

# **DRAFT REPORT #6 OF 6**

## **Nordic Nuclear Safety Research 1994 – 2008: From Standardized 4-Year Classics To Customized R&B**

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Text in red indicates major changes compared to draft #4.

# Abstract

This is a presentation of NKS (Nordic Nuclear Safety Research), its work and achievements in the years 1994 – 2008, during which the author served as Nordic secretary and (later) as coordinator. NKS and the Nordic perspective are briefly introduced. Then follows a description of the NKS support structure, organization and administration: owners, board, Nordic secretary, Bureau and Secretariat.

The author then embarks on a journey through the modern history of NKS work. The last two of the six fixed 4-year programs are described as regards planning, contents, project work, administration, dissemination of results, evaluations and conclusions. The trip continues to the land of R&B and the present (2011) structure of two general frameworks, namely, NKS-R: reactor safety, and NKS-B: emergency preparedness; each consisting of a set of flexible activities; hence, R&B. The reasoning behind this makeover is touched upon together with the new organization and simpler administration that developed. Major activities and the produced results are introduced and the evaluations summarized. The author's own conclusions and recommendations are followed by a short and subjective list of references.

In a number of appendices some important background material has been compiled: bullet point versions of minutes of owners group and board meetings; economic contributions and budgets; an overview of all NKS programs and evaluations; lists of R&B activities and funding; the author's personal remarks; a list of some NKS documents (other than technical reports and minutes); and a list of acronyms used in this report.

The author's personal views are essentially confined to two sections of the report: Concluding Personal Reflections; and Appendix 9: Author's Remarks. Other than that, they will be given in the form “(*Author's comment: ...*)” throughout the report (where applicable).

## Key Words

Aging; biological transfer; BWR; CAMS; call for proposals; Chernobyl; clean-up; clearance; computerized accident management support system; contamination; core coolability; countermeasures; database; decommission; dispersion; dissemination of information; dose assessment; EIA; emergency preparedness; environmental impact assessment; evaluation; exercises; food chains; framework program; human factor; integrated sequence analysis; intermediate storage; internal dose; international cooperation; LOCA; maintenance strategies; man-machine interaction; mass spectrometry; measurements; mobile reactors; monitoring; network; NKS; Nordic nuclear safety research; nuclear power; nuclear safety; nuclear threat; operability; organic iodine; plant modernization; probabilistic safety analysis; PSA; PWR; QA; quality assurance; radiation protection; radioactive; radioecology; radionuclide; reactor; recriticality; reflooding; risk assessment; safety culture; sampling; severe accident; spectrometry; source term; validation; vulnerability; waste

# Acknowledgment

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# Disclaimer

The views expressed in this report remain the responsibility of the author and do not necessarily reflect those of NKS. In particular, neither NKS nor any organization or body supporting its activities can be held responsible for the material presented herein, or how the material is interpreted or put to use.

# Color Code

Portions of the text in this report are written against a colored background. The colors signify:

Lilac	Matters related to the Owners Group
Yellow	Matters related to the Board
Blue	Information on the research program
Green	Organizational / administrative matters

**Don't ask me nothing 'bout nothing  
I just might tell you the truth**

**Bob Dylan: Outlaw Blues**

# Extended Summary

## **NKS: Nordic Nuclear Safety Research**

Nordic Nuclear Safety Research (NKS) is a platform for Nordic cooperation and competence in nuclear safety and related radiation safety issues including emergency preparedness and radioecology. The work is financed by Nordic authorities, research institutions and power companies; and supported by a number of other organizations. The objective is to produce seminars, exercises, scientific articles, technical reports and other deliverables. The participating countries are Denmark, Finland, Iceland, Norway and Sweden. Each major activity should involve at least three of the Nordic countries.

The owners and main financiers of NKS are:

- The Danish Emergency Management Agency (DEMA)
- The Finnish Ministry of Employment and the Economy (TEM)
- The Icelandic Radiation Safety Authority (IRSA)
- The Norwegian Radiation Protection Authority (NRPA)
- The Swedish Radiation Safety Authority (SSM)

Representatives of the owners form the Owners Group, and together with experts appointed by the owners they constitute the NKS Board. The owners decide in matters regarding funding, policy, structure and overall matters, whereas the Board handles questions regarding priorities, budgets, program plans and activity related issues. The quality and cost-effectiveness of NKS work is closely followed by the Board. Some noteworthy Owners Group and Board discussions and decisions are briefly summarized in the main text of this report and presented at greater length in two appendices.

The owners appointed a Nordic secretary to coordinate and oversee the scientific work and the secretarial services. Up to 1994 Franz Marcus had served as Nordic secretary; he was then followed by Torkel Bennerstedt who served for the 15 years covered by the present report; the last years as coordinator. The position was cancelled in 2008 and the tasks of the Nordic secretary / coordinator were taken over by others.

In 1994 – 2006 the Bureau served as the Board's working group. It consisted of the NKS chairman, the secretary of the Board and the Nordic secretary.

For the entire period covered by this report, the secretarial function rested with two FRIT members, first as a division of Risø, later as a private company within the premises of Risø.

## **NKS 1994 – 2008: 15 years of work and development**

This report covers the 15 years when the author served as Nordic secretary. It is impossible not to be impressed with the vast amount of research, exercises, dissemination of information, sharing of resources and experience, networking, recruitment and participation of many hundreds of persons in nuclear safety, radiation protection and emergency preparedness from all five Nordic countries. Most participants will remain anonymous to the reader of this report; but you can rest assured that all their contributions have made a difference in the development of NKS work and its high international standard. Without the support of the owners, the Board, other contributing organizations and last but not least the NKS Secretariat, all of this would not have happened. And it is an ongoing process, still as viable as ever after decades of Nordic collaboration and international cooperation.

During the first 8 of the 15 years, work progressed in accordance with the traditional pattern of 4-year programs, where the first part of the period was used to plan the work, the following years were spent on actual project work and the last part of the period was spent summing up, reporting and evaluating the old program and discussing the next.

In order to further improve the cost-effectiveness of the work and increase the flexibility, the NKS structure was changed in 2002. A new program structure, consisting of two research areas – NKS-R (reactor safety) and NKS-B (emergency preparedness) – was developed, together forming the new R&B program. In annual Calls for Proposals participating organizations can suggest activities, specify work plans and apply for NKS funding. Activities are no longer automatically prolonged for several years, as in the old 4-year programs. All applications for NKS funding shall answer some basic questions: Who is supposed to do what why when where how at what cost, who picks up the tab and who benefits from it all?

The yearly *contributions* to NKS work ranged from DKK 7391k to 9875k, totalling about DKK 124 million for 1994 – 2008. The in-kind contributions of participating organizations were of the same order of magnitude.

The yearly *budgets* ranged from DKK 6670k to 11978k, totalling about DKK 129 million for 1994 – 2008. There are numerous explanations as to these annual variations: fluctuations in national funding; transfer of unused funds from one year to the next; the number of activities that were supported; etc.

In the background, the NKS Secretariat did a tremendous work, keeping track of all administrative matters like finances, bookkeeping, audits, publication of reports, assisting project leaders, program managers and many others in their daily chores.

Initially, dissemination of information usually consisted of writing and distributing reports and articles, arranging or participating in seminars, conferences and workshops etc. But as new media emerged, the focus was on the Internet with email, websites, electronic reporting, CD and DVD formats in an ongoing evolution. Networking has taken on a whole new meaning.

NKS policy and administrative routines were developed in an evolutionary process over the years, maturing and adapting to the decisions of the owners and the Board and the needs of the participants.

The most important criteria for program plans and activity proposals have been

- Relevance to financiers and end users
- Conformity with policy and adopted program structures
- The Nordic perspective: of common Nordic interest
- High international standard of the work and its results

Simply put, NKS should engage in select and timely activities, for the right reasons, while striving for optimal quality, at a reasonable cost with maximum positive impact, benefitting as many of the stakeholders as possible.

The quality of the work is monitored by the owners and the Board through assessment of proposed activities and work plans, presentations and discussions at Board meetings, scrutiny of deliverables and independent evaluations of a well-defined program period according to directives stipulated by the Board.

The programs and results of NKS work in 1994 – 2008 are summarized in the sections below.

### **Scientific program of the fifth 4-year period 1994 – 1997**

The program adopted by the Board was divided into three project categories: RAK, AFA and EKO, plus a joint services function called SAM.

*RAK*                *Reactor safety:*

RAK-1            Strategy for reactor safety  
Objective: To explore strategies for reactor safety as applied in Finland and Sweden; specifically to investigate and evaluate the safety work; increase realism and reliability of the safety analysis; and suggest how safety can be improved in selected areas.

	Subdivided into: Mapping and evaluation of the safety work; Initiating events; Integrated sequence analysis – especially human errors; Maintenance strategies and aging; and Modernization.
RAK-2	Prevention of severe accidents Subdivided into: Studies of the consequences of selected severe accident scenarios and phenomena in Nordic reactors; Development and testing of a computerized accident management support system (CAMS); and Data collection on different mobile and British reactors in Nordic surroundings.
AFA	<i>Waste management:</i>
AFA-1	Safety in waste disposal Objective: To give authorities and waste producers background material for decisions on management and disposal of long-lived low and intermediate level radioactive waste. Subdivided into: Waste characterization; Performance assessment for repositories; and Environmental Impact Assessment (EIA).
EKO	<i>Environmental effects:</i>
EKO-1	Marine radioecology Objective: To enable better and faster assessments of the effects of releases of radionuclides to the marine environment, taking health and economy into account. Subdivided into: Model work; Research: field and laboratory studies; and Dissemination of information.
EKO-2	Long ecological half-lives in semi-natural systems Objective: To identify the contributions from semi-natural systems by determining ecological half-lives for specific foodstuffs from these areas, and determine dose to man. Subdivided into: The sheep project; The forest project; and The fresh-water fish project.
EKO-3	Preparedness strategy and procedures Objective: To assist Nordic authorities in improving their emergency response and international cooperation in selected issues. Subdivided into: Mobile measurements; Quality assurance; and Operational Intervention Levels (OIL).
EKO-4	Emergency preparedness exercises and information Objectives: To develop competence and contingency plans; to contribute to Nordic evaluation and coordination; and to improve understanding of actions taken in Nordic neighbor countries. Subdivided into: Various exercises and seminars on source term analysis; Atmospheric dispersion; Dose calculation; Clean-up operations; and Mobile measurements.
EKO-5	Pre-planning of early clean-up Objective: To work out guidelines to be used in the planning of early clean-up actions after a nuclear accident, in order to reduce doses from external radiation in inhabited areas. Subdivided into: Identifying relevant actions; Calculations for various building types; and Guidelines and tables for planners regarding the studied cases.
SAM	<i>NKS coordination:</i>
SAM-1	Secretarial services, administration Objective: Cost-effective services to the NKS organization. No subdivision.

SAM-2	<p>Coordination of NKS-Baltic activities</p> <p>Objective: To facilitate Nordic-Baltic cooperation when needed and in line with NKS policy.</p> <p>No subdivision.</p>
SAM-3	<p>Coordination of NKS-EU activities</p> <p>Objective: Meetings and seminar to investigate the possibilities for contacts and cooperation with EU.</p> <p>No subdivision.</p>
SAM-4	<p>Overriding information issues</p> <p>Objective: To create a forum for discussions and education in issues regarding information to media and members of the public.</p> <p>Subdivided into: How to inform about a difficult subject in a modern society; How to provide advance information; How to inform when an accident has occurred; and How to inform about NKS and its projects.</p>

### **Evaluation of the scientific program 1993 – 1997**

- The general aim of the program was well in line with NKS objectives. The planning and execution of the program has been systematically documented. With a few exceptions, deadlines have been met, and budgetary constraints were respected.
- The activities in the *nuclear safety* area concentrated on comparative analyses of nuclear safety work in Finland and Sweden. All subprojects were relevant and the objectives sufficiently ambitious.
- Among the problems on *radioactive wastes*, long-lived low and medium level waste management practices in the Nordic countries as well as approaches to analyze the environmental effects due to waste storing were under study and deliberation. Finnish and Swedish participation from authorities and the industry was scarce, which might reflect the choice of program contents.
- Main efforts in the area of *radioecology* were allocated to the modeling and analyses of long term radioactive contamination in a Nordic environment. Joint training and exercises were organized to test and develop emergency preparedness emphasizing the possibility of a nuclear accident.
- The selection of RAK, AFA and EKO projects was done after careful pre-studies. Some of the projects represent the top level of scientific technical knowledge, others are state-of-the-art. Important results have been presented and useful information collected for future use. Technical reporting should however be done only if real advancements can be presented or if there is a need to bring some special aspects to a broader forum for discussion.
- The *information* project consisted of a number of interesting and important subareas but was probably too ambitious. The NKS Board should seriously consider the pros and cons before adopting new information projects (other than communication techniques).
- The *administrative functions* and the corresponding documentation has improved vastly the last couple of years. The level of competence is high and the functions have served the program well.

### **Final seminar of the scientific program 1993 – 1997: Eight years with NKS**

The two-day seminar was arranged in Saltsjöbaden, Sweden in March 2008. It covered the results of the recently finished 4-year program and plans for the next. Most of the first day was spent on reporting of the project leaders and the evaluator, and discussions on the results, findings and recommendations. The Secretariat also presented its achievements. The second day was spent discussing NKS and the future. After a presentation of a proposed new research program, the participants formed a number of groups to discuss different aspects of the proposal and reported in plenum, after which followed a joint final discussion.

## Scientific program of the sixth 4-year period 1998 – 2001

The program adopted by the Board was divided into three project categories: SOS, BOK and SBA, plus a joint services function called SEK.

### *SOS Nuclear safety and radiation protection:*

- SOS-1** Risk assessment and strategies for safety  
Subdivided into: Risk assessment; Safety analysis; and Strategies for safety management.  
Highlighted current development within the nuclear energy area on a broad base. Safety is understood as awareness in regard of the control of risk. It cannot be said to be provided for until it has been communicated, implemented and well understood. The safety culture must continuously be encouraged and stimulated. Safety indicators reflect the safety of a nuclear facility and provide warnings that future performance might be in danger. Quality systems have an important task of ensuring a systematic knowledge sharing and learning. Safety analysis is at the core of risk assessment for decision making both in reactor safety and for waste disposal.
- SOS-2** Reactor safety  
Subdivided into: Safety development; Management of plant maintenance and renewal; and Severe accidents.  
Focused on certain safety-related topics of common interest to the Nordic nuclear community. Problems related to risk-informed decision making were addressed, especially uncertainties and incompleteness due to use of PSA. Analyses of human and organizational factors in maintenance were promoted, as was the need to enhance understanding related to maintenance management. Phenomenological studies of hydrogen combustion, formation of organic iodine, and core recriticality due to molten core – concrete interactions in the lower head of the reactor vessel were performed. The current status of research and management of severe accidents in the Nordic countries was reviewed.
- SOS-3** Radioactive waste  
Subdivided into: Environmental Impact Assessments (EIA); Intermediate storage of low and medium level waste; and Contamination levels in metals.  
Priority was given to a Nordic perspective with participation from all five countries. Therefore, work focused less on waste from nuclear power plants than on waste from research institutions, hospitals and industries. The target group for the results was primarily authorities and organizations managing waste in the Nordic countries. However, the results are presumably useful in other countries as well. This applies particularly to the work on contamination levels in metals. The EIA part of the project included four strictly Nordic seminars on procedures for the disposal of radwaste.

### *BOK Nuclear preparedness and consequences:*

- BOK-1** Nuclear emergency preparedness  
Subdivided into: Laboratory measurements and quality assurance; Mobile measurements and measurement strategies; Field measurements and data assimilation; Counter-measures in agriculture and forestry; Emergency monitoring in the Nordic and Baltic Sea countries; and Nuclear exercises.  
The project comprised a number of activities aimed at developing and improving nuclear emergency preparedness. The activities included surveys of techniques and equipment, workshops and exercises. The project included research activities concerning monitoring and modeling the radiological impact of nuclear accidents, aiming at developing emergency response plans. Radiation protection authorities, governmental agencies, universities, research organizations and laboratories have been



partners in the project, which have had participants from all of the Nordic and Baltic Sea countries.

**BOK-2** Radiological and environmental consequences  
Subdivided into: Important Nordic food chains: Radiological vulnerability; Internal doses; Radioactive tracers in Nordic sea areas: Sea water transport; Biological and biogeochemical processes; Applications of ICP-MS for measuring radionuclides; and Methodology for defining exemption levels of radionuclides in timber.  
The project focused on radioecology in the Nordic countries and areas of interest to them. An important aim was to provide a stimulating environment and to encourage contacts and cooperation between young and experienced researchers, between scientists in different fields (within and outside traditional radioecology) and between scientists within the Nordic countries and neighboring regions. This was done through meetings, seminars and dissemination of information, including use of the Internet. The Nordic network within radioecology is important for national authorities and for new people in the field and for making it possible to start close cooperation quickly between countries, e.g., if needed because of a nuclear accident.

**SBA** *Safety and preparedness related activities:*

**SBA-1** Nuclear threats in Nordic surroundings  
No subdivision.  
The main task was to aggregate already compiled knowledge of nuclear threats in the vicinity of the Nordic countries into a base of knowledge, presented by means of modern information technology and made available to Nordic authorities as a supplement to national emergency preparedness systems. The project focused on potential events in nuclear installations and the possible consequences for the Nordic countries and especially on vulnerable food chains, dose to man, environmental contamination and emergency preparedness. The main installations in question were nuclear power plants, nuclear powered ships and nuclear fuel and waste storage facilities. A literature database is presented on a website and as a report with some 500 references, including the most relevant publications, papers and reports on the topic at hand.

**SBA-2** Information issues  
Clear goals were never formulated, but the project intended to answer very much the same questions as the information project of the previous 4-year program. A workshop on information for NKS project leaders and participants was carried out and a combined course and field trip to Sellafield for journalists was arranged. Due to circumstances beyond the control of the project leadership, the Board decided in 2000 to cancel the project.

### **Evaluation of the scientific program 1998 – 2001**

- The program proved that this kind of cooperation is needed to develop the joint Nordic view on radiation and nuclear safety issues and to maintain and develop direct personal contacts between the authorities and researchers.
- It is recommended that a new criterion – the Nordic added value – should be applied when assessing project proposals.
- It is not always clear what the aims of a project or subproject are, or why a subproject was added.
- Parts of SOS-1 were carried out in cooperation with an EU project, focusing on Oskarshamn NPP and communication with the public. A continuation of the work on safety analysis is not necessary. The utilities participated in the part that dealt with safety management, and this work should be continued.
- To a large extent, SOS-2 was a continuation of RAK. The results are interesting and valuable both to authorities and end users. Good that the dependence of PSA results on the studied object is brought up. Risk informed methods are of great value. Maintenance and renewal issues are

important in view of the deregulation of the power market. It is essential to maintain competence as regards organic iodine, and work on severe accidents should continue.

- SOS-3 was partially a continuation of AFA-1.3. Nordic differences in EIA policy and work were highlighted in a series of successful seminars, where non-nuclear cases were also studied. The analysis of Nordic experience of waste storage and deposition excluded nuclear power, and Iceland was not mentioned. It was demonstrated that doses to man from contaminated scrap metal will be insignificant, which is an interesting result in itself. The compilation of Nordic regulations on clearance is valuable.
- BOK-1 had a background in earlier BER and EKO programs. The coordination and administration of the project was excellent, and the Nordic perspective well taken care of. It was demonstrated that the Nordic countries are well prepared to make good quality field and laboratory measurements in case of an emergency. The database on countermeasures in agriculture and forestry should be integrated with RODOS and ARGOS. The valuable handbook on Nordic and Baltic Sea states was updated and now covers 11 countries. The exercises strengthened the ability to cooperate under emergency conditions.
- BOK-2 had its background in earlier RAD and EKO programs. The many environmental surveys are more costly than other types of NKS work, so NKS funding was only a small fraction of the total budget. It was a good forum for networking and training, with some Baltic cooperation. The results of the studies of radionuclides in important Nordic food chains are of great use. The competence regarding radioactive tracers has increased. It was demonstrated that ICP-MS is applicable both for heavy and lighter isotopes. The results of the studies on timber clearance levels should be of interest to the forest industry.
- SBA-1 was divided into two parts. One created an Internet literature database of some 500 publications on nuclear installations in the Nordic countries and surrounding areas. The other part was the creation of an Internet base of knowledge on risks and nuclear threats to the public and the environment. It is important that these excellent databases are kept operational.
- SBA-2 failed to achieve most of its goals. No reports were published. As for NKS information activities in general, any actions should be end-user driven and future plans (if any) more concrete.
- The proposed division of the new NKS program into two main areas is supported.

### **Evaluation of the NKS structure 1998 – 2001**

- The overall impression is excellent.
- The total NKS organization generally prepares the ground well for the work carried out under the program.
- The internal dissemination of results is good; the external could be improved.
- Steps should be taken, for each project, to consider selective information measures vis-à-vis relevant users.
- The administrative support is excellent and comes at a cost of 20% of the budget.
- Budgeting is unrealistic. Achieving improved financial management requires realistic budgeting to ensure that costs accrue in the period to which the allocation applies and that actual costs are formally debitable. Realistic budgeting also enables financiers to run their own financial management according to the cash principle.
- Ensure that written documents from the secretariat are available for all business to be dealt with where they may be of use.
- Downsizing of the Board is recommended.

### **The transition seminar in Roskilde 2002**

The seminar “NKS Today and Tomorrow” marked the transition from the traditional model of cyclical 4-year programs to a more flexible structure of annual calls for activity proposals. The seminar agenda consisted of three main parts:

- Results of the 1998 – 2001 program (project leaders, secretariat, evaluators)
- Presentations by invited international speakers on
  - Nuclear power: Past accomplishments, future challenges
  - Radiological protection at the start of the 21st century: A progress report

- Plans for the new R&B structure (Reactor safety & Emergency preparedness) with presentations of the old and new chairman, owners, end users and the newly appointed NKS-R and NKS-B program managers

### Scientific program of R&B in 2002 – 2005

In 2001 the NKS Board adopted a dynamic scientific framework program, divided into two main areas, each led by a program manager:

- NKS-R: Reactor safety
- NKS-B: Emergency preparedness

Practical work began in 2002. Financial support is to be given fairly evenly to the R and B parts.

The contents, time frames and budgets of the program and its many activities are decided by the Board, in accordance with the NKS-R and NKS-B frameworks. All activity proposals are assessed against a set of criteria established by the Board. Changes in work plans are made when called for. Activities may be expanded, reduced, or cancelled; new activities are added. The program is constantly renewed through a regularly occurring procedure of Call for Proposals, which is open to all relevant Nordic organizations. When an activity has been finished and the final report accepted by the Board, the results will be disseminated and can be implemented by the end users.

#### *The NKS-R framework and results of some R activities:*

The program was divided into two main areas:

- |        |                                                                                                                                                                                                                                        |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DELI   | Development & Validation of assessment methods and new technology. This theme covers the challenges related to plant safety assessment and the introduction of new technology into the plants.                                         |
| MANGAN | Management & Organization of safety and quality assurance. This theme covers the challenges related to the implementation and assessment of effective safety and quality management, and to human performance in different situations. |

Under these two themes, five main topics have been identified: Prediction methods; New technology; Integrity and operability; Safety principles; and Human factors.

