non-response group, 48% of the respondents are affiliated with a research actor, compared with 37% of the non-respondents. On the other hand, respondents affiliated with a radiation safety authority are more common in the non-response group than in the response group, 23% of the respondents are affiliated with a radiation safety authority compared with 34% of the non-respondents. 74 (60%) respondents had been active in the NKS-B program, 49 (40%) with the NKS-R program and one respondent was active in both programs. This corresponds very well with the population of contact persons where 61% were active in NKS-B, 38% in NKS-R and three individuals (1%) in both programs). The survey response group is described in Figure 28 and Figure 29 below.

Figure 28. Number of survey respondents by type of actor

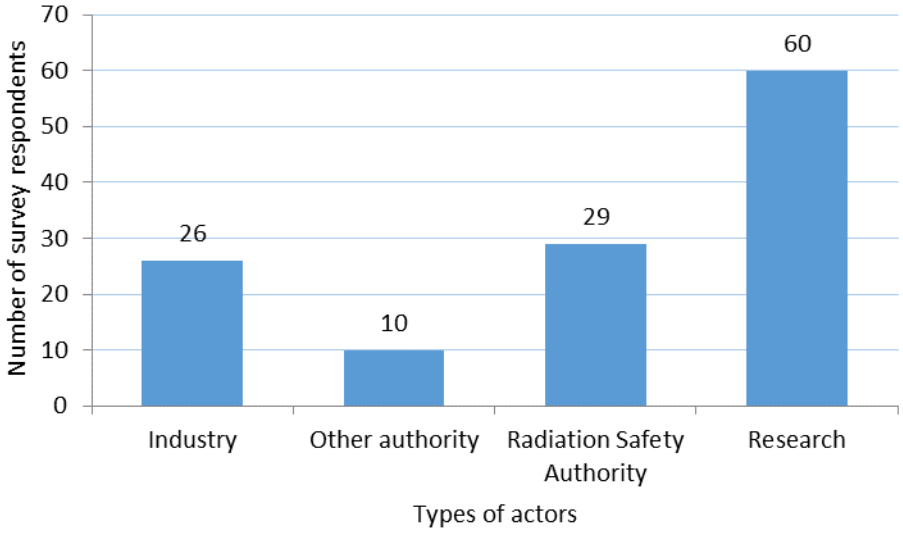
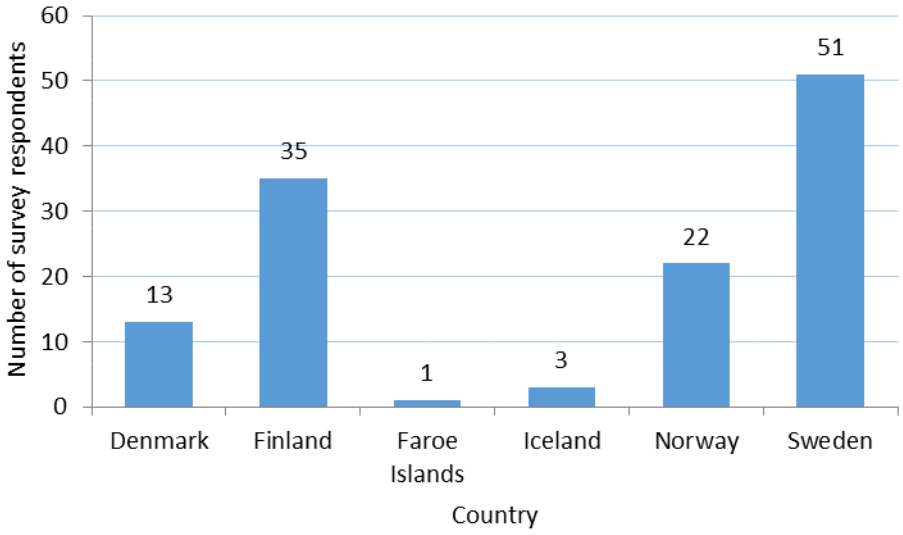


Figure 29. Number of survey respondents by country



2017:09

The Swedish Radiation Safety Authority has a comprehensive responsibility to ensure that society is safe from the effects of radiation. The Authority works to achieve radiation safety in a number of areas: nuclear power, medical care as well as commercial products and services. The Authority also works to achieve protection from natural radiation and to increase the level of radiation safety internationally.

The Swedish Radiation Safety Authority works proactively and preventively to protect people and the environment from the harmful effects of radiation, now and in the future. The Authority issues regulations and supervises compliance, while also supporting research, providing training and information, and issuing advice. Often, activities involving radiation require licences issued by the Authority. The Swedish Radiation Safety Authority maintains emergency preparedness around the clock with the aim of limiting the aftermath of radiation accidents and the unintentional spreading of radioactive substances. The Authority participates in international co-operation in order to promote radiation safety and finances projects aiming to raise the level of radiation safety in certain Eastern European countries.