The eight activities that received the most funding were the following.

1. BWR condensation pool experiments: DeliPool studied the effects of a rapid bubble collapse and a fluid-structure interaction. A method for calculation of pressure loads was tested.
2. Assessment of maintenance culture safety and efficiency in Finland and Sweden: MainCulture strives to combine technical and human resources approaches, raising questions that are not usually explicitly taken into account in change management.
3. Safety management: A theoretical framework was created to analyze non-nuclear industries, and the relevance of the results for the nuclear industry and its regulators was investigated.
4. Barriers, control and management: It was investigated how formalized concepts can be used to define concepts to be used in design and assessment of NPP safety systems and procedures.
5. Experiments on ruthenium behavior in severe accident conditions: RutheniumReleases studied how volatile Ru species are formed and deposited on piping or released into the containment.
6. Traceability and communication of requirements in digital I&C systems development: TACO created a framework for requirements handling, and represents a generic approach to lifecycle-oriented, traceability-based requirements management.
7. Nordic thermal hydraulic and nuclear safety network: NOTNet (now established as Northnet) combines the resources of different research teams in order to carry out more ambitious and extensive research programs than would be possible for the individual teams.
8. Ex-vessel coolability and energetics of steam explosions in Nordic boiling water reactors: ExCoolSE was an experimental activity to evaluate the consequences of severe reactor accidents involving melting of the core and release of radioactivity.

### *The NKS-B framework and results of some B activities:*

Potential activities should fall into any of the following three main areas and their sub-areas:

- Emergency preparedness – in general; and specific tools
  - Improving exchange of information and communication techniques
  - Decision support (handbooks on countermeasures, application of current radioecological knowledge in emergency preparedness)
- Measurement strategy, technology and quality assurance (this can include laboratory, mobile and whole-body measurements)
  - Quality assurance and improvements in the application of current technique
  - Testing the usefulness of new techniques, helping to create Nordic cooperation in their use
  - Radioecological studies of relevance for emergency preparedness
  - Nordic land use: effects of fresh fallout, long-term effects, effects of countermeasures
  - Studies for improvements of marine dose assessment models (i.e., transport with ocean currents, sedimentation processes, uptake in biota and pathways to man)
  - Syntheses of earlier radiological studies of Nordic interest (e.g., workshop / seminar)

The eight activities that received the most funding were the following.

1. Intercomparison of laboratory analyses of radionuclides in environmental samples: Labinco engaged 38 laboratories in an intercomparison exercise including alpha and beta emitters. The results were quite good, although there is room for improvements at most laboratories.
2. Radiochemical analysis in emergency and routine situations: RadChem compared and evaluated radiochemical procedures used in Nordic laboratories, and an intercomparison exercise was performed.
3. Nordic collaboration on the use of mass spectrometers for the analysis of radioisotopes: NorCMass dealt with problems in isotope ratio and ultra trace measurements of plutonium and uranium isotopes and Np-237 using ICP-MS, including an educational part.
4. Improving radiological assessment of doses to man from terrestrial ecosystems: EcoDoses improved the radiological assessment of doses to man from terrestrial ecosystems and developed a model for estimating radioactive fallout. Comparisons with ARGOS were made.
5. New indicator organisms for environmental radioactivity: Indofern identified organisms that effectively accumulate certain radionuclides in various Nordic ecosystems and yielded new data on occurrence and transport of radionuclides.
6. Decision support handbook for remediation of contaminated inhabited areas: UrbHand suggests methods for measurement of contamination and doses prognoses, and data for evaluation of countermeasures and associated waste management options.
7. Nordic network of meteorological services engaged in nuclear emergency preparedness: MetNet led to a certain harmonization of presentation of the modelling results.
8. Emergency management and radiation monitoring in nuclear and radiological accidents: EMARAD produced and gathered data and information to be used in preparing emergency procedures and radiation monitoring strategies.

### **Evaluation of the R&B program 2002 – 2005**

#### *The NKS-R program:*

- The results are very good, mostly applicable and cost-effective, with only a few delays.
- The Nordic perspective is lacking in many activities and utility participation was often scarce.
- The evaluation criteria were translated to 15 questions, and the answers were obtained through interviews, a survey and review of the deliverables.
- Conclusions regarding the eight NKS-R activities presented above:
  1. DeliPool: The scientific content is judged to be moderate.
  2. MainCulture: There is a substantial use for the study both by plants and authorities.
  3. SafetyManagement: The findings are new and the published book useful for end users.
  4. BarriersControlManagement: Gives interesting theoretical insights to the concepts routinely used in nuclear safety work.

5. RutheniumReleases: Of interest for all LWRs. The reports are of high international standard.
6. TACO: The developed structure is new but should be tested practically to assess its usefulness.
7. NOTNet: Several Nordic contracts have been signed for cooperation under the name Northnet.
8. ExCoolSE: The report is of high international quality, the questions raised are central to Nordic BWRs, and the activity has contributed to the maintenance of Nordic competence.

#### *The NKS-B program:*

- The seminars were very useful, but the quality of the deliverables varies considerably.
- Many of the activities definitely have the potential of being further developed.
- The activities were evaluated by applying ten criteria and graded on a scale A – E, with an overall average of B-.
- Conclusions regarding the eight NKS-B activities presented above:
  1. Labinco: Maintains and extends competence in radiological data acquisition. Pedagogical.
  2. RadChem: Valuable information on practices for specified analyses and separation procedures.
  3. NorCMass: Created a Nordic network. High pedagogical merits. Relevant and practical results.
  4. EcoDoses: Continuation of BOK-2. Very valuable results obtained for science and authorities.
  5. Indofern: Valuable data and results on new Nordic indicator organisms accumulating certain radionuclides, e.g., after a discharge into the Nordic ecosystem.
  6. UrbHand: Results and information in the handbook relevant in accident situations.
  7. MetNet: Results relevant for authorities assessing the consequences of a nuclear accident.
  8. EMARAD: Relevant when assessing nuclear threats and accidents, including malicious uses.

### **Continued R&B work after 2005**

Following the thorough evaluation of the first four years of R&B work and applying the practical experiences of the program managers, secretariat and others directly involved in the daily work, the program and routines were adjusted as needed and the smooth and valuable endeavors continued. Some of the post 2005 activities are listed below. A joint R&B seminar was held in 2009, and the proceedings were published as report NKS-201.

#### **Notes on some NKS-R activities 2006 – 2008**

- The activity RutheniumReleases was continued.
- The activity ExCollSE was continued.
- The aim of MORE was to improve management of all new Nordic NPP modernization projects. It was linked to TACO.
- Auto New Tech dealt with a turbine automation interface.
- WERISK studied the effects of extreme weather conditions on plant operation and shutdown.
- WASCO developed wire testing methods and performed experiments to check for safe operation.
- POOL studied thermohydraulics and thermal loads in the drywell and wetwell after a LOCA.
- SafetyGoal included NKS, NPSAG and OECD/NEA work on probabilistic NPP safety criteria.
- StratRev studied stratification issues in LWR primary systems: validation and modeling.
- NROI experimented on formation of iodine oxide aerosols and analyzed the reaction products.
- PODRIS studied effects of flaw detection probability assumptions on risk reduction at inspections.
- MOSACA gave insight into safety culture and factors considered important for safety.
- RiskEval published a guidance for evaluation of technical specification conditions with PSA.

#### **Notes on some NKS-B activities 2006 – 2008**

- BIODOS established improved biodosimetric applications in emergency preparedness.
- UrbHand further developed the first draft of the handbook and published the final version.
- SPECIATION focused on development of speciation analysis of radionuclides in the environment.
- NordRisk produced an atlas of risks from long-range radionuclide dispersion and deposition.

- HOT II gave an overview of sources of potential radioactive particles of Nordic relevance.
- BIOPEX was a continuation of BIODOS.
- GAPRAD filled knowledge gaps in radiation protection methodologies for non-human biota.
- In REMSPEC synthetic early-phase gamma ray spectra were used for analysis and comparison.
- LUCIA assessed the impact of releases of radionuclides into urban sewage systems.
- REIN studied the long-term decline of radiocesium in Fennoscandian reindeer.
- PardNor addressed shortcomings in modeling of ingestion doses for Nordic decision support.

## Revised R&B frameworks

New R&B frameworks were adopted by the Board in November 2008.

The nuclear power industry and regulatory bodies have a number of challenges of particular interest where research activities are essential, and will be prioritized. The following NKS-R main research areas were judged to be of current interest:

- Reactor physics and thermo-hydraulics
- Modernization, introduction of new techniques and new demands
- Aging of nuclear facilities
- Severe accidents
- Probabilistic methods
- Organization, man and safety culture
- Phase-out and decommissioning of nuclear facilities
- Common seminars for reactor safety and emergency preparedness

The aim of the NKS-B program is to strengthen Nordic work concerning

- radiological emergency preparedness
- management of radioactive waste and discharges
- radioecology and environmental assessments

Activities will be judged against how well they comply with the framework as well as against their scientific and pedagogical merits. The following main research areas were judged to be of current interest:

E	Emergency preparedness (in general as well as specific tools)
W	Waste and discharges
R	Radioecological assessments
M	Measurement strategy, technology and quality assurance

Joint R&B activities are foreseen regarding decommissioning and radwaste issues, joint R&B seminars and information and communication targeting media and the general public.

## Wrapping it up

Under the heading “Concluding personal reflections” the author summarizes his experiences from 15 years as Nordic secretary and coordinator, and gives his personal comments and recommendations as to research work and administrative routines. Additional personal views are collected in one of the appendices that conclude the report. The other appendices give details on Owners Group and Board meetings, economic contributions, budgets, evaluations, policy matters, R&B activities and funding, and NKS documents. The last item is a list of acronyms used in this report.

# Table of Contents

<b>Abstract .....</b>	<b>ii</b>
<b>Key Words.....</b>	<b>ii</b>
<b>Acknowledgment .....</b>	<b>iii</b>
<b>Disclaimer.....</b>	<b>iii</b>
<b>Extended Summary .....</b>	<b>iv</b>
<b>Table of Contents.....</b>	<b>xv</b>
<b>Introduction .....</b>	<b>1</b>
About This Report .....	1
NKS: Nordic Nuclear Safety Research.....	2
The Nordic Perspective.....	2
<b>Organization and Support Structure of NKS .....</b>	<b>4</b>
The NKS Owners Group .....	4
Funding of NKS.....	5
Owners Group Members.....	5
Owners Group Meetings.....	5
The NKS Board .....	6
Board Members .....	6
Board Meetings.....	7
The Nordic Secretary.....	11
The NKS Bureau .....	12
The NKS Secretariat .....	12
Evaluations .....	13
<b>Development of the NKS Policy.....</b>	<b>14</b>
Criteria for NKS Projects and Activities .....	14
Quality Assurance.....	15
International Cooperation .....	16
Dissemination of Information.....	17
<b>The Last 4-Year Programs .....</b>	<b>18</b>
General.....	18
The Fifth 4-Year Program (1994 – 1997).....	19
General Recommendations After the 1990 – 1993 Program .....	19
NKS Organization .....	19
Preparing for the New Program.....	20
Program Overview.....	20
Project Summaries.....	21
Major Seminars, Exercises and Other Events.....	30
Evaluation of the Scientific Program 1994 – 1997 .....	31
Final Seminar: Eight Years With NKS.....	35
The Sixth 4-Year Program (1998 – 2001) .....	36
NKS Organization .....	36
Planning, Pre-Projects and the New Program.....	36
Program Overview.....	37
Project Summaries.....	37
Major Seminars, Exercises and Other Events.....	47
Evaluation of the Scientific Program 1998 – 2001 .....	49
Evaluation of the NKS Structure .....	52



<b>Shaping a New NKS: The Transition Seminar in Roskilde 2002 .....</b>	<b>55</b>
<b>The R&amp;B Program: Toward Increased Flexibility .....</b>	<b>61</b>
A New Structure .....	61
Program Areas .....	61
Comments from the Nordic Directors Group .....	62
Basic Definitions .....	62
New Organization of NKS .....	62
The Administrative Support Function .....	63
The NKS-R Framework: Reactor Safety .....	63
The NKS-B Framework: Emergency Preparedness .....	65
Call for Proposals .....	67
The First Set of Activities .....	67
Results of the R&B Programs 2002 – 2005 .....	68
General .....	68
NKS-R Summary for 2002 – 2005 .....	69
NKS-B Summary for 2002 – 2005 .....	70
Major Seminars, Exercises and Other Events 2002 - 2005 .....	72
Relation Between the Directors Group and NKS .....	73
Feedback From Program Managers and Activity Leaders .....	74
Evaluation of the R&B programs 2002 – 2005 .....	74
NKS-R: Reactor Safety .....	74
NKS-B: Emergency Preparedness .....	79
Continued R&B Work 2006 – 2008 .....	83
NKS-R Summary for 2006 – 2008 .....	83
NKS-B Summary for 2006 – 2008 .....	87
Major Seminars, Exercises and Other Events 2006 Onward .....	89
Revised R&B Framework Programs for 2008 and Beyond .....	90
<b>Concluding Personal Reflections .....</b>	<b>92</b>
Conclusions and Recommendations .....	92
Points to Ponder .....	92
Areas of Discussion Throughout the Years .....	93
Some Final Business .....	94
Signing Off, At Long Last .....	95
<b>References .....</b>	<b>96</b>
<b>Appendices .....</b>	<b>97</b>
Appendix 1: Brief Summary of NKS Owners Group Meetings .....	98
Appendix 2: Brief Summary of NKS Board Meetings .....	104
Appendix 3: Overview of NKS Programs and Evaluations .....	121
Appendix 4: Economic Contributions to NKS in kDKK .....	123
Appendix 5: NKS Budgets in kDKK .....	124
Appendix 6: NKS Policy, Framework and Procedures .....	127
Appendix 7: NKS-R Activities and Funding .....	137
Appendix 8: NKS-B Activities and Funding .....	140
Appendix 9: Author's Remarks .....	143
Appendix 10: List of Some Important NKS Documents .....	147
Appendix 11: Acronyms and Abbreviations Used in This Report .....	152



# Introduction

## About This Report

This report gives the author's version of important NKS decisions, events and achievements during his 15 years as Nordic secretary and coordinator. Others could and probably would have written a different story. It has been the author's intention to put everything forth as it happened, to the best of his recollection, after digging through the archives and interviewing old colleagues and friends. Others might remember things differently or recall different things. Some would perhaps have made different choices in focus or perspective.

When the author of this report took over after Franz Marcus in 1994, he also took over a structure and administrative support function that had been in place for many years. The position held by Franz Marcus and Torkel Bennerstedt has been referred to as Nordic secretary, executive secretary, secretary general, and – for the final period – NKS coordinator. The job title used in this report is Nordic secretary.

As time passed, a series of changes and developments took place. Therefore, in 2009 the Board felt that a new historic NKS review was of interest. It was intended as a follow-up or sequel of “Half a Century of Nordic Nuclear Co-operation – An Insider's Recollections” by Franz R. Marcus from November 1997.

By agreement with NKS the objective of the present report is to give the author's personal impression of NKS, its work, results and development during his 15 years as Nordic secretary. Thus, the scope is quite wide:

- Research activities as well as structure, organization and administration of the work
- Major programs, projects and activities
- From pre-projects via technical / scientific work, results, major seminars and other forms of dissemination of information and networking to evaluation and follow-up
- Cooperation with other organizations (national, regional, European, international)
- Listing of owners, additional financiers, board members, project leaders, program managers and budgets through the years
- Author's comments where appropriate

“From Standardized 4-Year Classics To Customized R&B” – what kind of a title is that? How could it possibly describe anything but a change from classical music with its confined structure and regular patterns to the much freer and often improvised forms of present-day Rhythm & Blues? And since when does NKS deal with musical issues?

The title of this report refers to the structural and administrative evolution that took place during the author's 15 years of active NKS work. Up to and including 2001 NKS work was organized in standardized 4-year program periods, as it had been since the start of the first program in 1977. The first part of each program period was spent on pre-projects, the following years were devoted to the actual research work, and the last part of the period consisted of reporting, summing up and evaluation. This was, if you will, the classical model since it lasted for six 4-year periods. With time, the classical model was considered somewhat rigid. But the NKS work was followed closely by the Board, and on several occasions project plans were revised. The best example of this is perhaps the Chernobyl accident in 1986, which proved that plans could be significantly and swiftly revised when urgently needed.

After the sixth standardized classical 4-year program followed a more flexible structure of activities tailored to suit both financiers, participants and end users better, starting in 2002. All activities have to fit into the broad framework of reactor safety (R for *reaktorsäkerhet*) and emergency preparedness (B for *beredskap*) in a broad sense. They are called R&B activities in Scandinavian languages, and that acronym is also used here. An activity (formerly called project) no longer automatically continues for a given number of years. On the contrary, its merits are weighed and measured in competition with other

activities, new or ongoing, for NKS funding. Hence, NKS work has changed to customized R&B and the organization and administration has been trimmed to form a more efficient structure in 2008, that marks the end of this report.

This report will only be available electronically. The typical reader is expected to be interested in an overview of NKS and its work for about a decade and a half of dynamic development and dedicated efforts. This could be a junior or senior participant, someone who would like to join the work, or anyone who wants to know what is going on – all are equally important and just as welcome. Most likely, the primary target group consists of subscribers to the NKS electronic newsletters (which includes the board and all program participants; and many more); and secondarily all webpage visitors including both various types of stakeholders, media and the general public.

Some administrative documents (i.e., not scientific or technical reports) from the period 1994 – 2008 are listed in Appendix 10. These administrative documents are not available on the NKS website, only in the NKS archives. Appendix 11 explains the acronyms used in this report.

## **NKS: Nordic Nuclear Safety Research**

NKS was created in 1975 as an *ad hoc* committee under NKA (Nordic Liaison Committee for Atomic Energy) to assure the safety of the growing Nordic nuclear power program and secure funds to that end. NKA in turn was an organization under the Nordic Council, with joint Nordic funding. NKS was instructed to prepare a research program which would take up current safety issues. Practical NKS work did not start until 1977 with its first 4-year program (1977 – 1980), with Nordic funding. However, it soon became obvious that the involved politicians took an increasingly negative stand on NKA and NKS since their work involved nuclear power issues. After the Chernobyl accident in 1986 this grew to downright mistrust, especially on the part of the environmental ministers. NKA and NKS were regarded more as promoters of nuclear power than safety-driven work groups. So when NKA was dissolved in 1989, NKS had to find other ways and means of financing its research activities. After a period of negotiations a consortium of relevant central authorities and ministries in the five Nordic countries took over.

Since the start in 1977 NKS has served as a platform for Nordic cooperation and competence in nuclear safety and related radiation safety issues including emergency preparedness and radioecology. The work is now financed by Nordic authorities and a ministry, research institutions and power companies; and supported by a number of other organizations. The results must be of relevance to the involved parties, e.g., by being practical and directly applicable; or by increasing the knowledge base. Information on NKS activities is disseminated through seminars, reports, electronic newsletters and the NKS website. The results are used by financiers and other participating organizations in their decision making processes and information efforts, and are available free of charge to anyone interested in NKS activities.

## **The Nordic Perspective**

NKS is an informal forum, serving as an umbrella for Nordic nuclear safety and related radiation safety initiatives and interests. Its purpose is to support joint Nordic research activities, producing seminars, exercises, scientific articles, technical reports and other types of reference material and tools. Special efforts are made to engage young Nordic scientists. To ensure that the Nordic perspective prevails, each major activity should include representatives from at least three Nordic countries.

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



Nordic Heritage

Photo: Torkel Bennerstedt

The Nordic interest in cooperation and pooling of resources via NKS is due to a number of nuclear installations and activities in the region. There are four nuclear power reactors in operation in Finland, a fifth (Olkiluoto 3) is under construction and two more authorized (Olkiluoto 4 and Fennovoima's first unit). Sweden has 12 nuclear power reactors. Of these, 10 will continue operation and two (Barsebäck 1 and 2) have been permanently shut down and are being decommissioned. There are research reactors in Denmark, Finland, Norway and Sweden. The three Danish reactors have been closed and decommissioning work has started. The research reactors in Finland and Norway are still in operation. The two Swedish research reactors have been shut down and face decommissioning. Sweden has a nuclear fuel production plant in operation. There are no nuclear reactors in Iceland, but just like in its Nordic neighbors there are a number of hospitals, research institutions and industries that produce radioactive waste. All five Nordic countries have interim radwaste storages. Finland, Norway and Sweden have final repositories in operation for low and medium level waste. In Finland and Sweden work is in progress to allow construction of final repositories for spent fuel. Apart from nuclear installations in the Nordic countries, there are commercial, research and naval nuclear reactors and other nuclear installations and devices in surrounding eastern and western countries.



Torhamn, Blekinge in the southeast corner of Sweden.

Photo: Torkel Bennerstedt.

# Organization and Support Structure of NKS

The owners and main financiers of NKS are four central authorities and one ministry in the Nordic countries, all with interests and competence in the nuclear field. Together with a number of experts appointed by the owners they constitute the NKS Board. Decisions on financing, program activities, NKS policy etc. are made by the owners and the Board. A secretariat handles administrative duties such as economy, electronic media, publishing of reports etc.

Apart from NKS, five more Nordic bodies are referred to in this report:

- The Nordic Directors Group (*chefsgruppen*): the heads of the Nordic radiation protection and nuclear safety authorities. The group follows – but does not supervise – NKS work.
- The NEP group (Nuclear Emergency Preparedness) with members from relevant central authorities. There has been some coordination of NKS and NEP activities.
- The Nordic Society for Radiation Protection (*Nordiska sällskapet för strålskydd*, NSFS). NKS has cooperated with NSFS in arranging a few seminars.
- The Nordic Liaison Committee for Atomic Energy (*Nordiska kontaktorganet för atomenergi-frågor*), NKA; dissolved in 1989
- The Nordic Council of Ministers. There are now no official contacts between NKS and the Council, but in the years 1977 – 1989 NKS was fully financed by the Nordic Council of Ministers, via NKA.

The technical and scientific work carried out by the many hundreds of participants in NKS projects and activities will be covered in later chapters.

## The NKS Owners Group

Originally, the main financiers of NKS were referred to as the Consortium. Later this has been replaced by the Owners Group or simply the owners.

### NKS Owners

- DEMA (Danish Emergency Management Agency), Denmark
- TEM (Finnish Ministry of Employment and the Economy), earlier KTM (Finnish Ministry for Trade and Industry), Finland
- IRSA (Icelandic Radiation Safety Authority), Iceland
- NRPA (Norwegian Radiation Protection Authority), Norway
- SSM (Swedish Radiation Safety Authority), earlier SKI&SSI (Swedish Nuclear Power Inspectorate and Swedish Radiation Protection Authority), Sweden

The owners appoint on a national basis the experts that together with the owners form the NKS Board. The owners review and evaluate the scientific work and its results as well as the overall NKS structure, organization and administration to improve the efficiency of the research program and make the best use possible of available resources.

Cooperation under the umbrella of NKS rests on a written agreement, which has the form of a letter of intent, listing scope, objectives, organization, financing, immaterial rights and validity dates. Since all owners depend on funding over the national budget, no guarantees can be made for more than one fiscal year at a time. It is agreed that the NKS program shall

- promote competence and preparedness in all Nordic countries in order to jointly be able to assess important questions regarding nuclear safety and radiation protection

- initiate and support research projects in nuclear safety and radiation protection of central, common interest to the Nordic countries, e.g., as regards reactor safety and accident preparedness
- communicate a broad overview in the above matters and disseminate achieved results in a comprehensible form to involved authorities, industries and other affected societal institutions
- strengthen the possibilities of the Nordic countries to participate in international debate and cooperation in this field
- contribute to a common view on nuclear safety and radiation protection in the Nordic countries and encourage contacts between Nordic experts in these matters

### **Funding of NKS**

The owners constitute the main contributors to NKS funds. In addition, a number of organizations support NKS financially or in kind. These contributions have varied over the years, and it would be to go too far to list them all. In 2008 additional financial support was obtained from the following organizations:

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

In 2008 the contributions of the owners together with support from the additional financiers above totaled some 8.6 million Danish crowns (1.2 million euros). See Appendix 4 for additional figures.

To this should be added in-kind contributions by participating organizations, e.g., work hours, travel expenses, and laboratory and other resources. These contributions are worth approximately as much as the actual NKS budget, and the program is highly dependent on them. Hence, all activity proposals are expected to offer at least a 50/50 in-kind contribution by the applicants.

### **Owners Group Members**

The following persons have represented the owners at one time or another during the years 1994 – 2008.

<b>Members of the NKS Owners Group 1994 – 2008</b>	
Denmark	Bjørn Thorlaksen → Michael Boesgaard Brøndel
Finland	Sakari Immonen → Jussi Manninen → Timo Haapalehto → Olli Vilkkamo → Timo Haapalehto → Jorma Aurela → Anne Väättäinen (→ Jorma Aurela since 2009)
Iceland	Sigurður Magnússon
Norway	Knut Gussgard → Ole Harbitz
Sweden	Lennart Hammar → Christer Viktorsson → Lars Gunsell (SKI; now SSM) Jan Olof Snihs → Ulf Bäverstam → Leif Moberg (SSI; now SSM)

### **Owners Group Meetings**

The dates of the Owners Group meetings and a brief account of what happened at each of these meetings is given in Appendix 1.

### Some noteworthy Owners Group discussions and decisions extracted from Appendix 1:

- **Nov. 1993:** This was the first Owners Group meeting chaired by Magnus von Bonsdorff, newly elected chairman of NKS.
- **In Sept. 1994** the owners decided that NKS will not continue its service to the Nordic Council of Ministers of commenting reports on nuclear safety. The Nordic secretary was instructed to inform the Council that in the future such requests should be directed to pertinent national authorities, not NKS.
- **Jan. 1996:** The Swedish funding is handled by SKI but is shared equally between SKI and SSI. It was therefore confirmed that Sweden has two representatives in the Owners Group.
- **Sept. 1997:** The owners are to participate in future Board meetings. This will facilitate dissemination of information between the two groups and be practical from a number of aspects. Future project leaders are to report directly to the Board.
- **Feb. 1998:** It was decided that the owners are also members of the Board. Each country may appoint up to three national experts (Sweden four) as members of the Board. The scientific reference groups linked to the different 4-year programs were abolished, effective from the start of the coming 4-year program. All NKS projects and groups were urged to be more cost effective.
- **March 2001:** The work of the next program will be divided into **two areas**: the **NKS-R** program (**reactor safety** including waste and development issues); and the **NKS-B** program (**emergency preparedness** including radioecology and emergency preparedness related information/communication). Helge Smidt Olsen was appointed new chairman of NKS. He will take over after Magnus von Bonsdorff starting Jan. 1, 2002.
- **March 2002:** It was decided that from now on all contributions to NKS should be specified in euros, not in DKK or the various national currencies. (*Author's comment:* It seems like this decision is not followed any longer.)
- **May 2002:** It was decided that future Owners Group meetings should once again be separated from the Board meetings.
- **Nov. 2002:** It was decided to invite the NKS chairman to participate in future owners' meetings.

## The NKS Board

### Board Members

The following persons have served as Board members at one time or another during the years 1994 – 2008.

Members of the NKS Board 1994 – 2008	
Owners	The owners as listed above are permanent members of the Board
Others:	
Denmark	Benny Majborn Kaare Ulbak Bjørn Thorlaksen
Finland	Raimo Mustonen → Olli Vilkkamo → Marja-Leena Järvinen Lasse Mattila → Björn Wahlström → Ulla Ehrnsten Pekka Salminen → Heikki Raumolin → Nici Bergroth
Norway	Erling Stranden → (no successor since Ole Harbitz joined the Owners Group) Helge Smidt Olsen → Atle Valseth Erik Anders Westerlund → Magne Røed → Anne Liv Rudjord



Sweden	Jan Olof Snihs → (no successor as he joined the Owners Group) Ralf Espefält → Karl-Fredrik Ingemarsson → Synnöve Sundell-Bergman
Chairman	(Svante Nyman →) Magnus von Bonsdorff (1994 – 2001) → Helge Smidt Olsen (2002 – 2006) → Sigurður M Magnússon (2006 – present)
NKS secy.	(Bjarne Regnell →) Helge Smidt Olsen → Sigurður M Magnússon → Nordic secretary → program managers
Also partici- pating:	
Nordic secy.	Franz Marcus → Torkel Bennerstedt → position cancelled

The Board's decisions are consensus-driven. It is appointed by the owners and decides in matters concerning priorities, budgets, programs and research plans and activities. The quality and cost-effectiveness of NKS work is closely studied by the Board.

## Board Meetings

The dates and a brief account of what happened at each of the Board meetings is given in Appendix 2.

### Some noteworthy Board discussions and decisions extracted from Appendix 2:

- **Feb. 1994:** New chairman of the Board: Magnus von Bonsdorff. New secretary of the Board: Helge Smidt Olsen. New Nordic secretary: Torkel Bennerstedt. A special working group called the Bureau was formed. All final reports from the 1990 – 1993 period are delayed. The pre-project work for the 1994 – 1997 program progresses as planned.
- **June 1994:** Project leaders, chairpersons and members of the reference groups were named for the 1994 – 1997 program.
- **Sept. 1994:** The 1990 – 1993 evaluation report suggests that a midway evaluation of the projects be performed after about two years. 1994 – 1997 project plans: the Board needs additional information on three projects whereas the remaining four were satisfactory.
- **Feb. 1995:** The plans for the last 1994 – 1997 projects were approved. Work has already begun in most projects and subprojects. It was decided to write a policy document for NKS work. Franz Marcus presented a plan for a book on the history of Nordic nuclear cooperation. The idea was accepted in principle, but the economic issue remained unsolved.
- **Sept. 1995:** There are still three final reports missing from the 1990 – 1993 period. All 1994 – 1997 projects follow the adapted time schedule. RAK-1 has produced a paper on possible future cooperation with EU. The Board decided to develop informal contacts with EU (DG-XI and DG-XII). EKO-1 communicates with its participants via a WWW Home Page. The Nordic Directors Group expressed their satisfaction with NKS work at its last meeting. NKS will not finance cooperation projects with countries in eastern Europe. (*Author's comment:* Cf. Aug. 1996 below.)
- **Jan. 1996:** A critical review of the present program revealed some delays, and some sub-projects were questioned. The plans were adjusted as needed. Although an information project was accepted, there was a general attitude that information issues should be closer integrated with the projects in next NKS four-year program.
- **Aug. 1996:** Most projects are progressing as planned. The chairman will contact DG-XII in order to pave the way for a visit by a small NKS delegation. The Board stated that NKS should seriously consider a wider cooperation with eastern Europe. (*Author's comment:* Cf. Sept.

1995 above.) The Bureau was asked to compile project proposals for the next 4-year period and suggest a procedure for the upcoming planning process.

- **Jan. 1997:** NKS work is progressing according to plans. The recriticality work done by RAK-2 will be continued as an EU project. It was pointed out that all NKS activities shall be performed in such a fashion that they cannot be misinterpreted as regulations or recommendations issued by national authorities. (*Author's comment:* Cf. Feb. 1998 below.) When asked to perform an evaluation of the present NKS program, professor Antti Vuorinen declared that he was “not disinterested”. The policy document was adopted. It was reported that the Nordic Directors Group at their last meeting expressed a positive attitude toward NKS and its work. The NKS chairman, Nordic secretary and Franz Marcus will meet with EU representatives shortly to discuss modes of exchange of information and coordination.
- **Sept. 1997:** At joint seminar for all NKS projects is planned. The final reports will be distributed primarily as a CD-ROM. The evaluator, Antti Vuorinen, reported on his work. The owners were urged to nominate a program committee to work out the details of the new program in cooperation with the Bureau. There will be no reference groups in the next period. The Nordic history by Franz Marcus will undergo a language check before publication.
- **Feb. 1998:** Most final reports are finished and several of the final project seminars have been held. Antti Vuorinen recommended that NKS supports fewer but larger projects and focuses on training of young scientists and competence building. The Board stressed that the role of NKS is to give recommendations, not to issue rules or standards. (*Author's comment:* Cf. Jan. 1997 above.) A meeting with EU will be arranged in the spring. Sigurður Magnússon presented a draft structure of the 1998 – 2001 program: two major areas, SOS and BOK. A special reference group for the pre-projects will be appointed by the owners. Franz Marcus' Nordic history is ready to be printed. The graphic profile of NKS was approved. There is a growing interest in the NKS website; the number of hits is steadily increasing.
- **Sept. 1998:** Some final reports are still missing. Information was given on the joint NKS-EC seminar. NKS cannot expect EC funding, but a communication channel has been established. New project leaders will be instructed to keep abreast with EC projects and developments. EC does not find the existence of regional cooperation programs controversial. After some minor changes, project plans for the new NKS program were approved and project leaders appointed.
- **Feb. 1999:** The Board expressed concern regarding the slow start of some of the projects, caused by the long preparation phase. The ongoing work was approved. The Bureau shall prepare a document before the next Board meeting, outlining some ideas for the planning procedure and structure of the next 4-year program.
- **Sept. 1999:** The Board noted that two final reports for 1994 – 1997 were still missing. A mid-way seminar with tentative evaluation of the 1998 – 2001 program will be arranged next year.
- **Feb. 2000:** One final report from the 1994 – 1997 program is still missing. All annual project reports for the 1998 – 2001 program were approved.
- **May 2000:** Changes in some of the subproject work were made. The Nordic secretary was granted a budget for promoting Nordic – Baltic cooperation. The presented directives for the evaluation of the current program are to be revised by the Bureau. A planning group for the next NKS program is being organized.
- **Nov. 2000:** As suggested by the project leader, the information project will be discontinued. A transition seminar for final reporting of the present program and plans for the next will be arranged. Evaluators of the present scientific program: Raimo Mustonen, STUK, and Gustaf Löwenhielm, SKI. Evaluator of NKS organization and administration: Martin Høiby, NRPA. A memo from the Bureau outlining a new scientific program structure for future NKS work and a slimmer and more flexible *modus operandi* will be discussed further. The Bureau



suggested that two major areas of work be identified: Reactor safety including decommissioning and waste (NKS-R); and Emergency preparedness including radioecology (NKS-B) to form the new program frame, R&B. As Helge Smidt Olsen leaves the NKS Board, Sigurður M Magnússon was appointed new secretary of the Board.

- **May 2001:** The apparent overspending of SOS-1 funds has to be investigated and necessary action taken. The Nordic secretary reported on planned seminars and two international exercises (Baltic Nuclear and Barents Rescue) with NKS participation. The chairman summed up the evaluation reports. The Board was informed that the owners had appointed the two program managers: Timo Okkonen, STUK (NKS-R) and Sigurður Emil Pálsson, IRSA (NKS-B). A planning group shall propose the initial activities.
- **Nov. 2001:** The auditor reported on SOS-1 finances. There was enough blame to go all around, but the project leader and the Nordic secretary were especially singled out. The situation could however be corrected, and actions were taken to avoid similar situations in the future. The Bureau reported on the NRPA/IUR/NKS consensus seminar. The Board was reluctant toward future seminars on ethical/philosophical issues and environmental radiation protection, and consensus seminars in general. The R&B frameworks as presented at the previous status seminar were accepted after a few modifications. It was decided that organizations from Baltic Sea countries can participate in NKS activities at their own expense if it benefits NKS and its goals.
- **March 2002:** Helge Smidt Olsen took over as chairman of NKS after Magnus von Bonsdorff. The program managers' outlines of the structural framework and initial activities were well received. The Board stressed the importance of transparent assessments of proposed activities in accordance with NKS criteria and demanded that the program managers have full control of the financial situation.
- **May 2002:** It was reported that the Nordic Directors Group is satisfied with the new program structure and its initial activities, and stressed the importance of efficiency and cost effectiveness. To clarify the roles of the owners and the Board, respectively, a separation of Owners Group meetings and Board meetings is called for. (*Author's comment:* Cf. notes from the Owners Group meetings in Sept. 1997, Feb. 1998 and May 2002 above.) The program managers shall ensure that all activities are embraced by the potential end users and that the expected results are realistic. It was decided that on certain conditions MS and PhD courses and work can be supported by NKS. Two final reports are still missing from the 1998 – 2001 program. The scientific evaluation will be finished shortly.
- **Nov. 2002:** All future R&B contracts must specify a deadline for scientific work and final reporting. The Owners declared that measures should be taken to avoid an accumulation of unused funds. The chairman is invited to participate in future Owners Group meetings. In their status reports to the Board, program managers shall include information on participants, end users and an estimate of the quality of the expected results. The Board expressed its satisfaction with the beta version of the CD-ROM containing the final reports, technical reports and other NKS material. The scientific evaluation report of the 1998 – 2001 period is ready and will be discussed at the next Board meeting.
- **May 2003:** The strategy discussion continued, including a debate on whether an activity on nuclear vessels is something for NKS, and if so, where it belongs. It was decided that it should be handled by NKS-B. Work to find new co-financiers is in progress. The scientific evaluation for 1998 – 2001 was discussed in depth. The mostly positive report concludes that the objectives were fulfilled and recommends that NKS work continues for a new period. The evaluators supported the new structure and administrative changes.
- **Nov. 2003:** The Nordic secretary informed on the preparations for a joint NKS-BKAB seminar on Quality in Radiation Protection Work at Nuclear Installations. At its last meeting the Nordic Directors Group concluded that for the foreseeable future the Directors Meetings and

NKS will continue to be two separate arenas with no formal links. The Swedish owners presented a memo on efficiency and organization in the next couple of years. The Board agreed on the goals but differed somewhat in ways to get there. It was decided to let the program managers report whether they are able to take on additional tasks under the present contracts with NKS and let activity leaders answer a questionnaire on the new structure. The function of the Nordic secretary was discussed.

- **May 2004:** The Board wished to stress that if there is a request for relocating unused funds to another activity, this is to be considered as a new application and will be treated as such. The Nordic secretary informed on the participants' enthusiastic evaluation of the second joint NKS-BKAB seminar. The Bureau reported that the activity leaders were satisfied with the new R&B structure and the administrative support; and that the program managers saw no possibility to take on more administrative duties under the present contract. The Secretariat was requested to draft a policy for dissemination of information.
- **Nov. 2004:** The Board expressed some concern regarding the fact that there are R activities with as little as one or two participating organizations. Measures should be taken to avoid this to the extent possible. It was also pointed out that the process of assessing new B proposals should be made more transparent. The Consortial partners should from now on be referred to as the Owners. It is the Board that decides in budgetary matters. The Nordic secretary presented the new routines for dissemination of information. The NKS webpage is updated continuously. Electronic newsletters will be distributed at least twice a year.
- **May 2005:** The owners are very satisfied with the new structure. The Board expressed its satisfaction with R&B work. A replacement for the present program manager for NKS-R will have to be found soon since the present manager has been promoted within her own organization. The contract with the NKS-B manager will be prolonged. Administrative routines and costs will continue to be scrutinized. The need for an evaluation of NKS work since the start of the R&B program will be discussed in November. The Bureau was asked to produce a memo until then. A work group was established for the status seminar in Finland May 2006.
- **Nov. 2005:** Measures will be taken to reduce costs and simplify the administration. The Nordic secretary will be replaced by a time-limited coordinating function. The Bureau will be dissolved and the post as secretary of the Board discontinued. Finland and Sweden will check whether some large R activities could be carried out bilaterally. A review of the R program should consider the interests of the co-financiers. Sigurður Magnússon takes over as chairman of NKS after the next Board meeting. The Board declared its satisfaction with the progress of the R&B program. The Bureau presented its proposed directives for the evaluation of work and results in 2002 – 2005. The R&B evaluators were appointed.
- **May 2006:** Two work groups were appointed to review the R&B frameworks. The Call for Proposals (CfP) procedure and the assessment of proposed activities will be reviewed. The Board was pleased with the NKS status seminar. The coordinator was asked to arrange a meeting to speed up the process of finishing the evaluation report. Sigurður Magnússon now took over as chairman and thanked Helge Smidt Olsen for his many years of dedicated work for NKS.
- **Nov. 2006:** The new chairman, Sigurður Magnússon, noted that the structural and administrative changes seem to work well. The Board thanked the four evaluators for their fine work. NKS results are of high standard, especially considering available resources. The review of the R&B frameworks will continue. The revision of the Call for Proposals procedure concluded that end users shall be identified in all applications. There was again a change of NKS-R program managers. The website will undergo a complete overhaul.
- **May 2007:** The coordinator and the NKS-B program manager will be replaced in 2008. Work on the new R&B frameworks will continue in the summer. An information policy shall be

outlined by the chairman, the coordinator and the Secretariat. Together with the program handbook and the framework it will form an NKS policy document. R&B work is proceeding according to plans.

- **Nov. 2007:** After many years of outstanding leadership and constructive NKS work Sigurður Emil Pálsson will leave his position. The chairman expressed his and the Board's gratitude for his excellent and ambitious work through many years as project leader and program manager. The program managers presented the R&B status reports and their proposals for funding. Due to the large number of good R proposals extra funding was allocated. Since the number of B applications did not reach the expected level, a new CfP will be announced. The Board stressed that non Nordic participants to NKS seminars have to be cleared with the program manager. The owners have decided that the role and tasks of the coordinator will be gradually diminished and taken over by others.
- **May 2008:** The Board recommended that all applications for NKS funding under the CfP procedure be written in English. The extraordinary CfP for the NKS-B program resulted in a number of new activities. The Board decided that NKS does not support seminars outside the Nordic countries, with rare exceptions for the Baltic states when motivated. This was the Nordic secretary's / coordinator's last appearance at an NKS Board meeting.
- **Nov. 2008:** A new CfP for NKS-B activities will be announced in the spring of 2009 since considerable funding was still available. The chairman suggested that Board members should assess all R&B applications from future CfP procedures to ensure balanced priorities and secure national interests. A joint R&B seminar will be arranged in Stockholm in March 2009. The Board was positive to publishing NKS accounting and audit reports on the website. From now on material to be discussed at Board meetings will be available for download on the website. A special thanks was directed to Torkel Bennerstedt who left his position as Nordic secretary / coordinator at the last Board meeting. On behalf of the Owners the chairman will ask him to write the history of NKS for the years 1997 – 2007. (*Author's comment:* This was later corrected to 1994 – 2008.)

## The Nordic Secretary

The Nordic secretary (also referred to as executive secretary) was appointed by the owners. The post as Nordic secretary was discontinued in 2008. A formal job description written by the owners never existed. Below follows a list of the most important tasks of the Nordic secretary. For more details, see Appendix 9. The tasks varied somewhat over the years as the programs and support structure of NKS changed.

- Participated on a regular basis in the most important NKS meetings: the owners group; Board; reference groups; Bureau; coordination group; Secretariat.
- Reported to the owners and the Board.
- Served as the official head of the Secretariat.
- Prepared Board meetings (agendas, documents, budgets etc.).
- Compiled directives for pre-project work and evaluators, drafted policy papers and similar documents.
- Planned, prepared and supervised larger conferences.
- Coordinated the every-day work of NKS and kept an eye on the finances.
- Was at the disposal of the owners, the Board and to a certain extent the project leaders for *ad hoc* tasks.

The tasks of the Nordic secretary were specified in the administrative handbook and a contract between NKS and the person in question. For a number of years 75% of a full time was required to fulfill the tasks. With a tougher economic situation, cost reductions became necessary, especially as regards organizational structure and administrative matters. Thus, in later contracts the percentage was reduced to, first, 60%, and later to 40%, then to 25%. Effective from June 2006, the formal title was

changed from Nordic secretary to NKS coordinator at a meeting on Nov. 17, 2005, and the tasks were adjusted accordingly. The position as Nordic secretary was discontinued by the owners as announced at the May 11, 2007 Board meeting. Starting in June 2008 the tasks of the Nordic secretary were taken over by the NKS Chair, the Secretariat and the program managers.

## The NKS Bureau

In Feb. 1994 the Board created the NKS Bureau. It served as the Board's working group in 1994 – 2006. It had three members: the NKS chairman, the secretary of the Board and the Nordic secretary. Its main task was to prepare and follow up Board meetings, supervise the work of the project leaders / program managers and the Secretariat and perform whatever routine or *ad hoc* tasks the Board decided. The Bureau had no budget, unless explicitly allocated by the Board for specific purposes. Contrary to a widespread misconception, the Bureau had no general mandate to make decisions other than as concerned its own work. From time to time the Bureau initiated, e.g., structural or administrative changes and policy related developments by presenting written proposals to the Board.

### Members of the Bureau

1994 – 2000	Magnus von Bonsdorff, Helge Smidt Olsen, Torkel Bennerstedt
2000 – 2002	Magnus von Bonsdorff, Sigurður M Magnússon, Torkel Bennerstedt
2002 – 2006	Helge Smidt Olsen, Sigurður M Magnússon, Torkel Bennerstedt

When the bureau and the post as secretary of the Board (N.B.: *not* the Nordic secretary) were abolished by the Board in 2006, the chairman and Nordic secretary divided the tasks between them. An informal coordination group of the chairman, the program managers, the Secretariat and the Nordic secretary was formed and met twice a year to follow up on the activities, structure and practical matters, and to prepare for the next Board meeting.

## The NKS Secretariat

In 1994, at the onset of the term covered by this report, the Secretariat consisted of Henny Frederiksen (part-time secretary to Franz Marcus) and H C Sørensen who from his abode in the south of France took care of economic matters, bookkeeping etc. Since these two fine collaborators were about to retire, the Secretariat was taken over on Jan. 1, 1996 by FRIT, which was then a division of Risø and nowadays a private company located within the premises of Risø. The persons engaged were Annette Lemmens (secretary, bookkeeping) and Finn Physant (economy). The Secretariat was intact throughout the 15 years covered by this report. Of all its achievements, one of the most important was the creation of the NKS website (the first one appeared in 1996), the electronic reports, CDs and DVDs, and electronic newsletters. Formally, the Secretariat was headed by the Nordic secretary.

Audits previously performed by the Economy Department at Risø were taken over by Ernst & Young, starting with the bookkeeping for the fiscal year 1998. This has meant a closer scrutiny of the bookkeeping. Initially, a number of improvements were suggested and implemented. Since then, only minor modifications in bookkeeping and presentation have been necessary. The audits have never given rise to negative remarks of any kind.