The Authority reports to the Ministry of the Environment and has around 300 employees with competencies in the fields of engineering, natural and behavioural sciences, law, economics and communications. We have received quality, environmental and working environment certification.

Strålsäkerhetsmyndigheten
Swedish Radiation Safety Authority

SE-171 16 Stockholm
Solna strandväg 96

Tel: +46 8 799 40 00
Fax: +46 8 799 40 10

E-mail: registrator@ssm.se
Web: stralsakerhetsmyndigheten.se

Arkitektkopia AB, Bromma, 2017

Kasper Andersson and Christian Linde 13 May 2017

An overview of the scientific and administrative activities of the PC's

Scientific tasks:

Information

- Presentations of NKS programmes and their results at many seminars.
- Using personal network and opportunities at conferences, workshops, work meetings, etc. (which often have no direct relation to NKS) to promote NKS internationally as well as in the Nordic area. Promoting synergetic effects in Europe that are of benefit to Nordic organisations.
- Arranging and executing the Stockholm seminars in 2013 and 2016 (e.g., in liaison with a seminar program group, NEP group and others). Being a driving force in many meetings to ensure consensus about, e.g., scope, session topic sequence, topics of individual presentations, structure, contents, target groups, input facilitating discussions, invited speakers balancing a number of aspects (usually takes many meetings and discussions about content). Writing program booklet texts and proceedings texts. NOTE: prior to 2012, much less effort was put into arranging joint R/B seminars. We have tripled the audience since then.
- Issuing NewsLetters NewsFlashes and LinkedIn updates including scientific content.
- Writing texts about the Nordic strengthening of capacities, Nordic common view, securing competence and knowledge for the future, etc. for NKS website, pamphlets, programs and handbooks.
- Writing publications explaining and disseminating the overall results of NKS in Nordic and global forum. NOTE: this is an optional extra introduced in recent years without any extra financing. It was – at least until recently – warmly supported by the board, but if it is now not wanted, we can stop doing it.

Pre CfP

- Contacting people who can write a good proposal and are known to deliver good work, and persuade them to send in an application for a CfP. Often scientific ideas have been 'planted'. Discussing scientific ideas that could become a NKS proposal at various meetings and by phone or email. Leading role in general in call for proposals.

Check points

- Screening incoming proposals before sending to evaluators for evaluation
- Prepare CfP evaluation report for January board meeting
- Preparing status reports and presentations to board and coordination meetings twice a year (including scientific evaluations of status).
- Communicating with activity leaders checking continually that activities are run in accordance with the contract and NKS interests and proposing ways to handle problems so that the value of the work is not jeopardised.
- Participating in a number of NKS activity seminars/exercises/workshops each year, and presentation to the board of the scientific value of and Nordic interest for participation in these.
- Reading and approving (or delivering advice for revision of) NKS activity final reports.

Post CfP

- Writing contracts for new NKS activities and ensuring that details are compliant with applications.

Meetings

- Participating in two board meetings and two coordination meetings each year, informing about the status, agreeing on tasks for the future period that are for the benefit of NKS, and once a year proposing a package of new activities.
- Participation in other meetings (e.g., NKS work groups)

Scientific support/facilitation

- Writing recommendations for applicants and activity leaders, using experience from participation in project work over decades to avoid pitfalls and smoothly obtain the best possible results.
- Addressing special requests from the board (e.g., compiling material for an evaluation)
- Participating and coordinating in ad hoc work, such as the coordination of planning and execution of an external NKS activity paid by Nordic Council of Ministers on radioactive waste handling in the Nordic countries, including work meetings and report writing.

Administrative tasks

Information

- CfP administration – prepare call, handling of incoming proposals, prepare for evalution
- Providing individual solutions to different organisations in contract writing and final reporting (actually not purely administrative - this work could be done by activity leaders, but the burden and cost would then be transferred as well, although in an intransparent way)
- General support is received from the organisation of the PC (PC's depend on this, which adds to the overhead cost of the PC)
- Smallish NKS web tasks (actually not purely administrative).
- Parts of NewsLetters and NewsFlashes.

Data processing

- Annual summary calculation of the board's recommendations following the CfP.

Internal check points

- Keeping own accounts of the NKS activities running.
- Dealing with invoices and young scientist travel claims.

It is estimated that somewhere between 80 and 90 % of the PC's time on NKS tasks is spent on scientific tasks.
On average (over seminar and non-seminar years) the NKS time spent in a year by a PC clearly exceeds the number of accountable hours in a half year at DTU.

Proposal for a WG to review and revise PC´s activities:

Timeframe: Final report in good time before the 2018 January board meeting

i.e. 1 December 2017.

Draft ToR:

- evaluate the present activities of the PC´s with regard to scope and volume taking into consideration the views expressed by Danmark at the january 2017 board meeting of NKS and the evaluation report of Oxford Research.
- evaluate possible changes in activities of the PC´s in order to lower costs and further optimize and enhance the efficiency of PC activities without compromising the quality of their work or the outcome of the activities.
- propose changes in PC´s activities as needed (based on the outcome of the evaluation of present activities and possible changes) and evaluate the total corresponding change in % of a full position separating clearly administrative and technical/scientific acivities.
- propose changes in the wording of current contracts for PC´s in order to improve clarity with regard to volume of activities and separation of administrative and technical/scientific activities.