### The NKS Secretariat

- Torkel Bennerstedt, TeknoTelje HB
- Finn Physant, FRIT
- Annette Lemmens, FRIT

The most important tasks of the Secretariat (in addition to the tasks of the Nordic secretary as described above):

- Support function for the rest of NKS.
- Participation as needed in Board meetings and other meetings.
- Economic services, bookkeeping, invoicing, VAT matters, reporting.
- Regular contacts with the project leaders / program managers, especially as regards financial matters and publications.
- Editing and publishing of NKS reports, operating the website, publishing of electronic newsletters, CDs and DVDs.
- Development of administrative routines and the administrative handbook.
- Central archive function (library, reports, contracts, economic material etc.).
- *Ad hoc* services as requested by the Board or others.

Throughout the years the Secretariat has looked for possibilities to increase the net income from bank transactions and interests. It has for a number of years meant a contribution to NKS funds of some DKK 100 000 per year.

The Board has, both collectively and individually, on numerous occasions expressed its satisfaction with the fine and dedicated work of the Secretariat.



The NKS Secretariat

Photo: Claus Rubin

## Evaluations

-Each 4-year NKS program has been evaluated by independent evaluators at the end of the program. On one occasion NKS organization including the Secretariat and the total administrative support function were evaluated, along with the scientific work.

During the years covered by this report, the following evaluations were performed:

Fifth 4-year program 1994 – 1997

Antti Vuorinen

Sixth 4-year program 1998 – 2001

Gustaf Löwenhielm, Raimo Mustonen, Martin Høiby

R&B program 2002 – 2006

Risto Sairanen, Per Persson, Per Hedemann Jensen, Tore Lindmo

Summaries of all evaluations of the NKS programs from 1994 and onward are given under the respective NKS program below. An overview of the programs and evaluations since the first 4-year program 1977 – 1980 is found in Appendix 3.

## Development of the NKS Policy

In 1994 NKS work was conducted according to the guidelines of a project handbook, and an administrative handbook laid down rules for practical day-to-day work of project participants and the Secretariat. Owners Group and Board meetings could add new policy statements and decisions as reflected in the minutes of these meetings. But there was no comprehensive policy document to govern the NKS work. To increase transparency, the Nordic secretary initiated in 1995 a document called This is NKS to complement the project handbook. Later, the two documents were joined in the first and still, in the summer of 2011, valid policy document that appears as Appendix 6.

The NKS policy has been remarkably consistent over the years, since long before 1994, and evolved slowly over the years. The consensus among the owners and other Board members has obviously been strong that NKS work should be characterized by

- joint Nordic funding based on a letter of intent that is revised and renewed when needed
- participation of at least three Nordic countries and several organizations in all major activities
- quality assurance through seminars, publications, Board discussions, evaluations etc.
- comprehensive and easy to understand project criteria
- increasing the Nordic knowledge base, developing and maintaining skills through cooperation
- networking
- dissemination of results and other forms of technical information

Although the policy has evolved over the years, some characteristic traits have remained basically the same: the Nordic perspective, networking, project criteria, quality assurance, dissemination of information and international cooperation. The areas of research may have varied, depending on the current situation – fallout from the atomic bomb tests in the 1950's and 60's, the safety concerns after the Three Mile Island accident and the aftermath after the Chernobyl accident may serve as examples – but the underlying issues do not change very much.

The need for fast and correct information – to international organizations, Nordic, regional and other national authorities, media and the general public – has increased with time, especially in the last decade of swiftly expanding possibilities for communication and data retrieval. Very few reports are printed any longer; they are posted on the website or published in CD or DVD format. All reports are available free of charge.

New: young scientists encouraged to participate. Nowadays travel grants are available in some cases. PhD and MS work is encouraged. These trends are believed and hoped to augment. International cooperation is believed to become increasingly important.

Obviously there has been some confusion as regards the status of NKS reports and actions. In order to set things straight the Board in Jan. 1997 took the unusual decision to declare that all NKS activities shall be performed in such a fashion that they cannot be misinterpreted as regulations or recommendations issued by national authorities.

An entirely new financial situation has emerged the last couple of years. Funding from national authorities has varied widely over time. The results of NKS do not appear to have suffered – at least not yet. But both the scientific work and the secretarial support need a critical mass to function well. A word of caution might be in order.

## Criteria for NKS Projects and Activities

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

- Relevance to financiers and end users
- Demonstrated compatibility with the current framework program

- A clear Nordic added value, including increased competence, networking and dissemination of information
- Participation of at least three Nordic countries in all major activities
- High international standard of the technical/scientific work
- Comprehensive and transparent activities, open to the widest possible range of participants, including young scientists
- Distinct and measurable goals, including deliverables, economy and time plans

NKS aims at an approximately even overall distribution of funding between the present R&B programs as well as between participating Nordic countries and organizations within the various activities. Gender neutrality and participation of young scientists is encouraged. When possible and relevant, MS and PhD support may be included in ongoing or proposed activities as well as NKS activities coordinated with international projects. Measures are taken to ensure cost-efficiency, save resources and protect the environment.

Simply put, NKS should engage in select and timely activities, for the right reasons, while striving for optimal quality, at a reasonable cost with maximum positive impact, benefitting as many of the stakeholders as possible.

**I skate to where the puck is going to be, not where it has been.  
(Wayne Gretzky, NHL Hockey Pro)**



Testing the Limits

Photo: Lena Bennerstedt

## Quality Assurance

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

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

**Quality is not in the eye of the beholder.  
Quality is getting everything right from the very beginning.  
(Personal definition by Torkel Bennerstedt, former Nordic secretary)**

## **International Cooperation**

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

One particularly important area of international cooperation has been with Estonia, Latvia and Lithuania. Some of the projects and the positive results are presented under the various research programs below. As decided by the Board (cf. Board notes from Sept. 20, 1995 and Aug. 27, 1996), this cooperation took place without extra cost to NKS; yet, the benefits for all participants have been widely recognized.



## **Dissemination of Information**

The major channels for distributing NKS information are:

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

Some statistics from May 2008:

- Some 11,000 website visits per month
- Normally 4 – 6 newsletters per year (NewsLetters + NewsFlashes)
- Some 330 subscribers to the electronic newsletters

# The Last 4-Year Programs

## General

In spite of the fact that this report only covers the years 1984 – 2008, all 4-year programs since the start in 1977 are listed in Appendix 3 for handy reference. Although the structure of NKS and its policy have varied over the years, these features and the responsible bodies are fairly representative of all 4-year programs:

- Funding, policy questions, contractual issues: the Owners Group
- Decisions on budgets, projects etc.: the Board
- Supervision of projects: the reference groups
- Scientific work: Pre-projects, projects and subprojects
- Deliverables: semi-annual, annual, technical and final reports; seminars, workshops etc.
- Follow-up: implementation, evaluation, conclusions
- Administrative support: the Nordic secretary and the Secretariat

The 4-year program period can be divided into a number of phases:

- Preliminary discussions on the new program (owners, board, Nordic secretary)
- Appointment of one or more working groups (board)
- Decision on pre-projects: directives, staffing, mandate, budget, deadline etc. (board)
- About one year later: pre-project reports, discussions (stakeholders, incl. board)
- Decision on the new program: project plans, project leaders, budget, time schedule, deliverables etc. (board)
- Some three years of project work including technical reports, semiannual reports, annual reports and final reports (project leaders supported by their respective reference group)
- Approval of final reports and the results of the projects (board)
- Evaluation of the 4-year program (evaluators, appointed by the board)
- NKS seminar to present the results of the old program and discuss plans for a new program

Implementation of results and feed-back from end users and others constitute a final stage once an NKS program, project or activity has been concluded.

In practice, it is hard to draw an exact line at what point in time a nominal 4-year program was finished. Some projects or evaluation reports were delayed. Some end users may report back quickly on the relevance and practicability of the results. Others may be late in doing so, or perhaps not respond at all. But an overall estimate is that a planned 4-year program period actually lasted anywhere from 4.5 to 5.5 years in extreme cases.



Staying Focused

Photo: Torkel Bennerstedt

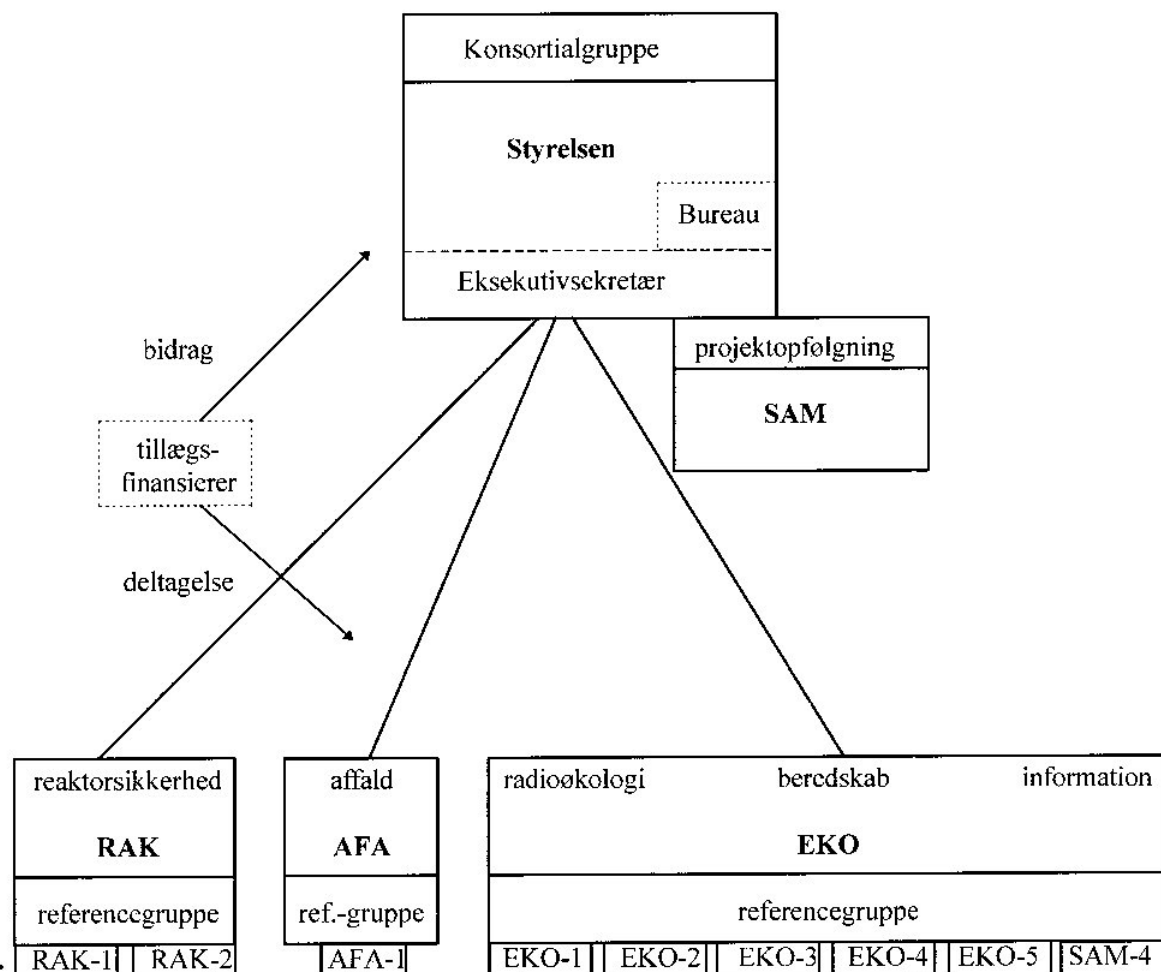
## The Fifth 4-Year Program (1994 – 1997)

### General Recommendations After the 1990 – 1993 Program

The evaluators recommended annual project seminars to disseminate information and discuss results, and suggested that a midway evaluation of the projects should be performed after about two years. Furthermore, they recommended that a certain portion of the budget for every project be withheld until the final report has been delivered. For more information: see the full evaluation report on the [webpage](#).

### NKS Organization

The organizational chart for the fifth program was quite impressive but perhaps not that informative. Many people said that they enjoyed working with NKS activities but never really understood the structure and organization behind it. In retrospect it is easy to see why – just take a look below!



The top rectangle is the wallet, brains and executive branch of the steering group of NKS: the owners (*konsortialgruppe*), the board (*styrelsen*), its working group (*bureau*) and the Nordic secretary (*eksekutivsekretær*). The secretariat (*projektopfølgning*) was called SAM (Scandinavian abbreviation for coordination). There were three program areas: RAK, AFA, EKO and their respective projects (explained below) and reference groups (*referencegruppe*, abbreviated *ref.-gruppe*). A number of additional financiers (*tillægsfinansierer*) contributed financially (*bidrag*) and participated in the practical work (*deltagelse*).

## Preparing for the New Program

Some conclusions and recommendations of the evaluation of the preceding fourth 4-year program 1990 – 1993 were summed up in a report edited by Franz Marcus, NKS(94)7:

- The evaluators recommend to ascertain, at the outset, the preparedness of project participants and their organizations to dedicate time according to the plans. Project plans need to be revised at mid-term to enable corrections and updating.
- During the project period, NKS should make use of specific criteria in order to judge progress and success. Each project leader must make sure that the various subprojects are tied together into a unified project. The project leader should resort to economic pressure in order to adhere to time tables.
- The majority of recommendations deal with reporting and presentation of results. Thus, it is the project leaders' task to convey information on the professional level, and to organize seminars with an extended attendance. The NKS annual reports should be conceived so that they can also be used for external information.
- It is recommended that NKS establishes a policy aiming at enhanced information about its projects. Final reports should contain conclusions and recommendation which can subsequently be followed up. Thus, the directors of the competent authorities in the Nordic countries should be requested to give their views on the recommendations, and industry likewise on the usefulness of the results. The evaluation group even proposes that NKS consider presentation of the outcome to responsible ministers and their staff. For this purpose summaries in all Nordic languages would be needed.

The fifth Nordic safety research program started with a general planning period in 1993, with participation of Bjarne Regnell (NKS chairman), Sören Norrby (SKI), Eiliv Stennes (University of Trondheim) and Klaus Singer (Risø), led by Franz Marcus. It resulted in a report, NKS(93)8Rev., with plans for 1994 – 1997. After this followed seven pre-projects in 1994, with the following leaders:

### *Pre-project leaders:*

- Kjell Andersson, Karinta-Konsult (RAK-1)
- Ilona Lindholm, VTT Energy (RAK-2)
- Karin Brodén, Studsvik RadWaste (AFA-1)
- Sigurður Emil Pálsson, IRSA (EKO-1)
- Hanne Solheim Hansen (EKO-2)
- Jens Hovgaard, DEMA (EKO-3)
- Eldri Naadland, NRPA (EKO-4)

Some of the evaluators' recommendations above were taken into account during the pre-project period. Others were subsequently dealt with by the NKS Board. The pre-project work followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. The report NKS(94)8 presented the results of the pre-project and discussed the continued work

## Program Overview

Acronym	5th 4-Year Program: Projects 1994 – 1997	Reference group chairman / Project leader
RAK RAK-1 RAK-2	Reactor Safety Strategy for Reactor Safety Prevention of Severe Accidents	Bjørn Thorlaksen, DEMA Kjell Andersson, Karinta-Konsult Ilona Lindholm, VTT Energy
AFA AFA-1	Waste Management Safety in Waste Disposal	Erling Stranden, NRPA Karin Brodén, Studsvik RadWaste
EKO EKO-1 EKO-2	Environmental Effects Marine Radioecology Long Ecological Half-Lives in Semi-Natural Systems	Sigurður M Magnússon, IRSA Sigurður Emil Pálsson, IRSA Tone D Selnæs (later Bergan), IFE

EKO-3	Preparedness Strategy and Procedures	Jens Hovgaard, DEMA → Anneli Salo
EKO-4	Emergency Preparedness Exercises and Information	Eldri Naadland (later Naadland Holo), NRPA
EKO-5	Pre-Planning of Early Clean-Up	Thomas Ulvsand, FOA NBC Protection
SAM	NKS Coordination	
SAM-1	Secretarial Services, Administration	Torkel Bennerstedt & FRIT
SAM-2	Coordination of NKS-Baltic activities	Torkel Bennerstedt
SAM-3	Coordination of NKS-EU contacts	Torkel Bennerstedt
SAM-4	Overriding Information Issues	Vibeke Hein, DEMA

**N.B.:**

1. The EKO-2 pre-project leader was unable to continue as project leader due to promotion within her own organization. Other than that, all pre-project leaders continued as project leaders.
2. The EKO-5 project was added to the EKO program in 1996 with 100% external funding.
3. Toward the end of the 4-year period Anneli Salo, private consultant and former STUK employee, took over as project leader for EKO-3 since Jens Hovgaard was recruited by a Canadian company manufacturing and marketing systems for mobile measurements of radioactivity.
4. No pre-project was carried out for the information project (SAM-4).

## Project Summaries

**Based on the project leaders' Summary Reports; see report no. NKS(98)2.**

Project budgets: See Appendix 5.

### **RAK-1: Strategy for Reactor Safety**

**Kjell Andersson, Karinta-Konsult**

The general objective of the RAK-1 project was to explore strategies for reactor safety as applied in Finland and Sweden. On a more concrete level the project aims were to:

- Investigate and evaluate the safety work
- Increase realism and reliability of the safety analysis
- Suggest how safety can be improved in selected areas

The project consisted of five subprojects:

- RAK-1.1 Mapping and evaluation of the safety work
- RAK-1.2 Initiating events
- RAK-1.3 Integrated sequence analysis – especially human errors
- RAK-1.4 Maintenance strategies and aging
- RAK-1.5 Modernization

RAK-1.1 made a survey of safety work in Finnish and Swedish nuclear installations, and addressed the issue how we can assess the suitability and effectiveness of the safety work. The subproject report is based on extensive interviews with plant and authority staff. It turns out that the operation of nuclear power plants demands considerably more resources than earlier expected. A combination of more resources and higher efficiency seems to be the way forward. E.g., there is a need to increase the efficiency of inspections and safety reviews performed by the authorities.

RAK-1.2 tackled the problem of how to improve WASH-1400 values for LOCA frequencies for pipe ruptures, and explored LOCA risk dominating mechanisms.

RAK-1.3 addressed how complex event sequences can be analyzed with new approaches integrating different disciplines. The concept of Integrated Sequence Analysis (ISA) was introduced.

RAK-1.4 discussed how to optimize maintenance and testing with improved maintenance strategies, and developed tools for this purpose. E.g., a maintenance data information system (ReIDAT) was developed and installed at the Barsebäck plant. Tools were tested for decision analysis with respect to maintenance programs, and the importance of human error in maintenance was studied.

RAK-1.5 was devoted to plant modernization and explored how we can meet up with modern safety standards. The final report advises both the utilities and the authorities to actively follow the evolving safety standards for new reactors, e.g., the development of the European Directives. This is irrespective of whether new reactors are planned or not, since the new standards may have implications for assessing the safety of the existing reactors as well.

Some RAK-1 contributions to reactor safety:

- Initiating event protection
- Integrated sequence analysis
- Improved PSA for some sequences
- Better estimations of LOCA frequencies
- Improvement and development of plant maintenance

The work and results of the RAK-1 project led to initialization of a Concerted Action within the Nuclear Fission Safety Program of the European Union.

## **RAK-2: Prevention of Severe Reactor Accidents**

**Ilona Lindholm, VTT Energy**

RAK-2 comprised three research areas:

- RAK-2.1 Studies of the consequences of selected severe accident scenarios and phenomena in Nordic reactors.
- RAK-2.2 Development and testing of a computerized accident management support system (CAMS).
- RAK-2.3 Data collection on different mobile reactors and the British reactor types for extension of the Nordic database started in the previous NKS 4-year program covering the reactors in Nordic surroundings.

RAK-2.1, severe accident phenomenology, focused on studying in-vessel melt progression and core coolability at various stages of a severe accident. It was divided into five subtasks.

1. The first subtask was the investigation of core coolability in the original core boundary. The performed analyses suggest that fuel damage can be prevented under certain temperature conditions. Core spray is more efficient in cooling of an overheated core than downcomer injection. A small time window exists where reflooding of the Boiling Water Reactor (BWR) is likely to reach criticality. The scoping studies for containment response to recriticality suggest that a stabilized power level of 20% of the nominal power would be too high for prevention of containment failure with the current safety systems. The RAK-2 work in this area laid foundation for continued work in the EU SARA project 1997 – 1998.
2. If core degradation proceeds to the late-phase, where core melt migrates into the lower head, the performed studies suggest that the Reactor Pressure Vessel (RPV) failure in an ABB ATOM type of BWR most likely occurs due to instrument tube nozzle failure. Large differences exist in the predictions of the codes used for timing of local creep rupture. The coolability of debris in the lower head by late reflooding was also predicted differently by the two integral codes used.
3. A 2-D numerical model was developed to address the heat transfer phenomena in a homogeneous, hemispherical melt pool. When applied to a typical Nordic BWR and boundary conditions, the model predicted a lower head wall ablation failure in 2 – 5 hours.
4. Numerical analyses of the effects of High Pressure Melt Ejection (HPME) on the containment suggest that the pedestal and the drywell will experience a pressure for the first minutes. Even more damaging to the containment penetrations may be the gas temperatures in the containment.
5. Source term analyses for Swedish PWRs were initiated toward the end of the 4-year period and will be continued with national resources.

RAK-2.2 included the development and testing of a Computerized Accident Management System (CAMS). It provides support in normal as well as accident states. Support is offered in identification of the plant state, in assessment of the future development of an accident, and in planning of accident mitigation strategies. It does not give support in execution of the chosen mitigation strategy.

The first phase of the subproject focused on

- information needs during normal and accident conditions in a nuclear power plant
- methods that can be successfully applied to CAMS
- man-machine interaction and human factors requirements

The second phase of the subproject was to test the system in a simulated environment.

During CAMS design considerable effort has been made to maintain the generality of the CAMS concept. Although the referenced process was a BWR plant, the use of this structure and design can be applied to other processes, also non-nuclear.

RAK-2.3 dealt with the investigation, collection, arrangement and evaluation of data on reactors in the Nordic neighborhood to be used by the Nordic nuclear preparedness and safety authorities. It was an extension of previous NKS work (SIK-3 in 1990 – 1993). Now, British reactors of all types were included, together with mobile reactors (satellite, submarine and nuclear ship reactors). Accidents on nuclear ships were also addressed. A database of NPPs (including the ones covered by SIK-3) within about 150 km from Nordic borders plus British reactors was prepared, for authority use in emergency situations.

#### **AFA-1: Safety in Waste Disposal**

**Karin Brodén, Studsvik RadWaste**

The objective of AFA-1 was to give authorities and waste producers in the Nordic countries background material for decisions on management and disposal of radioactive waste. The primary focus was on long-lived low and intermediate level waste from research institutions, hospitals and industries. Most of the work was performed by a broad group of experts from all five Nordic countries. This has contributed to a better understanding of national situations and – in some cases – to common recommendations.

The AFA-1 project was subdivided into three subprojects:

- AFA-1.1 Waste Characterization
- AFA-1.2 Performance Assessment for Repositories
- AFA-1.3 Environmental Impact Assessment (EIA)

AFA-1.1 included an overview of waste categories in the Nordic countries and methods to determine or estimate the waste content. New available methods were presented based on answers to questionnaires distributed to suppliers. The study also included recommendations regarding the characterization of waste under treatment and the characterization of existing and old waste packages. It is advisable to obtain information concerning waste under treatment. New regulations for the inventory of a repository may demand new assessments of old radioactive waste packages. Additional measurements may be necessary.

AFA-1.2 dealt with the performance assessment of the engineered barrier system (near-field) of the repositories for low and intermediate level radioactive waste. The geological host medium was intentionally excluded in the study, since different media can be considered in the Nordic countries. The results from the study include a short overview of different waste management systems existing and planned in the Nordic countries. However, the main emphasis of the study was on a general discussion of methodologies developed and employed for performance assessments of waste repositories. Some of the phenomena and interactions relevant for generic types of repositories were discussed as well.

AFA-1.3 results included information on similarities and differences between Environmental Impact Assessments (EIA) in the Nordic countries and a review of experiences from national EIA processes, both in the nuclear field and in other fields. The national EIA system is dependent on the legislative structure, the application of legislation, administrative practice and general social objec-

tives. It is therefore natural that the EIA systems differ from country to country, even if EU directives and internationally accepted principles are adopted. Differences can also be found in responsibilities concerning Environmental Impact Statements (EIS). The proponent of the project bears the responsibility for the EIS in Finland, Iceland, Norway and Sweden. In Denmark the responsibility rests with the authority.

#### **EKO-1: Marine Radioecology**

**Sigurður Emil Pálsson, IRSA**

In the original EKO-1 project plan it was stated that:

*The main aim of this project is to enable better and faster assessments to be made of the effects of releases of radionuclides to the marine environment, taking health and economic factors into account.*

Assessments are generally based on models describing the main processes influencing the behavior of the radionuclides. In the marine ecosystem these main processes are:

1. Water movement and mixing
2. Sediment-water interaction
3. Biological transfer (e.g., the uptake of radionuclides by fish)

Of these processes the interaction with sediments with water has been studied relatively less than the others. It was therefore decided to focus on sediments and water and their interaction. Various site specific factors can affect this interaction, e.g., sedimentation rates. The ability of the sediment to bind radionuclides from sea water is also an important factor.

EKO-1 project work was planned as follows:

1. *Model work* – Identifying, estimating and validating parameters of main interest
2. *Research*
  - 2a) *Field studies:*
    - 2a1) Environments typical for various Nordic regions
    - 2a2) Environments with special physical or chemical characteristics
  - 2b) *Laboratory studies*
3. *Dissemination of information* – Seminars, reports, articles

In the project work emphasis was also put on other aspects viewed to be important for the aim of the project:

- Quality assurance
- Use of internet technology for more efficient dissemination of information
- Maintaining a link with related work done within EKO-2.3 on freshwater ecosystems
- Following what was being done internationally in a similar field and avoiding duplicate work
- Supporting developments of plans for a Nordic course on radioecology

Maybe the most important outcome of EKO-1 is the increased Nordic competence and cooperation in marine radioecology, especially concerning the interaction of radionuclides with sediments. The quality of the the research done is manifested in the scientific articles that have been published, and in the number of PhD and MSc theses based on EKO-1 work.

Models are important tools for assessing the (real or possible) consequences of releases of radionuclides to the environment. EKO-1 supported model studies for the Baltic Sea area and the long term effects of reactors dumped in the Kara Sea and the Komsomolets submarine. Model studies have shown that the collective dose to the year 2050 is dwarfed (by a factor of 20,000) by natural radionuclides such as polonium-210.

The laboratory studies have helped to gain a better understanding of the water-sediment interaction process. They showed a variation in the distribution coefficient with, e.g., sediment type and salinity. The results imply that floods moving contaminated sediments from freshwater systems to the sea could



cause release of radionuclides from the sediments. The results from the laboratory studies are also important for model work where the distribution coefficient is an important parameter.

Process studies of environments with special physical or chemical characteristics focused mainly on the behavior of plutonium in sediments and its interaction with water. A study at Framvaren fjord in Norway was first to prove that remobilization is taking place and a model explaining the behavior of the plutonium was constructed. The model fits well with the observed data.

Field studies were carried out in various environments typical for the Nordic countries. The study area spanned from Thule on the west coast of Greenland to the Arctic Seas north of Siberia. The Baltic Sea was included, as were parts of the Atlantic Ocean. The studies helped to determine site specific characteristics and parameters for the different areas. They also showed that the sedimentation rate could not in some cases be correctly determined by using just one single method; more than one method should thus be used when possible.

Quality assurance was an important ingredient in EKO-1 work. Emphasis was put on *sampling* and *analysis*. A survey was made of the samplers in use and a report was written listing the results and discussing the advantages and disadvantages of each type of sampler. In an intercomparison of Nordic, Baltic and other laboratories two samples were sent to the participants for analysis. Many laboratories did not show satisfactory results. This was especially true for the beta emitting radionuclides. But the study also showed that the analysis of gamma emitters such as cesium-137 can be improved considerably. The participation of invited Baltic laboratories did not require any NKS funding.

Two major seminars were arranged during the 4-year period:

- Sedimentation processes, Kristineberg, Sweden, September 20-21, 1995
- Dating of sediments and determination of sedimentation rate, Helsinki, Finland, April 2-3, 1997

NKS has created a network of competent people in the field of marine radioactivity in the Nordic countries. Other forms of international cooperation and projects cannot replace this network.

## **EKO-2: Long Ecological Half-Lives in Semi-Natural Systems**

**Tone D Bergan, IFE**

Foodstuff from semi-natural areas, such as uncultivated pastures, mountain areas and uplands account for a considerable portion of intake of radiocesium and radiostrontium, and thus to dose to man. Within EKO-2 three problem areas were chosen:

- Sheep grazing on uncultivated pasture
- The influence of mushrooms
- Freshwater fish

The main aim has been to identify the contribution from semi-natural systems by determining ecological half-lives for specific foodstuffs from these areas, and thus determine dose to man. Data were produced or compiled for 8 – 11 years after the Chernobyl accident.

The recovery of Nordic ecosystems from Chernobyl is gradually slowing down, at the same time as areas vary widely in susceptibility and recovery rates. Accordingly, ecological half-lives are gradually increasing and cannot be treated as constants, neither over time nor space. Although it has not been easy to determine simple or general ecological half-lives the projects have given us useful understanding of the mechanisms governing the transfer of radionuclides, and more knowledge about typical Nordic ecosystems.

*The sheep project* involved studies of the soil – vegetation – sheep system in Denmark, the Faroe Islands, Iceland, Norway and Sweden. Coordinated sampling started already in 1990 and continued until 1997. Large differences in transfer were found, and by studying the production intensity, biomass production, climate conditions, the presence of mushrooms, intake of soil and experimental studies of stable elements in the soil it was possible to explain some of the differences. Since soil represents an

important reservoir for radionuclides in the terrestrial system the soil characteristics have been the most important factor for the different transfer factors that were observed in the various grazing areas.

*The forest project* studied the consumption of food products from the forest system. A questionnaire was performed on the consumption of wild berries and mushrooms. A survey in Sweden revealed the amount of radiocesium transferred yearly to man via mushrooms. Most animals show increasing levels of radiocesium when mushrooms are available in August-September. Roe deer are among the largest mushroom consumers. Up to 20-30% of their paunch content is mushroom in this period.

*The freshwater fish project* studied limnic systems, focusing on ecological half-lives in Nordic lakes. The main aim was to investigate the processes and mechanisms leading to radiocesium being easily available for uptake in fish. A Nordic map was developed, containing descriptions of fallout, limnic data (such as water quality, size and water transport), radiocesium levels in freshwater fish and water, as well as runoff from surrounding areas. Resuspension of sedimented radiocesium, along with runoff from catchment areas, are important sources for biological uptake, forming the dominating factor contributing to long ecological half-lives in freshwater fish. It is important to follow the time development of cesium-137 in fish and the controlling factors of critical catchments and lakes.

**The main conclusions** of the EKO-2 project are that semi-natural systems were at the time becoming increasingly more important with time when it comes to transfer of radionuclides to man, and that ecological half-lives were increasing with time.

### **EKO-3: Preparedness Strategy and Procedures**

**Jens Hovgaard, DEMA → Anneli Salo**

The overall objective of EKO-3 was to assist Nordic authorities in improving their emergency response and international cooperation in selected issues. The project was divided into four subprojects:

- Mobile measurements
- Quality assurance in sampling and analysis
- Operational Intervention Levels (OIL)
- Intervention issues in agriculture and food chains

In 1995 an NKS exercise called RESUME (Rapid Environmental Surveying Using Mobile Equipment) was conducted in Sweden with Nordic participation plus teams from Canada, France, Germany and Scotland. The results demonstrated the excellent capability of the airborne teams. Of the ten teams eight were able to deliver cesium-137 maps very soon after the surveys were completed, in some cases within a few hours. In general, the cesium deposition map from the airborne and carborne teams showed the same spatial features but with some variation in absolute levels. Most of the observed differences can be attributed to difference in calibration methodology and spatial attributes of the various measuring techniques. It was found that accurate flight-path navigation and software for presentation and analysis played an important role in the search for hidden sources. – RESUME95 was followed up with similar exercises in 1999 (Sweden) and 2002 (Scotland).

With regard to quality assurance in environmental sampling and analysis, the project provided an up-to-date picture of the state-of-the-art in gamma spectrometry in the Nordic countries. Problems were identified and solutions suggested. One of the improvements needed was to develop access to software for gamma spectrometric analysis. A manual was produced for one such program. Software inter-comparison showed that considerable differences occur among programs in their quality of peak area estimates.

A survey of measurement geometries in use in the Nordic countries revealed the wide variety of sample containers used. Several advantages were identified in having the same geometry. It is therefore recommended to agree on a few of these containers to be used as reference containers, and to participate in ongoing international work. An intercalibration exercise was carried out for whole-body measurements, which led some laboratories to improve their calibrations. An outline for a quality manual was prepared. With regard to the accreditation of gamma laboratories, the work resulted in clarifying the process, but implementation remains the task of the institutes in question. It is important

to maintain Nordic contacts during the process since it may save time and effort. Finally it was recommended that trends in information technology be carefully monitored.

Operational intervention levels (OIL) were treated within a probabilistic framework in which only a few basic facts concerning the accident are known at the time of decision making. The probabilistic approach developed offers a method for characterizing the uncertainties in the efficiency of early intervention measures. The recommendation is that OILs are defined within a probabilistic framework. In this framework an optimized OIL is given as the measurement value, for which the average avertable dose is equal to the (generic) intervention level. Furthermore, it is recommended that the probabilistic approach be developed as a tool for optimizing existing and future measuring strategies. This may involve optimizing the type and number of measurements and the time scheme for deployment of mobile measurement units.

As for agricultural measures, a satisfactory preparedness scheme of action should exist already before the alert phase after a release. Deliberations clearly showed that many differences are present among the Nordic countries regarding the agricultural situation, and that too hasty conclusions about harmonization of countermeasures should be avoided. Cooperation between the radiation protection, agricultural and food producing communities was necessary and very fruitful. It is essential that involved authorities develop an adaptable preparedness organization that can implement the necessary measures in a quick and efficient manner. Knowledge of alternative measures and their consequences is a prerequisite for efficient and timely implementation of these measures. A forum should exist where agricultural, food and emergency preparedness experts can exchange views and experiences.

#### **EKO-4: Emergency Preparedness Exercises and Information**

**Eldri Naadland, NRPA**

The objectives of EKO-4 were to:

- Contribute to competence development of personnel in emergency organizations
- Draw attention to and further develop contingency plans for nuclear accidents
- Contribute to joint professional evaluations and coordination between the Nordic countries
- Improve the understanding of various types of actions and decisions taken in neighboring countries through joint Nordic exercises and improved systems of exchange of information and data between the Nordic countries

Implementation of the results of an exercise is not regarded as being part of the exercise itself, and was therefore not an objective of this project.

Exercises were arranged frequently to validate plans and procedures and stimulate early notification and exchange of information. Although Nordic agreements exist in certain areas of work, no joint contingency plan exists between the countries. Exercises are scenario-driven activities, each having different scopes and objectives. They all develop in three phases: planning, execution and evaluation. The activity can be executed in real time or independent of time. All three phases require resources; however, joint Nordic exercises and participation in international exercises render the work more cost-effective.

During the 4-year project period several functional exercises and similar activities were arranged:

- Seminar on evaluation of accidents and analysis of the source term (1997)
- Exercises and seminars on atmospheric dispersion (1995 and 1996)
- Exercise and seminar on dose calculation (1995)
- Decision conference on clean-up actions in urban environments (1995)
- Information exercise in connection with RESUME95 (1995; cf. EKO-3)

After the series of functional exercises a large-scale exercise was arranged in which Nordic objectives were linked to the international exercise INEX-2-FIN, arranged by OECD/NEA.

Further development is required in a number of areas, e.g.,

- Methods and tools for dispersion models, dose calculations and source term determinations

- Systems for communication and exchange of data and other types of information
- The content of the information to be exchanged and formats to be used
- Joint terminology and methodology for, e.g., scenarios, types of exercises (full-scale; table-top; decision conference, etc.) and evaluation

When planning exercises scenarios must be developed. Different groups have different requirements as regards detail. There seems to be a tendency in Nordic exercises to create scenarios with very serious consequences. Exercises should not contribute to creating myths as to what type of situations will have to be handled. One must also ensure that the security of the plant in question is not weakened by participation in the exercise.

The exercises carried out during the project period have provided useful knowledge and many proposals for the further development of nuclear emergency preparedness in many different professional areas, both nationally and jointly in the Nordic countries. However, there seems to be a need to develop more long-term plans and strategies for Nordic contingency planning and Nordic exercises, as well as a greater awareness of what is an appropriate exercise format to achieve a given objective. This can contribute to reduce costs and optimize the benefits of the exercises which are arranged.

Exercises can be regarded as a **means** to develop, harmonize and validate plans, procedures and tools. But work with exercises can also be regarded as an **objective** in the same sense that it can contribute to optimize the use of resources allocated for exercises. Increased awareness of *inter alia* these problems will be advantageous to continuing work with Nordic exercises. Increased awareness will also contribute to “practice makes perfect”.

#### EKO-5: Pre-Planning of Early Clean-Up

Thomas Ulvsand, FOA NBC Protection

The purpose of EKO-5 was to work out guidelines to be used in the planning of *early* clean-up actions, i.e., actions which have to be taken during the first three weeks after an accident in order to be meaningful. Only actions for reducing doses from external radiation in inhabited areas were considered. The project was ordered and totally financed by the Swedish Rescue Services Agency. The main target group was persons responsible for planning contingency operations following a radioactive release.

The following actions can be regarded as early:

- Hosing of roofs, walls and paved areas
- Lawn mowing and removal of grass cuts
- Pruning of trees and bushes
- Removal of snow
- Vacuum cleaning of streets

Calculations were made for a reference deposition of cesium-137 considering urban and suburban environments such as

- detached wooden or brick houses
- semi-detached houses
- terrace houses
- city center multi-storey buildings

In the case of dry or wet deposition, the document describes the expected effects of the various actions and the practical, economical and protective-relevant consequences generated by them.

In the guidelines resulting from this work, the reduction of life time dose has been considered as the relevant parameter. The actions giving the *largest effects*, measured as life time dose reduction, are *lawn mowing, removal of snow and pruning of trees and bushes*.

The document finally discusses clean-up actions and their effects on the rural living environments. The relevant actions are the same as in urban and suburban areas. In more densely populated areas the

actions will to a great extent be managed and performed through societal efforts. But in rural areas the results very much depend on private initiatives by, e.g., farmers who have the necessary equipment and perform the recommended actions themselves.

The document ends with guidelines, describing each of the 44 considered cases. The guidelines are directed to the planners and are presented as tables, with the following headings:

- House type
- Expected effects
- Staffing and costs
- Equipment and costs
- Practicability, waste
- Protection
- Influence on other procedures

### **SAM-3: Coordination of NKS-EU Contacts**

**Torkel Bennerstedt, NKS**

In order to introduce NKS and its research activities to EU, two visits were paid to DG XII during the period. Also, a joint CEC-NKS Seminar on Possible Information Exchange and Cooperation in Nuclear Safety and Radiation Protection was arranged at STUK in Finland on Jan. 9, 1996. Information was shared between EU and NKS, and issues of mutual concern were discussed and summarized in a memo by the secretary of the NKS Board. It was agreed that this type of information exchange should be continued in the future. This led to a workshop in Brussels in June 1998; for more information, see next 4-year period below.

### **SAM-4: Overriding Information Issues**

**Vibeke Hein, DEMA**

During the pre-project period an information project was proposed but not accepted by the Board. But the heads of the information departments of the Nordic authorities found the need for a new project so pressing that they maintained the initiative, and at the semi-annual review of ongoing projects SAM-4 was launched. It consisted of ten subprojects focusing on four subject areas:

- *How to inform about a difficult subject in a modern society*  
Nuclear energy, radiation and emergency preparedness may be strange, even frightening concepts to some people. At the same time, the volume of information increases over time. So there is a need to identify target groups and the best channels and means of communication. A seminar was arranged, featuring Dutch experts on crisis management in connection with disasters. The public expects a high level of safety, security and service. It was found that our modern society can be seriously affected even by simple, uncomplicated events.
- *How to provide advance information*  
The authorities depend heavily on news media to communicate their message in case of an incident or accident. Hence, journalists must be prepared and preferably trained in advance. This cannot be done on the day of a serious, acute situation. It is important for all parties that journalists are briefed beforehand on the subject matter. A seminar was arranged on the occasion of the 10th anniversary of the Chernobyl accident, and a study tour to the Kola nuclear plant was organized. The immediate possibility to inform the citizens continues to be covered by, e.g., brochures and webpages. An existing list of information material published by Nordic authorities was updated, and – for the first time – a comprehensive list of NKS project reports was compiled.
- *How to inform when the accident has occurred*  
It is important to let experts and journalists exercise together, to learn each other's language and needs. Besides, exercises are instrumental in doing away with myths and preventing that they arise. Thus, Nordic authorities and SAM-4 participated in two international emergency preparedness exercises arranged by OECD/NEA. The first exercise, INEX-2-CH in November 1996 with Switzerland as Acciland, sparked a certain exchange of information among the Nordic countries, primarily concerning precautions, travel restrictions etc. E-mail was tried as a mode of communication, with moderate success. In the second exercise, INEX-2-FIN in April 1997 with Finland as

Acciland, the Nordic countries took active part right from the beginning, including the planning phase. Nordic criteria were stressed, including information to media and the public. It was decided to exert a uniform Nordic media pressure by means of journalists nationally dispatched to the scene of the accident. As this was a very realistic situation it provided important training for the participants.

- *How to inform about NKS and its projects*

A communication strategy, including an information policy, was produced and accepted by the Board. The external image of NKS will be strengthened by means of a graphic profile for all publications, to be implemented under the next 4-year program. To provide inspiration for the information task a seminar was held in Stockholm, October 1997, for project leaders and project participants.

### **BER-6: Reclamation of contaminated urban and rural environments following a severe nuclear accident**

In the fall of 1997 the much delayed final report appeared. It was the last report from the 1990 – 1993 BER program.

### **Major Seminars, Exercises and Other Events**

NKS supported Nordic courses and related activities that led to financial support to the publication of two books:

- Nordic Radioecology – The Transfer of Radionuclides Through Nordic Ecosystems to Man. Editor: Henning Dahlgaard, Risø, Denmark. Elsevier 1994.
- Radioecology – Lectures in Environmental Radioactivity. Editor: Elis Holm, Lund University, Sweden. World Scientific 1994.

Final seminars (cf. Board minutes from Snekkersten Sept. 4, 1997):

- RAK-1.2, RAK in 1997
- EKO-1 and EKO-2 (joint), emergency part of EKO in 1998
- Joint final seminar for the entire NKS program in Stockholm March 1998

Joint RAK-1 and RAK-2 seminar, Stockholm, Sweden, Nov. 25 – 27, 1997.

EKO-1: Sedimentation processes, Kristineberg, Sweden, September 20-21, 1995

EKO-1: Dating of sediments and determination of sedimentation rate, Helsinki, Finland, April 2-3, 1997

EKO-3: RESUME95, NKS exercise (Rapid Environmental Surveying Using Mobile Equipment) with international participation, Sweden 1995.

ETEX-1 (European Tracer Experiment), full-scale exercise arranged in France October 1994.

OECD/NEA exercise INEX-2-CH in November 1996 with NKS/SAM-4 participation.

OECD/NEA exercise INEX-2-FIN in April 1997 with NKS/ EKO-4 and SAM-4 participation.

Seminar with Dutch experts on crisis management, Nov. 1996 (SAM-4).

In connection with the 10th anniversary of the Chernobyl disaster: Seminar plus study tour to Kola NPP (SAM-4).

Information seminar for project leaders and participants, Stockholm, October 1997 (SAM-4).

The Nordic secretary arranged a 3P seminar on information and communication issues.

Final seminar: Eight Years With NKS, Saltsjöbaden, Sweden March 11 – 12, 1998, on the results of the NKS program 1994 – 1997 and plans for the 1998 – 2001 program.

## **Evaluation of the Scientific Program 1994 – 1997**

**Evaluator: Antti Vuorinen. See report no. NKS(98)2.**

Prof. Antti Vuorinen, former director of STUK, kindly agreed to singlehandedly evaluate the entire fifth 4-year program. It proved to be a formidable task, requiring much more time and effort than anticipated. The evaluation followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. In conclusion, NKS came out quite favorably, and when presenting his report to the Board, prof. Vuorinen stated that his view of NKS was far more positive now than at the start of the evaluation. These are some of his findings.

The general aim of the fifth 4-year program 1994 – 1997 is well in line with the goals and objectives described in the Owners Group's contract and reflects the ambitions summarized in the document "This is NKS". The planning and execution of the program has been systematically documented. With a few exceptions, deadlines have been met; and budgetary constraints were respected.

The activities in the **Nuclear Safety** area have concentrated on the comparative analyses of nuclear safety work in Finland and Sweden; severe accident analyses of Nordic boiling water reactors; approaches to improve the methodology and the basic data for PSA (Probabilistic Safety Analysis); and the development of the methodology for maintaining and upgrading nuclear power plants. All subprojects were relevant and the objectives sufficiently ambitious.

*The RAK-1 project* was well managed and divided into five subprojects:

- RAK-1.1 The responsibility of the plant operator is stressed; but the responsibility of the authority has unfortunately been ignored. The summary report on reactor safety and safety work in the Nordic countries offers an important analysis of the situation at the time and hints at improvements.
- RAK-1.2 This subproject produced a useful tool for practical purposes and is of a certain scientific value.
- RAK-1.3 Many areas lack practical, uncomplicated analytical methods. Therefore the work produced here should be greeted with satisfaction.
- RAK-1.4 To make sure that the results of this type of projects are fully exploited it must be embraced by the top management of the company and the dedicated participation of the plant staff.
- RAK-1.5 The final report is recommended reading for all who are involved in the modernization process.

*The RAK-2 project* consisted of three subprojects.