Members of the WG should preferably be board members (or advisors) having practical experience with the NKS PC activities and projects.

Proposal for members of the WG: Astrid, Carsten, Karin and Nici (chair).

1.6.2017

SMM

Finn Physant, 22 May 2017

An overview of the technical/administrative, scientific and strategical administrative activities of the Secretariat:

1. Technical/administrative work:

The contract AFT/NKS(17)3:

"Based on the experiences from more than 20 years of NKS Secretariat work it has become clear to split the work into 4 categories.

1. Finances

    - Financial administration and auditing including agreements/reservations
    - Reporting to the Owners, Board and Programme Managers
    - Bookkeeping and payments

2. Secretariat assistance

    - Preparation and updating of administrative documents including address lists, handbooks, the Administrative Handbook, composition of new administrative documents as required etc.
    - Issuing of information (reports, call for meetings, meeting material etc.) to the Board, Programme Managers etc. as required and participation in Board and Coordination meetings
    - Keeping of the archieves and organising of reference library and library services

3. Publishing work

    - Editing and publishing of NKS reports in electronic and printed versions
    - Specific reports in adequate media
    - Controlling of printing agreements, distribution and reporting of materials
    - Preparation and distribution of NewsLetters and NewFlashes

4. Running of www homepages

    - Everyday maintenance and updating of "public" homepage
    - Everyday maintenance and updating of "internal" homepage including individual sites as required"

The NKS Administrative Handbook (NKS(17)3) appendix 7 – 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, participates in Board meetings and takes minutes at these 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.
- Requires 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) are 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.
- 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 NKS Administrative Handbook (NKS(17)3) appendix 8:

The NKS Calendar Year

January: Board meeting early January with status reports from the programmes – the Board approves the new year's activities and budget. – A NewsLetter is published approximately one

week before the Board meeting, and a NewsFlash is published approximately one week after the meeting.

January/February: New programme activity agreements are signed, and the new activities start. End and start of NKS's fiscal year.

February/March/April: Preparation of last year's accounts.

March/April: A NewsFlash presentation of new programme activities including reports, seminars etc.

April/May: Coordination meeting with follow-up after the January Board meeting and preparation and planning of the upcoming May/June Board meeting and programme status reports.

May/June: Board meeting with status reports from the programmes and presentation and approval of last year's accounts. Plans are made for this year's call for proposals (CfP). – A NewsLetter is published approximately one week before the Board meeting, and a NewsFlash is published approximately one week after the meeting.

August/September: CfP for next year's activities is started with a combined website and NewsFlash release.

October: deadline for CfP.

October/November: Evaluation of new proposals.

November/December: Coordination meeting with preparation of the January Board meeting, programme status reports, new proposals/activities, new budget etc.

2. Scientific administrative work

A greater part of the Secretariat work has become "scientific administration" – especially during the last 5-6 years. Examples:

-participation in the seminars 2013, 2016 and 2019 in planning, organizing, carrying out, reporting etc.
-participation in article/abstract/presentation work since 2012 as presented on the website http://www.nks.org/en/this_is_nks/articles/
-participation in the NSFS conferences in 2011 and 2015 in planning, organizing, carrying out, reporting etc.
-build-up and running of the websites especially the report database, which makes NKS actual scientific results – namely the final activity reports – public.

3. Strategic administrative work

Another level of tasks has been added to the more regular duties, which have become more scientific:

Strategic administration – which is the work you get done after decades of activities – like programme continuity, passing on of routines, overview at a high level, teaching from one generation to the next of colleagues, standard answers to FAQ's, knowledge of which buttons to push, experiences for future use, networks of relevant people etc.

Writing strategically and diplomatically correct meeting arrangements, minutes with root in deep knowledge and experience. This knowledge and experience is also vital to the biannual reporting to the coordination group and board, and the various customer contacts over the year.

Without the continuity and present knowledge it for instance wouldn't have been possible to meet the requests from Oxford Research last year. Various requests for information from board members are also met on occasion.

4. Final remarks

About the volume of the work and split between "scientific administration" and general administration it's only 3 months ago that we agreed to the contract covering 1000 adminstrative/technical hours and 75 academic hours, which is the volume to be worked according to. – Contracts including this volume have been made for a number of years, and from the above it must be understood that quite a number of technical/administrative hours in fact have become technical/scientific during the last years. The amount of strategic administrative work is continuously becoming a bigger and bigger part of the present Secretariat's work.

Minimum requirement of the Secretariat: an office (address and archieves) and at least 3 persons – one signer of payments – one co-signer of payments – and one bookkeeper (staff minimum according to agreement with the auditor).

Furthermore note that the Secretariat has implemented English as the working language of NKS during the last 5-10 years.