- RAK-2.1 To select a severe accident and possibilities to control it, and to concentrate mainly on Nordic BWRs is certainly a good choice. The results are of great interest to both regulatory bodies and utilities. Although the computer codes used predicted the progression of the core damage slightly differently, the results are believed to be of value to the emergency operating procedures.
- RAK-2.2 The CAMS project was one of those important long-term projects needed to provide practical results which are badly needed to increase confidence in the safety of NPPs. CAMS will provide a common information platform to the plant personnel and people at the licensing body.
- RAK-2.3 The technical reports contain clear presentations and form as such a practical library of documents in line with the objectives of the subproject.

Among the problems on **Radioactive Wastes**, long-lived low and medium level waste management practices in the Nordic countries as well as approaches to analyze the environmental effects due to waste storing were under study and deliberation.



*The AFA-1 project* was professionally planned and consisted of three subprojects.

- AFA-1.1 Nordic waste characterization methods were described and evaluated and lacking methods identified. The final report is useful reading for persons responsible for management of radioactive waste and repositories.
- AFA-1.2 After the first AFA-1.1 activities the identification and description of the components of a performance analysis could be performed. The project report describes present and planned methods and systems for waste handling in the Nordic countries. It is useful reading for all in the waste handling business.
- AFA-1.3 After the opening seminar in 1995 actual work was not begun until 1997. EIA requirements were fairly new at the time. Hence, this was a very rewarding NKS subproject, which might be followed by similar activities.

The minutes of the reference group meetings show that the AFA-1 project steering on this level was of a rather general character. Finnish and Swedish participation from authorities as well as the industry was scarce, which might reflect the choice of project contents.

Main efforts in the area of **Radioecology** were allocated to the modeling and analyses of long term radioactive contamination in a Nordic environment, including future effects of dumped radioactive wastes into the northern seas. Joint training and exercises were organized to test and develop emergency preparedness emphasizing the possibility of a nuclear accident.

*The EKO-1 project* can be considered as consisting of three subprojects:

- EKO-1.1 Development of models
- EKO-1.2 Research: field and laboratory studies
- EKO-1.3 Dissemination of information

There is a great interest in the type of work that EKO-1 encompasses, both scientifically and politically, not least among the media. This includes dumped radioactive material as well as releases from nuclear installations. Responsibility and work was distributed between all Nordic countries. The importance of integrating NKS work with planned or ongoing national projects is stressed. Contacts were made with Russian institutions to make studies of contamination of northern areas possible. The results of EKO-1 were compiled in a comprehensive report. The produced results will be of interest also to others than Nordic experts. At the time of the evaluation of the NKS program only a draft EKO-1 report was available.

*The EKO-2 project* plan is easy to read and contains all pertinent details.

- EKO-2.1 Transfer of radiocesium and radiostrontium from soil to plants and sheep
- EKO-2.2 Transfer of radiocesium via mushrooms to reindeer and man
- EKO-2.3 Ecological half-lives in limnic ecosystems

Even though all three subprojects are quite specific, they attracted wide Nordic interest. The last status report delivered by the project clearly outlines the disposition of the planned final report. At the time of the evaluation of the NKS program only a draft EKO-2 report was available. It contains interesting information on the project, but alas practically all conclusions and recommendations are missing. This is a disadvantage since they should be a valuable input in discussions on the next 4-year program.

*The EKO-3 project*, together with EKO-4, marked a continuation of the BER projects of the fourth 4-year program. It was divided into four subprojects (the last one added after two years).

- EKO-3.1 *Mobile measurements.*  
The very complex and well planned exercise RESUME95 was a successful and valuable experience. It was a major undertaking, and the organizers must be congratulated on a work well done. It showed that international cooperation in an acute situation is possible, but further harmonization of systems and intercalibrations might be a theme for the upcoming RESUME98 which is being planned together with EU. (*Author's comment:* There were two more RESUME exercises, in 1999 and 2002, respectively.)

- EKO-3.2      *Quality assurance in sampling and analysis.*  
The subproject focused on gamma spectrometry in conjunction with laboratory analysis and *in situ* measurements. The work was partly coordinated with EKO-1. The subproject was successful and will raise the standard of the participating laboratories.
- EKO-3.3      *Operational Intervention Levels.*  
The selection of the subject is excellent. The work is very well done and clearly presented. This subject has been discussed in the Nordic countries extensively in the course of several years; however, the progress in crystallization of the results has been rather slow. That is why this study is very welcome, although the terminology used in connection with intervention is somewhat vague.
- EKO-3.4      *Measuring strategies, decision making and actions in the agricultural area.*  
This subproject was added in 1996 and was divided into six areas. The plans could serve as a good example in planning and presentation. The suggestions and recommendations presented are well founded.

*The EKO-4 project*, together with EKO-3, marked a continuation of the BER projects of the fourth 4-year program. EKO-4 had two subprojects.

- EKO-4.1      *Exercises and scenario development.*  
The work was organized in a number of packages including reactor safety; dispersion models and trajectories; harmonization of action levels; information services in connection with EKO-3.1; and dose calculations. Nordic countries participated in the full-scale tracer experiment ETEX-1 arranged in France in 1994, and EKO-4 hosted a follow-up meeting. The attempts to solve the problems should be started from the strategy of emergency preparedness and closer to the strategy of countermeasures. What is really needed, and when, should be discussed before too much efforts are devoted to harmonization. At a decision conference on urban clean-up experts and decision makers met. This is important; but training should probably be organized nationally.
- EKO-4.2      *Nordic system for exchange of data and information.*  
A contact seminar was organized and the handbook on Nordic nuclear preparedness revised. It is an important and useful tool both during exercises and in case of acute situations. It is a living document that must be updated on a yearly basis.

At the time of the evaluation of the NKS program only a draft EKO-4 report was available.

*The EKO-5 project* was added to the EKO program in 1996 with 100% external funding. Two documents, both very valuable, were produced on early clean-up following a nuclear accident, with the objective to reduce individual lifetime doses. As a continuation of this decontamination project one might want to consider whether the requirement to minimize dispersion of radioactive substances to surrounding areas and the environment would influence the choice of countermeasures. It is vital that the reports be published in Nordic languages as well, since they are of significant value. NKS has demonstrated great flexibility when accepting this project midway into the 4-year program. The project was efficiently carried out and well reported.

The **administrative functions** plus a project on information were organized under a separate heading called SAM (short for *samordning*; Scandinavian for coordination). There were four subprojects.

- SAM-1      Overall program management, economy and administration  
SAM-2      Coordination of NKS-Baltic activities  
SAM-3      NKS-EU contacts  
SAM-4      Overriding information issues

*The SAM-1 project:* The administrative functions and the corresponding documentation has improved vastly the last couple of years. The level of competence is high and SAM-1 has served the program well.

*The SAM-2 and SAM-3 projects* were not commented by the evaluator.

*The SAM-4 project* was added to the NKS program in 1996 after a proposal from the Nordic information chiefs of the various authorities. The suggested information project was formally incorporated with the SAM program but practically handled in the same reference group as the EKO projects. The project consisted of eight interesting and important subareas but was probably too ambitious. Perhaps it would have been wiser to work more intensely with a smaller number of questions. There are a number of angles on the issue of the information policy of NKS. NKS is basically intended to be a forum of research, with the aim to produce good results and train the participants. But the outside world should also be made aware of the possibilities and results of the work of NKS. How well known, then, is NKS and its work? A number of participants of an NKS seminar answered a questionnaire that was handed out by the evaluator. 40% claimed to know fairly well what NKS is. 35% responded that they had used NKS results; however, 55% found NKS activities useful! 40% found NKS work efficient; 25% felt not, and 35% offered no opinion. Some remarks were: NKS should concentrate on exchange of information; focus on fewer but larger projects; coordinate with EU work; and simplify the organization.

The selection of technical / scientific RAK, AFA and EKO projects was done after careful pre-studies; the projects cover rather evenly the cooperation area. Some of the projects represent the top level of scientific technical knowledge, others represent more or less preparation of state-of-the-art reports. Important results have been presented and useful information collected for further use, e.g., material for educating young experts and maintaining and further developing the competence of senior experts.

The joint RAK-1/RAK-2 seminar at the end of the 4-year period was very successful.

The benefits of NKS work should be systematically discussed and evaluated, and the results implemented in such a manner that it serves to improve the *supervision and control* of NKS work. The most essential factor in reaching success is to select projects that are of current importance to NKS promoters and of special interest to project leaders and their team of researchers.

It is evident that the basic administrative structure of NKS is in good condition. However, there are some features that could be simplified and the number of less effective technical meetings could be reduced. The Nordic secretary could have intervened more strongly to avoid some of the delays of the scientific program. The NKS Board should seriously consider the pros and cons before adopting new information projects (other than communication techniques).

The reporting of administrative matters should be done on time, clearly and concisely, avoiding repetitive parts. Technical reporting should be done only if real advancements can be presented or if there is a need to bring some special aspects to a broader forum for discussion.

In recent years NKS has taken a rather broad approach to information. Prof. Vuorinen concludes his evaluation by stating that it might be advisable for NKS to focus its information activities mainly to the experts who are the potential users of NKS results. NKS is a good forum for preparation of special material for public information purposes; nevertheless, interaction with mass media is justified only when NKS has *news* to offer journalists.

## **Final Seminar: Eight Years With NKS**

A two-day seminar called Eight Years With NKS was arranged in Saltsjöbaden, Sweden in March 1998. The seminar covered NKS results in 1994 – 1997 and plans for 1998 – 2001. The target groups were

- the owners, board and other financiers and supporters of NKS work
- decision makers and other end users of NKS results
- persons who wanted to learn about and discuss the results of the last program period and the plans for the next program

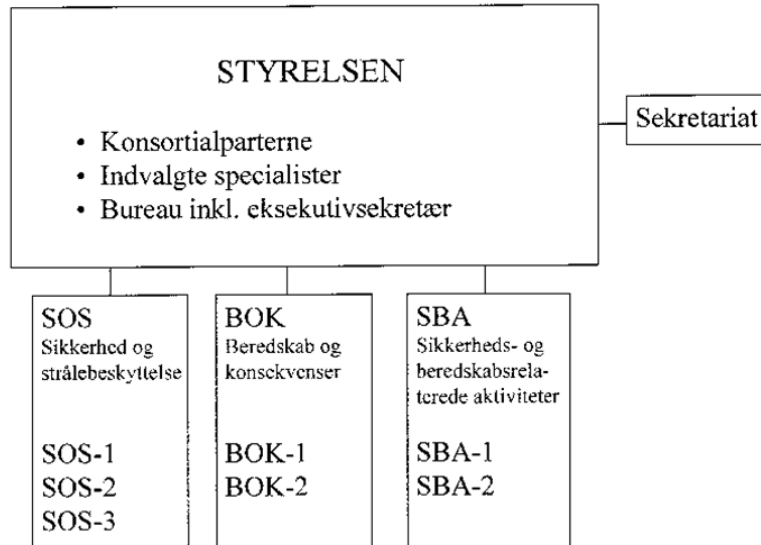
After opening the seminar, the Nordic secretary gave an overview of the recently concluded research program. After this, the project leaders presented the work and most important results of their respective project. Ample time was reserved for questions and discussions. Then Antti Vuorinen presented his evaluation report and especially his conclusions and recommendations, upon which followed an intense discussion. The Secretariat gave a short presentation of its achievements, after which the Nordic secretary summarized the last four years of NKS work. The first day was rounded off by Franz Marcus in his talk on half a century of Nordic nuclear safety cooperation and EURATOM treaty issues.

The second day was spent discussing NKS and the future. In his keynote address the new director of STUK, Jukka Laaksonen, shared his views and expectations, and again time was set aside for a good discussion. This was followed by an in-depth presentation of the proposed new 4-year program, led by Sigurður M Magnússon. A number of groups of varying size were formed to penetrate the proposal, comment and complement it and report back in plenum in a final joint discussion. After a brief summary by Sigurður M Magnússon, the seminar was closed.

## The Sixth 4-Year Program (1998 – 2001)

### NKS Organization

By and large, the NKS organization was basically the same as in the previous program period. The organizational chart was simplified but still somewhat complex.



The top rectangle represents the board (*styrelsen*), with three main parties: the owners (*konsortialparterne*), recruited specialists (*indvalgte specialister*) and the bureau including the Nordic secretary (*bureau inkl. eksekutivsekretær*). Administrative tasks were handled by the secretariat (*Sekretariat*). The three main program areas (SOS, BOK and SBA) are explained below. The scientific reference groups linked to the different 4-year programs in the past were abolished by an Owners Group decision on Feb. 5, 1998, effective from the start of the sixth 4-year program.

### Planning, Pre-Projects and the New Program

NKS report NKS-5 summarizes the planning of the 1998 – 2001 program and gives details on the project plans. They included reactor safety, radioactive waste, emergency preparedness, radioecology and cross-disciplinary studies including information.

The work to develop the sixth 4-year program started with the evaluation of the previous program summarized above and the subsequent discussions on the findings and recommendations of the evaluation. At the same time, suggestions and proposals for the new program were invited, both on a national level and from involved organizations and researchers. A special program group was established to find a coherent project structure based on the more than 200 suggestions that were received. Their work is reported in NKS(98)1. The Board then decided to carry out a number of pre-projects and feasibility studies under supervision of a temporary reference group chaired by Sigurður M Magnússon, IRSA. This work attracted some 70 persons from all five Nordic countries and almost all relevant organizations. The pre-project leaders and reference group members appointed by the Board are listed below.

#### *Pre-project leaders:*

- Lennart Hammar, ES-konsult (SOS-1)
- Kaisa Simola, VTT Automation (representing KTM; SOS-2)
- Magnus Westerlind, SSI (SOS-3)
- Per Hedemann Jensen, Risø (BOK-1)
- Sigurður Emil Pálsson, IRSA (BOK-2)
- Inger Margrethe H Eikermann, NRPA (SBA)

#### *Reference group:*

- Bjørn Thorlaksen, DEMA (Denmark)
- Timo Haapalehto, KTM (Finland)
- Sigurður M Magnússon, IRSA (Iceland; chairman)
- Erling Stranden, NRPA (Norway)
- Christer Viktorsson, SKI (Sweden)
- Ulf Bäverstam, SSI (Sweden)

The pre-project work followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. Draft final reports of the pre-projects were presented to and discussed by the Board. Some revisions were made at the Board meeting in February 1999, after which the project plans were adopted. At that meeting decisions were also made on budgets, time schedules and project leaders. After this, the actual NKS project work began.

### **Program Overview**

The 1998 – 2001 NKS program finally adopted by the Board was divided into three categories of altogether seven research projects as listed below:

SOS	Nuclear and reactor safety, waste management
BOK	Emergency preparedness, radiological and environmental consequences of radioactive releases
SBA	Information about nuclear facilities in the neighboring areas of the Nordic countries and about cooperation of competent authorities

<b>Acronym</b>	<b>6th 4-Year Program: Projects 1998 – 2001</b>	<b>Project leader</b>
SOS	Nuclear Safety and Radiation Protection	
SOS-1	Risk Assessment and Strategies for Safety	Kjell Andersson, Karinta-Konsult
SOS-2	Reactor Safety	Kaisa Simola, VTT Automation
SOS-3	Radioactive Waste	Karin Brodén, Studsvik RadWaste
BOK	Nuclear Preparedness and Consequences	
BOK-1	Nuclear Emergency Preparedness	Bent Lauritzen, Risø National Laboratory
BOK-2	Radiological and Environmental Consequences	Sigurður Emil Pálsson, IRSA
SBA	Safety and Preparedness Related Activities	
SBA-1	Nuclear Threats in Nordic Surroundings	Inger Margrethe H Eikermann, NRPA
SBA-2	Information Issues	Vibeke Hein, DEMA → Anders Jörle, SKI

Due to a number of unacceptably long delays in previous programs, resulting in final reports appearing a year or more later than planned, the Board decided that NKS should write contracts with the project leaders' home organization, specifying the time schedule and stating that the final payment (usually in the order of 30% of the agreed cost) would be withheld until the project was finished and approved by the NKS Board. This proved to be a very effective remedy.

### **Project Summaries**

**Based on the project leaders' Summary Reports; see report no. NKS(98)2.**

Project budgets: See Appendix 5. (Approximate project spending under the heading Facts in figures at the end of this chapter.)

Formally, the SOS-1 project was divided into three subprojects:

- SOS-1.1 Risk Assessment
- SOS-1.2 Safety Analysis
- SOS-1.3 Strategies for Safety Management

SOS-1 highlighted current developments within the nuclear energy area on a broad basis. It took the view that safety essentially should be understood as awareness among those concerned in regard of the control of risk. This means that safety cannot be said to be provided for until it has been communicated, implemented and well understood. There is thus a close connection between risk communication both within (and between) the expert groups, and between them and concerned citizens.

The project made an attempt to describe nuclear safety with a broad spectrum of perspectives. This has been done with a variety of methods, such as questionnaires, interviews, seminars, special research projects and focus group discussions. Mostly people working with nuclear safety (in industry, regulatory bodies, universities and consultant companies) were involved. Parts of the project were also approached by lay people, but with some connection to nuclear safety. In a broad sense, the the project was devoted, first, to how one can organize for safety; and second, to how risk communication can be improved.

Experience from high reliability organizations has brought many insights in how to organize for safety, but has also demonstrated various mechanisms, which may introduce hidden deficiencies in safety activities. The challenge is to detect and correct such deficiencies before the risk is realized. Three key concepts for this, which were subject to special attention in the project, were safety culture, safety indicators and quality systems.

The concept of **safety culture** that emerged after the Chernobyl accident has a considerable impact on the nuclear safety work, even if it may be hard, or probably impossible, to define it so that it can be measured. The interpretation of the concept as the ability of an organization to create safety by knowledge and involvement seems constructive and inspiring. A special aspect of the concept concerns the regulatory bodies, since for them it has a two-fold purpose. They have to review the safety culture at the utilities at the same time as they in their own work need commitment and responsibility to develop and maintain a safety culture appropriate for a regulator. The safety culture must continuously be encouraged and stimulated by management, especially since it can be exposed to negative pressure from both inside and outside factors. Many see deregulation as a potential threat to the safety culture and others have mentioned the difficulty of attracting young professionals to the nuclear area.

Even if the concept of safety culture cannot be accurately defined, it is connected to the concept of **safety indicators**, which is used to reflect the safety of a nuclear facility. The indicators should also be able to provide warnings that future performance might be in danger. Furthermore, safety indicators should reflect a development over time to make a judgment if present development is for the better or for the worse. There are many benefits with the use of indicators, but they need to be reviewed and changed regularly to better reflect the goals of the organization.

The concept of **quality systems** has also been subject to special interest in SOS-1. On a generic level it can be seen to contain documentation of an agreed quality together with a description of how that quality is reached. It seems clear that the quality systems have an important task of ensuring a systematic knowledge sharing and learning.

How, then, could risk communication be improved? It can well be said that the nuclear waste area is a forerunner in developing methods and frameworks for transparency and public participation, which have also been applied, e.g., in the site selection process. The Environmental Impact Assessment (EIA) has been an “umbrella process” for this both in Finland and Sweden, within which many new and innovative initiatives have been taken. It is believed that some of the methods developed could set

examples not just within the nuclear sector, but also for other complex areas such as biotechnology. The report suggests some elements in a strategy for risk communication:

- The overall attitude (among decision makers, industry regulators etc.) must become more communicative, with the point of departure that decisions on nuclear power, siting of repositories etc. are grounded in public values.
- The nuclear waste issues and possible new reactors have shown that communication can be based on an all-covering “umbrella process” such as EIA or SEA (Strategic Environmental Assessment).
- Within the umbrella process there is room for testing many kinds of means such as different forms of hearings, consensus conferences etc.
- There is room for the regulatory bodies to play an active role in this communication.
- One should not underestimate “the public” which also possesses various areas of expertise.

The safety analysis is at the core of risk assessment for decision making both in reactor safety and for waste disposal. One key element in the improvement of risk communication is thus the development of more communicative ways for safety analysis and performance assessment. The **SOS-1 economy** was discussed at a midway status seminar at VTT; see below under the heading **Facts in figures**.

#### **SOS-2: Reactor Safety                      Kaisa Simola, VTT Industrial Systems (earlier VTT Automation)**

The project focused on certain safety-related topics that were identified to be of common interest within the Nordic nuclear community, and that were not covered by other international research projects. SOS-2 was realized in three subprojects, each consisting of several tasks and research topics:

- |         |                                                                                                                                                                                                                                                                                                                                                           |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SOS-2.1 | Safety development<br>The subproject concentrated on the problems related to risk-informed decision making, especially on the uncertainties and incompleteness of probabilistic safety assessments (PSA) and their impact on the possibilities to use the PSA results in decision making.                                                                 |
| SOS-2.2 | Management of plant maintenance and renewal<br>One aim of this subproject was to promote the analyses of human and organizational factors in maintenance. Another aim was to enhance understanding related to maintenance management.                                                                                                                     |
| SOS-2.3 | Severe accidents<br>This subproject concentrated on phenomenological studies of hydrogen combustion, formation of organic iodine, and core recriticality due to molten core – concrete interactions in the lower head of the reactor vessel. Also the current status of research and management of severe accidents in the Nordic countries was reviewed. |

In **SOS-2.1** a comparative study of two PSAs of nearly identical nuclear power units, both with significantly different results, was conducted. The aim was to identify, clarify and explain the differences between PSA studies, and to give recommendations for the comparison of PSA studies. The impact of assumptions and uncertainties on the results was evaluated. The study resulted in recommendations concerning the documentation of PSAs. A need for harmonization of certain parts of the studies also arose. A second study highlighted the need for structural analysis and presentation of uncertainties to facilitate the communication between different experts and authorities. The emphasis was on the identification and documentation of various types of uncertainties and assumptions in the modeling of the phenomena. A study on active human errors, also known as commission errors, was conducted. According to the study, a significant number of events were due to human actions outside the control room, which should be reflected in the PSA models. A review on decision criteria was done and the principles for evaluating the criteria were identified. A pilot study was conducted to develop a safety classification proposal based on risk for selected equipment of a nuclear power plant (in this case unit 1 of Loviisa NPP). As the risk-informed in-service inspection applications have become increasingly attractive, the quantitative estimation of pipe break frequencies has become an interesting topic. A comparative analysis of pipe failure probabilities due to stress corrosion cracking based on two alternative analysis methods was performed. The main reasons for the differences in the numerical results were analyzed, and the applicability and restrictions of the approaches were discussed.

**SOS-2.2** addressed the quality of maintenance work by considering the role of human errors in maintenance with respect to operability and safety. In Finland, systematic and in-depth analysis of



operating experience of human errors related to maintenance was started during the 1994 – 1997 NKS program and continued in 1998 – 2001. Human common cause failure studies at Finnish power plants show that maintenance work order data are helpful in the identification and analyses of human failure events. A structured classification and analysis facilitate the identification of failed barriers and the error mechanisms behind them. A review of research needs in the area of human factors in maintenance in Sweden was done by interviewing both the authority and the utilities. The needs for future research and development projects were classified and summarized. Since transformer explosions are also a risk, recommendations on condition monitoring of the transformer isolation and oil were reported. A discussion group on maintenance decisions was established, consisting of power plant representatives. Exchange of information was carried out in order to compare and identify good practices, especially to assure economically competitive electricity production without decreasing reactor safety. A survey on the management of condition monitoring information was conducted by interviews at several Nordic power plants. Predictive maintenance strives to prevent component failure by utilizing condition monitoring and information systems for maintenance steering. The interviews and plant visits show that the maintenance strategies are only slowly turning condition-based in spite of access to proper methods and equipment.

Severe accident research in **SOS-2.3** consisted of a review of the current status of research and management of severe accidents in the Nordic countries. The phenomenological studies focused on hydrogen scenarios and formation of organic iodine. In addition, a study on recriticality of a BWR core after molten core – concrete interactions in the lower head was conducted. A scenario of a hydrogen detonation in a BWR reactor building was investigated in order to evaluate the integrity of the containment in case of detonation loads from the outside. The study consisted of analyses of detonations based on earlier calculations of hydrogen concentrations, and of structural calculations. The formation and behavior of organic iodine was addressed by two literature surveys and small scale experiments, aiming at creating an understanding of the underlying chemistry. In the experimental studies the dependence of the formation of organic iodine on the pH of the filter solution was verified. A study was conducted to determine the potential for recriticality of the degraded core of a BWR. In the analyzed scenario a large amount of melt enters the lower head resulting in a melt – water interaction. A steam explosion or a strong evaporation in the lower plenum may push a water slug into the downcomer and core regions, which may lead to a prompt power excursion that in turn may fragment the fuel pins.

Some concluding SOS-2 remarks:

- The need for interdisciplinary work seems to be increasing along with the growing use of risk-informed regulation and plant management. The limitations of the PSA model have to be identified and evaluated in all applications where it is used as an aid for decision making.
- Maintenance management has not traditionally been considered a reactor safety research issue. However, lately the importance of human and organizational factors in maintenance work has received growing attention, and further research needs were identified.
- The deregulated electricity market has forced the utilities to identify cost savings, e.g., in maintenance actions. However, it should be achieved without compromising plant safety. Procedures, such as reliability-centered maintenance and risk-informed in-service inspections are aimed at optimizing the maintenance by taking into account the reliability and risk analysis results.
- The SOS-2 studies have increased the understanding of some severe accident phenomena and identified remaining work in these topics.
- *As EU funding for nuclear reactor safety research is significantly decreasing, the importance of Nordic cooperation within NKS is increasing and the focus of Nordic research should be a subject of continuous discussion.*

### **SOS-3: Radioactive Waste**

**Karin Brodén, Studsvik RadWaste**

The project was divided into three subprojects:

- SOS-3.1 Environmental Impact Assessments (EIA)  
(Continuation of AFA-1.3 1994 – 1997)
- SOS-3.2 Intermediate storage  
(Continuation of AFA-1.1 and AFA-1.2)

### SOS-3.3 Contamination levels in metals (Continuation of KAN-1.1 in 1994)

Priority was given to a Nordic perspective with participation from all five countries. Therefore, the work focused less on waste from nuclear power plants than on waste from research institutions, hospitals and industry. The target group for the results is primarily authorities and organizations managing waste in the Nordic countries. However, the results are presumably useful in other countries as well. This applies particularly to the subproject on contamination levels in metals.

The management and disposal of radioactive waste is governed by national legal frameworks and international requirements and guidance on EIA. **SOS-3.1** included four EIA seminars on the use of EIA in the Nordic countries. The seminars focused on experiences from EIA procedures for the disposal of radioactive waste and other processes. Both Finland and Sweden have repositories for operational waste from nuclear power plants. Finland has experience of a performed EIA process regarding an encapsulation and disposal facility for spent nuclear fuel and similar EIA processes related to the modernization of existing nuclear power plants and a planned new plant. Sweden has experiences from an on-going EIA process regarding plans for disposal of spent nuclear fuel. Norway has experiences from a completed site with the construction of a combined disposal and storage facility for radioactive waste in Himdalen. Furthermore, Norway has experience of EIA work based on support of environmental clean-up activities in Russia. Denmark has initiated comprehensive planning for the decommissioning of all nuclear facilities at Risø. The initial steps in planning for a disposal facility have also been taken. Iceland has only small quantities of radioactive waste, but has experiences from EIA procedures related to other areas.

The objective of **SOS-3.2** was to analyze Nordic experiences of the storage of low and intermediate level waste, and to give recommendations on suitable intermediate storage conditions. Experiences of different intermediate storage conditions, and how these affect the containers and their content, are valuable both to authorities and industry when assessing and planning future storage facilities. An overview of the principles for intermediate storage of radioactive waste packages in Denmark, Finland, Norway and Sweden was made. Recommendations were given regarding different intermediate storage options, as well as control and supervision. The disposal of drums in Kjeller, Norway, was also included in the overview. This is an example of an intended disposal facility turned into what in practice has become a storage system.

**SOS-3.3** included both a study on clearance in the Nordic countries and a study on radioactivity in commercially available metals. Within the study on clearance in the Nordic countries, an overview of official requirements for clearance and information on clearance experiences was prepared. Practices from both nuclear and non-nuclear activities were presented. Clearance of radioactive material, in particular scrap metal, is a quite important issue, nationally as internationally. The volume of scrap metal cleared for recycling is expected to increase as the nuclear installations grow older and the need for refurbishment and modernization increases. However, controlled clearance is not the only source of radionuclides in materials and products. Other sources are naturally occurring radionuclides, accidental smelting of radiation sources, fall-out from nuclear weapons tests, etc. Within the study on radioactivity in commercially available metals, samples from different steel, aluminum and magnesium producers in the Nordic countries were analyzed at different laboratories. The samples were analyzed with gamma spectrometric equipment. In some cases, beta measurements or neutron activation analyses were also performed. No activity at all or activities in the same range as the detection limit were found in the steel samples. Very low activities of natural uranium and thorium were found in some of the aluminum and magnesium samples. No indication of elevated radioactive contamination due to recycling of metals from the nuclear industry was found. Nevertheless, the results may be valuable for comparison with future measurements in order to detect any changes in activity levels.

#### **BOK-1: Nuclear Emergency Preparedness**

**Bent Lauritzen, Risø National Laboratory**

The project comprised a number of activities aimed at developing and improving nuclear emergency preparedness. The activities included surveys of techniques and equipment, workshops and exercises. The project included research activities concerning monitoring and modeling the radiological impact of

nuclear accidents, aiming at developing emergency response plans. Radiation protection authorities, governmental agencies, universities, research organizations and laboratories have been partners in the project, which have had participants from all of the Nordic and Baltic Sea countries.

The project was divided into six subprojects.

**BOK-1.1**     *Laboratory measurements and quality assurance.*

The objective was to develop the quality of laboratory measurements of radioactivity, aimed both at emergency situations and at radioecology studies using radioactive tracer elements. To this purpose, two intercomparison exercises of alpha, beta and gamma measurements on environmental samples were carried out. Two consecutive intercomparison exercises of gamma spectrometry software were conducted to check the ability to handle emergency situations. Seminars on accreditation and measurement techniques were arranged and a study of source preparation techniques for alpha and beta measurements was undertaken. In addition, a survey of sampling techniques employed in the Nordic countries was carried out. The Nordic intercomparison exercises of laboratory analyses revealed large differences in reported results, and were found to be important both for quality assurance / control reasons and as a part of basic training for new staff.

**BOK-1.2**     *Mobile measurements and measurement strategies.*

The objective was to test, compare and integrate different types of field measurements using mobile equipment. Mobile gamma spectrometry aims at mapping contamination levels following a nuclear accident or searching for lost radioactive sources. A Nordic exercise for car-borne gamma spectrometry (CGS), RESUME99, was carried out in Sweden in September 1999, and spectral data collected during the exercise were used in a study of CGS techniques and interpretation of such data. As part of the Barents Rescue 2001 LIVEX in September 2001, the "Gamma Search Cell" exercise was aimed at the search for and identification of lost radioactive sources by airborne and car-borne teams. The BOK-1 project was engaged in the planning and evaluation of this exercise and provided financial support for Nordic participation.

**BOK-1.3**     *Field measurements and data assimilation.*

Data assimilation denotes the integration of available data following a nuclear accident, with the purpose of improving early prognoses on the radiological consequences of the accident. Activities included a PhD program on data assimilation of atmospheric dispersion, focusing on making a source term estimate based on off-site dose rate measurements, and an Ar-41 field experiment for simultaneous monitoring of meteorology, source term, plume and radiation field. Both the PhD program and the experiment produced valuable information on, e.g., modeling short-range atmospheric transport.

**BOK-1.4**     *Countermeasures in agriculture and forestry.*

The main objective was to produce a Nordic handbook on agricultural countermeasures, intended for a target group of nuclear and agricultural authorities, the agricultural community and the food industry end users. Quantitative information has been compiled on dose-reducing countermeasures in agriculture and forestry, and presented in a datasheet report and in an electronic database. A late-phase exercise, Huginn, was conducted to test the ability, based on the datasheets, to calculate the radiological and economic consequences of an agricultural countermeasure following a nuclear accident. In addition, a survey of environmental transfer factors for nuclear emergency preparedness was undertaken. In a separate study, forest remediation techniques in the Nordic countries have been reviewed. Increased collaboration between the Nordic agricultural and radiation protection communities was a valuable outcome of this subproject.

**BOK-1.5**     *Emergency monitoring in the Nordic and Baltic Sea countries.*

A survey of radiological monitoring systems in the Nordic countries, Russia, Estonia, Latvia, Lithuania, Poland and Germany was carried out. The survey was presented in a joint publication of NKS and the Reference Group for Baltic Sea States on Emergency Monitoring Integrated Systems and Early Warning.

**BOK-1.6**      *Nuclear exercises.*

A workshop, Baltic Nuclear, was held with participation by nuclear authorities and the top management of nuclear power plants in the Baltic Sea region, with the purpose of testing the ability to handle the information pressure encountered during a nuclear emergency. A study of a mobile Internet for nuclear emergency preparedness was undertaken and the system was tested at nuclear emergency exercises.

Many of the results obtained in the subprojects have been communicated in project reports and through dedicated seminars, but also through the use of web pages and internally at numerous project meetings.

**BOK-2: Radiological and Environmental Consequences**

**Sigurður Emil Pálsson, IRSA**

The project focused on radioecology in the Nordic countries and areas of interest to them. An important aim was to provide a stimulating environment and to encourage contacts and cooperation between young and experienced researchers, between scientists in different fields (within and outside traditional radioecology) and between scientists within the Nordic countries and neighboring regions. This was done through meetings, seminars and dissemination of information, including use of the Internet. The Nordic network within radioecology is important for national authorities and for new people in the field and for making it possible to start close cooperation quickly between countries, e.g., if needed because of a nuclear accident.

In accordance with the suggestions of the NKS program group, it was decided to structure the BOK-2 project as follows:

**BOK-2.1**      *Important Nordic food chains.*

**BOK-2.1.1**      *Radioecological vulnerability.*

The main emphasis was on using old fallout data to improve methods of estimating the effects of radionuclide deposition. This was done by using traditional UNSCEAR models on a combined data set of fallout and Chernobyl data, and by using precipitation data to predict deposition. Each approach was used successfully by participants from the Nordic countries; combined they involved all five Nordic countries and the Faroe Islands.

**BOK-2.1.2**      *Internal doses.*

The aim was to improve methods for dose calculations based on dietary methods (indirect method) and whole-body counting (direct method). It has, e.g., involved two courses with practical exercises, calibration and intercalibration of equipment and preparation of a handbook for use in emergency situations.

**BOK-2.2**      *Radioactive tracers in Nordic sea areas.*

**BOK-2.2.1**      *Sea water transport.*

The subproject focused mainly on radioactive tracers in Nordic waters Tc-99, Cs-137 and, to a lesser degree, I-129. Particular use was made of the Tc-99 peak in a release from Sellafield in 1995. This release has been followed through the Danish straits into the Baltic Sea (with Cs-137 moving in the opposite direction) and along the Norwegian coast into the Arctic Ocean. At the end of the project period no significant increase of Tc-99 had been observed at the Faroe Islands, but indications of increased concentrations in seaweed were found at the northern coast of Iceland.

**BOK-2.2.2**      *Biological and biogeochemical processes.*

This part of the project focused on processes in the Baltic Sea. Main emphasis was on evaluating existing sediment data, comparing it with recent data, improving the coverage of sampling in the Gulf of Bothnia and improving the knowledge on the role of sedimentation in losses of radionuclides from the water column to the seabed. The last part of this study was to investigate the role of river discharges from Finland into the Baltic Sea.

- BOK-2.3     *Applications of ICP-MS for measuring radionuclides.*  
This subproject was introduced late in the project period in order to meet increasing interest in investigating the applications of mass spectrometry for measuring long-lived radionuclides. It involved a training course, opportunity for work on own samples and experimental work.
- BOK-2.4     *Methodology for defining exemption levels of radionuclides in timber.*  
This subproject was also introduced late in the project period. It involved a study on methodology for defining exemption levels for radionuclides in timber.

The BOK-2 project has through the tasks mentioned above provided a stimulating environment for cooperation in various fields of Nordic radioecology. Eight meetings and seminars were held during the project period and feedback obtained from participants indicates that the Nordic network is a highly valued part of the project work.

#### **SBA-1: Nuclear Threats in Nordic Surroundings**

**Inger Margrethe H Eikermann, NRPA**

The main task was to aggregate already compiled knowledge of nuclear threats in the vicinity of the Nordic countries into a *base of knowledge*, presented by means of modern information technology and made available to Nordic authorities as a supplement to national emergency preparedness systems. Other users of the website could be media and the general public. The project focused on potential events in nuclear installations and the possible consequences for the Nordic countries and especially on vulnerable food chains, dose to man, environmental contamination and emergency preparedness. The main installations in question were nuclear power plants, nuclear powered ships and nuclear fuel and waste storage facilities. A literature database is presented on a website and as a report with some 500 references, including the most relevant publications, papers and reports on the topic at hand.

At the Workshop 2000 experts from the different Nordic countries presented each country's evaluation of the threats against their territory together with discussions on source terms, models and consequences of nuclear threats.

Atmospheric emission, distribution and deposition of radioactive particles of different size, composition and density were the main topics of a subproject on gravitational settling of particles in dispersion model simulations using Chernobyl data. In another subproject a nuclear emergency preparedness handbook for the Nordic countries ("*Håndbok for atomberedskap i Norden*") was updated. The new version also includes contributions from Estonia, Latvia, Lithuania and Poland.

A workshop on information preparedness in nuclear emergencies was organized in conjunction with the Barents Rescue Exercise 2001. The fact that it always takes too long for authorities to inform the public in the event of an emergency was discussed. Other topics were how the authorities can set up independent channels to the media; and information handling during a crisis. The authorities can prepare for this by creating contact networks and using modern information technology.

#### **SBA-2: Information Issues**

**Vibeke Hein, DEMA → Anders Jørle, SKI**

Clear goals were never formulated, but the project intended to answer very much the same questions as the information project of the previous 4-year program. A workshop on information for NKS project leaders and participants was carried out and a combined course and field trip to Sellafield for journalists was arranged. No reports were published. In 1999 a series of organizational and other changes affected the job situation of the project leader and two other central information officers. They all left their positions and no longer were available for NKS work. The Board appointed a new project leader and accepted a new project plan in the fall of 1999. When the new project leader's organization would not support the activities, the Board at its fall meeting in 2000 decided to cancel the information project.

#### **SEK: The NKS Secretariat / NKS-EU Contacts**

**Torkel Bennerstedt, NKS**

During the 1994 – 1997 program period it was decided jointly by EU/EC and NKS to continue the exchange of information initiated during that period. To that end a joint EC-NKS workshop was held in Brussels in July, 1998, with a greater EU / DGXII attendance than was possible at the STUK

seminar in the previous NKS program period (see above). The objective of the workshop was to exchange scientific information and future work plans, identify possible gaps and overlaps in the EU and NKS programs, identify possible fields of cooperation, and lay a foundation for more intensified cooperation in the future. The scope of the workshop was EU and NKS activities (present and planned) in the fields of reactor safety; radwaste management and decommissioning; radiation protection; radioecology; and emergency preparedness.

*NKS representatives:* Magnus von Bonsdorff, Sigurður M Magnússon, Erling Stranden, Christer Viktorsson, Torkel Bennerstedt.

*EU representatives:* Hans Forsström, Georges van Goethem, Gilbert Desmet, Giuseppe Cottone, Bertus Haijink, Sandro Zero, Henning von Maravic, Gerhard Keinhorst, Neale Kelly, Kurt Flugrad, Alejandro Zurita, Joaquin Martin Bermejo.

The appendices of NKS report no. NKS-5 include a summary by the Nordic secretary and the EU conclusions of the workshop in a report by van Goethem. Also see the Board meeting notes from Sept. 17, 1998 at IVO, Finland. This NKS-EU workshop was followed up by a national STUK-EC seminar in Helsinki in September 1998.

### **Facts in figures:**

(Based on information in the evaluation report, NKS-66)

SOS-1	Approximate total NKS spending: DKK 3.7 million 1 summary report 6 technical NKS reports 7 seminars (6 summarized in NKS reports) 3 conference presentations
SOS-2	Approximate total NKS spending: DKK 5.3 million 1 summary report 17 technical NKS reports plus 4 other technical reports Over 10 publications (conference presentations and articles)
SOS-3	Approximate total NKS spending: DKK 2.3 million 1 summary report 3 technical NKS reports 4 seminars (all summarized in NKS reports)
BOK-1	Approximate total NKS spending: DKK 7.7 million 20 technical reports 9 seminars A number of courses and exercises 45 active project participants
BOK-2	Approximate total NKS spending: DKK 7.1 million A great number of reports and publications 4 seminars or courses 70 active project participants
SBA-1	Approximate total NKS spending: DKK 2.0 million 1 literature database on the Internet 1 knowledge database on the Internet 6 reports 6 seminars and workshops Some 40 active project participants
SBA-2	Approximate total NKS spending: DKK 0.7 million 1 workshop for project leaders and participants 1 course and field trip to Sellafield for journalists

## **Economic issues**

During the 1998 – 2001 program two unforeseen economic problems evolved, one of a troublesome nature, the other less unfortunate. A brief account follows in that order.

As a part of the continuous evaluation of the NKS program, the Board ordered a midway status seminar to be held at VTT in November 2000. The evaluation was in most parts positive, and no major changes or corrections of the course ahead were called for. After the seminar there was a serious discussion on some aspects of the **SOS-1 economy** which called for and initiated further action. The Nordic secretary reported on the actions taken during the summer and fall. The Bureau had ordered an investigation by the auditor, and the results were now discussed by the Board. This problem would not have occurred had the project leader been more diligent in following up the expenditures; and the Nordic secretary was too late in realizing the seriousness of the situation. The information from the Secretariat to the project leader had been correct, but it was understandable that he could miss the warning signals, given the format for presenting the figures. The figures were there for everyone to see, also the Board, but nobody reacted in the early phases of the development; and the Nordic secretary did not sound the alarm as early as could be expected. However, the internal system of checks and balances worked, although a bit late. The secretarial routines and formats for presenting economic reports were revised. SOS-1 was later granted additional funding, and the project leader reduced his fee so the total cost matched the given budget. For more information, e.g., on figures and dates, see the minutes of the Board meeting in Roskilde Nov. 7, 2001.

A less serious problem to tackle was what was referred to as “the luxury problem”: the growing amount of funds on the four national NKS accounts. The development of present funds at the end of the fiscal year, as can be seen from the records distributed annually by the Secretariat, was the following:

1997	DKK 4.7 million
1998	8.4
1999	11.4
2000	11.1
2001	5.6
2002	4.0

The situation led to several Board discussions on the reasons and the way forward. The owners (or the home organization, be it a department, ministry etc.: or the taxpayers, for that matter) did not want to spend money on accumulating NKS funds. If nothing was done to rectify the problem, chances were that NKS funding would dwindle in the future. The root of the problem was two-fold: the Board could have commissioned more work to be carried out; and the organizations performing the work – especially in the BOK area – were usually late in billing NKS for their work. The obvious long-term solution was to review the budget process as regards new project proposals (which was done under the new R&B program starting in 2002), acutely add a couple of new projects to the ongoing program (see below) and not least, to make sure that all organizations under contracts with NKS send their bills regularly, as stated in the contract. As can be seen from the table above, this had an immediate effect, and the problem has not occurred again.

## **Additional activities**

In addition to the the regular NKS program described above, the Board sanctioned NKS participation in one large-scale international exercise (Barents Rescue, presented under BOK-1.2 above) and two seminars, all in cooperation with non-NKS organizations.

In the first of the two seminars, NKS commissioned its Norwegian owner, NRPA, to arrange and host – with generous NKS financial support – a seminar entitled “ Radiation Protection in the 21st Century: Ethical, Philosophical and Environmental Issues” in Oslo, Norway in October 2001. NRPA cooperated with the Agricultural University of Norway and The International Union of Radioecologists. In a number of sessions and with several invited speakers the following topics were covered:

- Risk assessment and management
- Practical application
- Public perception, communication and participation
- Waste management
- Protection of the environment from ionizing radiation
- General philosophical and legal issues
- Ongoing work
- Uncertainty and the precautionary principle

In a concluding session, called Consensus Conference, participants were served a draft Consensus Statement, which caused some controversy. After intense discussions the majority of the participants signed the final, somewhat diluted document which was published separately as a folder. At a later stage the NKS Board decided not to sponsor this type of events in the future and declared its unwillingness to participate in consensus seminars or similar events in general.

The second extracurricular NKS activity was a seminar in Malmö, Sweden, in November 2001 on the theme “Quality in Radiation Protection Work in Nuclear Installations”. The project was initiated by the Nordic Society for Radiation Protection (NSFS) and carried out in close cooperation with staff from the Barsebäck NPP (BKAB) in Sweden. The intention was cost-sharing and close cooperation between NSFS and NKS. It soon turned out, however, that NSFS would not contribute in any fashion. Had it not been for the sponsoring, enthusiasm, vast network and dedication of the Barsebäck representatives, there would not have been a seminar. Now some 70 people gathered to listen to presentations and take part in in-depth discussions on practical, hands-on radiological work in a diversity of situations during normal operation conditions. The presentations covered areas like the following:

- What is required in radiation protection work
- What quality in radiation protection work means and how to achieve QA
- What environmental and quality certification processes mean in practice
- The future of nuclear power in the Nordic countries
- Challenges in nuclear safety in a longer perspective, including decommissioning

A questionnaire showed that the majority of the participants were satisfied or very satisfied with the seminar and wanted to see a new seminar on the same theme in about two years. (*Author’s comment:* A second seminar on the same theme was arranged by NKS and BKAB in Malmö, Sweden, in February 2004.)

## Major Seminars, Exercises and Other Events

Pre-project seminar on Sept. 16, 1998, the day before the Board meeting at IVO, Finland.

Status seminar on Feb. 9, 1999, the day before the Board meeting at DEMA, Denmark.

Status seminar on Sept. 14, 1999, the day before the Board meeting at SKI, Stockholm, Sweden.

Midway seminar with tentative evaluation of current results on Nov. 7 – 8, 2000 before the Board meeting in Helsinki.

The Eighth Nordic Seminar on Radioecology, STUK, Rovaniemi, Finland 2001 (with an NKS session).

SOS-1:

- SOS-1.1 seminar on Risk Assessment in Bergendal, Sweden in April 1999.
- SOS-1.1 presentation at the international VALDOR conference in Stockholm, Sweden in June 1999.
- SOS-1.1 seminar on Risk communication in Oskarshamn, Sweden in October 2000.
- SOS-1.3 seminar on Safety Analysis at Risø, Denmark in March 2000.



- Joint SOS-1.2/SOS-3.1 seminar on EIA and SEA in Turku, Finland in August 2001.
- SOS-1.3 seminar on Safety Indicators at VTT, Finland in March 1999.
- SOS-1.3 seminar on Safety Culture in Olkiluoto, Finland in October 1999.
- SOS-1.3 seminar on Quality Assurance in Ringhals, Sweden in January 2001.

#### SOS-2:

- SOS-2.1 Seminar on Risk Informed Principles in Bergendal, Sweden in April 1999.
- SOS-2.1 participation at the ESREL conference in France, March 2002.

#### SOS-3:

- Four SOS-3.1 EIA seminars: Gardermoen, Norway in November 1998; Roskilde, Denmark in August 1999; Mývatn, Iceland in September 2000; and Turku, Finland in August 2001.
- SOS-3.1/SOS-1.2 seminar on EIA and SEA in Turku, Finland in August 2001.



SOS-3 EIA Seminar in Mývatn

Photo: Lena Bennerstedt

#### BOK-1:

- BOK-1.1 seminar on detectors and techniques for analysis of radionuclides in Sweden March 2001.
- Two BOK-1.1 seminars on accreditation: Skagen, Denmark 1999 and Oslo, Norway 2000.
- Two intercomparison exercises on gamma spectrometry.
- BOK-1.2: RESUME99 – International exercise on mobile gamma spectrometry, Sweden, September 1999 plus follow-up seminar.
- BOK-1.2: “Gamma Search Cell” exercise of Barents Rescue 2001 LIVEX in Sweden September 2001 plus follow-up seminar.
- BOK-1.3: Participation in an international experiment on monitoring and mapping an Ar-41 release in October 2001. NKS, SCK-CEN/Mol, Belgium and Risø, DTU and DEMA, Denmark.
- BOK-1.4: Nordic table-top exercise Huginn in 2000 to calculate radiological and economic consequences of a nuclear accident.
- BOK-1.6: Baltic Nuclear Workshop in Lidingö, Sweden 2001 on on crisis management and crisis communication.

#### BOK-2:

- BOK-2.1.2: Two courses in internal dose calculations (STUK, Finland in October 1999 and one planned for the fall of 2001 but postponed to the spring of 2002).

- BOK-2.3: Training course in mass spectrometry at NLH, Norway in November 2000.

#### SBA-1:

- Workshop 2000 in Oslo, Norway, on nuclear threats in Nordic surroundings.
- Participation in Barents Rescue 2001 LIVEX in Sweden September 2001 with a Nordic workshop on information preparedness in nuclear emergencies.

#### SBA-2:

- Workshop 1999 on information issues for NKS project leaders and participants.
- Combined course and field trip to Sellafield for journalists in 1999.

**EC-NKS Workshop at DGXII in Brussels in July 1998 on the topic of possible future cooperation and exchange of information.**

NKS/NSFS/Barsebäck NPP seminar on quality in radiation protection work at nuclear facilities (November 2001) in Malmö, Sweden.

Radiation Protection in the 21st Century: Ethical, Philosophical and Environmental Issues. Consensus Conference on Protection of the Environment. Formally arranged by NRPA and NLH on behalf of NKS, in cooperation with IUR. (Oslo, October 2001.)

Transition seminar “NKS today and Tomorrow” (March 19 – 21, 2002) on the results of the old NKS program and plans for the new program; in Roskilde, Denmark.

### **Evaluation of the Scientific Program 1998 – 2001**

**Evaluators: Gustaf Löwenhielm, SKI, and Raimo Mustonen, STUK. See report no. NKS-66.**

The scientific achievements of the sixth and last 4-year program were evaluated by Gustaf Löwenhielm, SKI (focusing on SOS and SBA issues) and Raimo Mustonen, STUK (focusing on BOK and SBA issues). The scientific evaluation followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. One of the major recommendations was to introduce the added Nordic value as a new criterion when assessing new proposals. The evaluators supported the proposed future division of NKS work into two areas (R&B). These are some of their findings.

More than 200 experts from the Nordic countries participated in the SOS, BOK and SBA projects of the sixth NKS 4-year research period. The program clearly proved that this kind of cooperation is needed to develop the joint Nordic view on radiation and nuclear safety issues and to maintain and develop direct personal contacts between the authorities and researchers. In this sense NKS is not only a forum for research cooperation, but also an important contact organ between the competent authorities. The general objectives of NKS cooperation are described in the contract of main sponsors (nowadays called the owners), but it is obvious that further and wider information about the objectives is needed.

General remark: It is not always clear what the aims of a project or subproject are (expected results, deliverables etc.). At times it is unclear when and why a subproject was added. Things like that should be clearly reflected in the minutes of the Board meetings.

#### *The SOS program (Nuclear safety and radiation protection):*

SOS-2 focused on reactor safety and SOS-3 on waste safety. SOS-1 was more aimed at meetings to discuss “soft” issues, e.g., safety culture and risk assessment, which led to interesting discussions between Nordic organizations. SOS-2 addressed technical questions such as PSA and severe accidents, and many interesting results were published in NKS reports and other publications. One of the SOS-3 subprojects addressed EIA in yearly meetings, and participants from all Nordic countries attended these meetings. The other subprojects gave a good survey of Nordic interim storage for low and intermediate level waste and also for clearance levels for metals.

- SOS-1      **Risk assessment:** The work was carried out in cooperation with the EU project RISCOM-II. Focused on Oskarshamn NPP and communication with the public. The report is of great interest.  
**Safety analysis:** No clear definition of the objectives has been found. A continuation of the subproject is not necessary.  
**Strategies for safety management:** A concise set of objectives is hard to find. Dealt with issues relevant to safety management. The utilities participated, which is very valuable. The latest international trends and development should have been included – the Nordic situation does not give a full grasp of the situation. It is however important to continue this work.
- SOS-2      General remark: A very productive project when it comes to the number NKS reports and international publications. Much less focus on seminars. The results of SOS-2 are interesting and valuable to the end users.  
**Safety development:** Continuation of RAK-1. Connected to SOS-1. Good that the dependence of PSA results on the object and evaluators is brought up. Risk informed methods are of great value to utilities and authorities alike.  
**Management of plant maintenance and renewal:** Continuation of RAK-1. Of interest both to utilities and authorities, especially in view of the deregulation of the electrical power market and the rising demand on increased profits.  
**Severe accidents:** Continuation of RAK-2. Compiling state-of-the-art information is worthwhile and should be done on a regular base. Important to maintain Nordic competence as regards organic iodine. The results are valuable and work should be continued either by NKS or the power plants. The hydrogen issue is interesting in the case of BWR; it is not obvious why the PWR case was included.
- SOS-3      Oddly enough there does not seem to exist any overall objectives for the entire project, just goals for the three subprojects. The work was led by the project leader personally, not with the assistance of a project group, as the others. This had advantages and disadvantages (resources vs. overview). In this case (SOS-3.2 and SOS-3.3) a project group had been preferable.  
**Environmental impact assessments:** Continuation of AFA-1.3. The aim was to highlight the differences in EIA policy and work in the Nordic countries. This was achieved through a series of seminars where some non-nuclear cases were also studied. The seminars were successful and had deserved a larger audience. The Nordic perspective was strongly stressed, and the Icelandic participation was valuable.  
**Intermediate storage:** The objective was to analyze Nordic experiences of storage and deposition of low and medium level waste. Swedish NPPs were not included. Iceland was not mentioned. The work at Kjeller, Norway, was delayed which affected SOS-3.2.  
**Contamination levels in metals:** Measurements show no or insignificant amounts in the studied samples. Hence, doses to the public will be small. This is an interesting result in itself, and should be communicated. The compilation of Nordic regulations on clearance is valuable.

*The BOK program (Nuclear preparedness and consequences):*

Management of nuclear emergencies and consequences of radioactive releases into the environment are of common interest to all Nordic countries. The projects in this field (BOK-1 and BOK-2) gathered plenty of participants from all the Nordic countries. In this sense BOK-1 and BOK-2 had a very wide Nordic dimension. Activities in BOK-1 aimed at more coherent procedures in the authorities' arrangements in emergency management and produced a real Nordic added value. BOK-2 was a more heterogeneous project than BOK-1, but on the other hand BOK-2 produced new knowledge which can be applied in development of emergency management. BOK-2 also succeeded to attract young scientists to join NKS work. This is of special importance in a business where concern about the future of competence has increased. That is why it is important that NKS continues to develop contacts with different universities in the Nordic countries.

BOK-1 The project had its background in the earlier BER and EKO programs. It attracted participants from all Nordic and Baltic Sea countries, Belgium, Canada, EU and Scotland. The coordination and administration of the project was excellent. The Nordic perspective was well taken care of.

**Laboratory measurements and quality assurance:** All activities were valuable. It was demonstrated that the Nordic countries are well prepared to make good quality measurements in case of an emergency. But there is a common need to continue the work. Cooperation pays off.

**Mobile measurements and measurement strategies:** Basically the same conclusions as for the subproject above.

**Field measurements and data assimilation:** This was the only BOK-1 subproject that was not Nordic, with just Danish and Belgian participation. It was the first NKS sponsored PhD study.

**Countermeasures in agriculture and forestry:** Continuation of EKO-3.4 and EKO-5. The database created here should be integrated with RODOS and ARGOS. This subproject has strengthened the Nordic outlook and approach to these issues. Good compilation of Nordic procedures.

**Emergency monitoring in the Nordic and Baltic Sea countries:** Update and extension of BER-2.1, initiated by the Council of the Baltic Sea states. This valuable handbook covers 11 countries. Good compilation of involved organizations and their tasks.

**Exercises:** This subproject has strengthened the Nordic outlook and ability to cooperate and exchange information under emergency conditions.

BOK-2 The project had its background in the earlier RAD and EKO programs and was more heterogeneous than BOK-1. The many environmental surveys are more costly than other types of NKS work. This required cooperation and co-financing of a number of organizations. NKS funding was only a small fraction of the project budget. BOK-2 was a good Nordic forum for networking and training, with some Baltic participation. The importance of involving universities could be stressed even more, and the NKS Board should consider ways to support this.

**Important Nordic food chains:** It is obvious that the term "radiological vulnerability" has been used without prior definition. However, the spectrum of the nuclides studied is wide and the results are of great use in radiation protection. It was shown that frequent intercalibrations are needed in whole body measurements.

**Radioactive tracers in Nordic sea areas:** The Tc-99 studies were valuable, not only because of public concern regarding some actual releases. The Nordic competence has increased. The vulnerability of the Baltic Sea was clearly demonstrated.

**Development of application of ICP-MS:** It was demonstrated that this technique, with some caution (interference with other isotopes than the one being studied), is applicable both for heavy and lighter isotopes.

**Methodology for defining exemption levels of radionuclides in timber:** Different clearance levels and dose limits were studied. The results should be of commercial interest to the forest industry.

*The SBA program (Safety and preparedness related activities):*

The SBA projects were an attempt at dealing with aspects of the SOS and BOK areas simultaneously in transdisciplinary studies.

SBA-1 The project was divided into two parts. One aimed at creating an Internet literature database with publications on nuclear installations in the Nordic countries and surrounding areas. Approximately 500 publications were included. The other part of the project was to create an Internet base of knowledge on risks and nuclear threats to the public and the environment. It is important that these excellent databases are made and kept operational, and that NKS or relevant authorities take on the responsibility of updating and developing the databases. This task might be handled by the NEP group. SBA-1 depends on the SOS and BOK programs for input, and this work was not completed at the time of the evaluation. Overall, the project reached its goals fairly well.

SBA-2 No goals or objectives were defined for this project, which instead set out to answer a number of essential questions. Due to a number of circumstances mostly beyond the control of the project as such (plus perhaps a lack of proper planning) a restart was required. The project never quite recovered after this, in spite of a new project leader and changed plans. Thus, the Board decided to close the project in the fall of 2000. By then SBA-2 had arranged a combined course for journalists and a field trip, plus a workshop for project participants. The project failed to achieve most of its planned activities. No reports were produced. The necessary task of developing the NKS website was taken over by the Secretariat. *As for NKS information activities in general, the proper authorities and financiers should define what services are required from NKS – any actions should be end-user driven. Future plans – if any – should be more concrete.*

***The evaluators' recommendations:***

- Coordination of NKS cooperation with national and European programs will become more and more important since the resources are limited. It is therefore recommended that NKS applies a new criterion – **the Nordic added value** – when assessing new project proposals. This criterion should answer the question why a certain project should be carried out at the Nordic level rather than the national or European level.
- Radioecological studies should aim at resulting in environmental models to be incorporated with national decision making tools.
- Strive for development of a joint Nordic strategy for actions in case of a radiological emergency (Strategy of Emergency Response):
  - Joint generic criteria for protection of the general public
  - Jointly agreed cooperation procedures in emergency situations (who will do what?)
  - Joint basis for decision making in radiological emergencies
  - This Nordic strategy is to be accepted at the highest possible authority level
- Develop procedures for evaluation of new project proposals (continuous call).

***The evaluators' concluding remarks***

The proposed division of the new NKS program into two main areas, each led by a relatively independent program manager, is supported.

As a part of the evaluation, a questionnaire was sent to the most important potential end users of the NKS results. The following organizations did not respond:

- DEMA and SIS in Denmark
- TEM and TVO in Finland
- NRPA in Norway
- SSI in Sweden

(*Author's comment:* It is of interest to note that four out of six owners did not respond to the questionnaire.)

**Evaluation of the NKS Structure**

**Evaluator: Martin Høiby, NRPA. See report no. NKS-67.**

Normally, only the scientific work and results have been evaluated, with the possibility for the evaluator(s) to comment on structural and administrative questions as needed. But in this transition period between the old 4-year programs and a more flexible structure, it was decided to evaluate non-scientific issues as well. To this end, Martin Høiby, NRPA, was engaged. The structural and administrative evaluation followed directives compiled by the Nordic secretary, discussed by the Bureau and issued by the Board. Overall, the evaluation was quite positive; however, the cost for the administrative services was found to be a bit high. These are some of the evaluator's findings.

The main object of the collaboration under the auspices of Nordic Nuclear Safety Research (NKS) is to promote greater safety, expertise and knowledge in the field of nuclear safety. The institutions that fund NKS decide what projects the organization is to carry out.

In principle NKS purchases all requisite services. This includes executive secretary and secretariat services as well as project management. The executive secretary prepares and monitors implementation of decisions, coordinates east-west cooperation and contact with EU and, in conjunction with the secretariat, provides administrative support to the entire organization. The safety, radiation protection and emergency preparedness authorities in the Nordic area (the consortium partners, now called the owners of NKS) and other interested parties finance the program with financially debitable funds and cover the costs of releasing staff for NKS operations.

NKS operations were at the time of the evaluation planned on a cyclical basis. The governing bodies adopted a program for a given period on the basis of the wishes and needs reported by the interested parties. The program was divided into projects, and the actual research and report work was done by a project group headed by a project manager. The program was funded, implemented and evaluated.

In connection with the evaluation of the 1998 – 2001 program the Board decided to commission an evaluation of the organization. The mandate for this evaluation was to

- establish whether the work of NKS has been well planned and cost-effective in organizational and administrative terms, and the results properly disseminated
- assess the role of the Board and its working group (the Bureau) as well as the administrative support given to the program as a whole and for the respective projects
- learn lessons from the experience and make recommendations for a possible new research program

In terms of method, the basis for the evaluation was three-fold:

1. A questionnaire circulated among Board members and project managers
2. A review of material forwarded by the secretariat concerning finances and administrative matters
3. Attendance at the Owners Group and Board meetings in May 2001 in Reykjavik

The conclusion of the above review is that

- the overall impression is excellent
- the NKS organization – i.e., the Board, its working group, executive secretary and secretariat – generally prepares the ground well for research and report work carried out under the program, including the necessary planning
- the technical support of some of the projects could have been somewhat more intense and/or consistent in the program period
- the internal dissemination of results from research and report work (i.e., among colleagues and the parties) is good, but could be improved somewhat where external institutions are concerned
- the administrative support is excellent; the costs make up about 20% of total debitable expenses
- budgeting is unrealistic

In order to put the overall basis for the program period on a firmer footing, this review proposes drawing up a strategic, long-term plan for NKS collaboration. The strategic plan should, in addition to technical aspects, indicate where the line should be drawn between program projects on the one hand and work done at the national level and in other international nuclear safety contexts – both at the governmental level and other levels – on the other. Plans for the NKS program in the program periods should then be linked up to the strategy document. In order to achieve better separation of roles and responsibilities, the task of the consortium partners could suitably be confined to appointing the Board, which in turn would have all the tasks traditionally assigned to a board. On grounds of practicality and efficiency this review recommends downsizing the Board somewhat, with nine persons given as an example.

When it comes to bringing research and report results to a wider audience than the inner circle of NKS, and to market NKS competence to take on commissioned assignments, steps should be taken, for each project, to consider selective information measures vis-à-vis relevant users.

Achieving improved financial management requires realistic budgeting to ensure that costs accrue in the period to which the allocation applies and that actual costs are formally debitable. This will

significantly improve the opportunity to discover variance and – not least – enable audits to be carried out early enough for a balance to be maintained year by year across the period. A further effect of realistic budgeting, which is crucial to future NKS funding, is that it enables financiers to run their own financial management according to the cash principle, which is a basic premise where the Norwegian consortium partner is concerned. In order to facilitate and quality assure the basis for the governing bodies' decisions, a requirement could be introduced to ensure that written documents from the secretariat are available for all business to be dealt with where they may be of use. Such documents should show what type of case is involved; whether for information purposes, for discussion or for a decision to be made. The documents should in such case accompany notice of the meeting in question.





House with Japanese Garden, Roskilde  
Photo: Lena Bennerstedt

## Shaping a New NKS: The Transition Seminar in Roskilde 2002

The discussions on a new NKS program structure were formally initiated by the Owners at a meeting in February 2000, when there still remained two years of the sixth 4-year program. It was decided to start national processes to review the overall structure and organization of NKS work and outline a new program. A series of interviews, meetings and discussions were arranged in the five owner countries, especially in Finland where a number of very constructive meetings were held with all involved parties. The Bureau initiated an iterative process where the Bureau presented a proposal to the Board; the proposal was discussed and commented by the Board; the Bureau worked out a revised proposal; etc. This eventually resulted in a comprehensive document, NKS(01)2, identifying the major areas of work, each led by a program manager reporting directly to the Board:

- NKS-R: Reactor safety
- NKS-B: Emergency preparedness

Once finalized, it was decided to present the plans to a wider audience at the transition Seminar "NKS Today and Tomorrow" in Roskilde, Denmark, March 19 – 21, 2002. There were three main agenda points for the seminar:

- Results of the 1998 – 2001 NKS program
- Invited international speakers
- Plans for a new NKS structure

This seminar marked the formal termination of the old program and the commencement of the next. It also meant new leadership for NKS, since Magnus von Bonsdorff had declined to continue as chairman; instead, the Owners had appointed Helge Smidt Olsen as his successor.

### **The Roskilde Seminar March 19 – 21, 2002**

After a short opening statement and welcoming address by the chairman and the Nordic secretary followed a number of presentations, and – where time so allowed – discussions. These were the presentations.



### **The sixth 4-year program**

- BOK-1: Bent Lauritzen, Risø, Denmark
- BOK-2: Sigurður Emil Pálsson, IRSA, Iceland
- SOS-1: Kjell Andersson, Karinta-Konsult, Sweden
- SOS-2: Kaisa Simola, VTT Automation, Finland
- SOS-3: Karin Brodén, Studsvik RadWaste, Sweden
- SBA-1: Inger Margrethe H Eikermann, NRPA, Norway
- NKS Secretariat: Finn Physant and Annette Lemmens, FRIT, Denmark
- Scientific / technical evaluations: Gustaf Löwenhielm, SKI, Sweden, and Raimo Mustonen, STUK, Finland
- Organizational / administrative evaluation: Martin Høiby, NRPA, Norway

Since all the above material has already been presented elsewhere in this report, it is not further commented or quoted here.

### **Invited speakers**

- Nuclear Power: Past Accomplishments, Future Challenges  
Gail de Planque, former commissioner at the US Nuclear Regulatory Commission
- Radiological Protection at the Start of the 21st Century: A Progress Report  
Roger H Clarke, Chairman, ICRP

The international session was opened by Sigurður M Magnússon, IRSA, Iceland, who also introduced the two distinguished speakers. They had been invited by NKS to share their expertise and offer inspiration when planning for future R&B work.

In her presentation, **Gail de Planque** pointed to the fact that nuclear power undeniably is a mature industry with worldwide positive trends. Operational parameters have improved substantially. The public safety record is superb. Economics have improved dramatically. International infrastructures are in place to ensure continued progress, safety and cooperation. So, she asked, what about the next 40 years? The worldwide demand for electricity is going to continue to increase. This will require the contribution of nuclear power; some even argue that this will be the generation mode of choice. However, many factors, beyond logic and statistics, will influence the actual outcome. These factors can be broadly categorized as technical, economic, infrastructural, social and political with many elements falling in more than one category, forming a complex matrix of challenges to the future of nuclear power.

The technical issues are most easily identified and addressed. They involve plant aging management and the need to develop and commercialize plant designs for the future. Also included is the need to advance other aspects of the fuel cycle technically. Not so obvious are human resources and expertise, where technology can play a meaningful role in ensuring these essential resources.

Economic issues are also relatively straightforward. The bottom line is that nuclear power must be competitive with respect to both time and money in terms of

- construction costs
- fuel and other operation costs
- waste management and disposal
- liability issues

Critical to economic viability is the overarching need for known and stable regulatory environments, which in turn are influenced by socio-political and infrastructure considerations.

The more difficult areas are social and political, which of necessity must be considered in combination because they are inextricably intertwined. Since 9/11, security has perhaps emerged at the top of the list of socio-political issues, with proliferation not far behind. Then there is the issue of energy independence. Not far behind is the concept of "sustainable development", which is overlaid with philosophical, social and politically controversial baggage. But perhaps most critical to the future of nuclear power is the need for public support and political will which are almost totally interdependent.

To flourish in the future, nuclear power needs adequate international infrastructures

- to provide international consensus standards
- to enable rapid exchange of technical knowledge and experience
- to foster creative economic mechanisms and solutions
- to provide transparency with respect to all matters affecting societal risk in the areas of safety, health and environmental integrity
- to provide channels of credible scientifically-based information

Will the above requirements be met in a way that will secure a future for nuclear power? Well, this wasn't purported to be simple or easy.

**"It is difficult to make predictions, especially about the future."  
(Baseball player Yogi Berra, as quoted by Gail de Planque)**

After this, **Roger Clarke** reported on the ongoing deliberations regarding new recommendations for radiological protection, to replace those given in ICRP Publication 60. ICRP (International Commission on Radiological Protection) has stated that its basic recommendations are either restated or revised at intervals of about 15 years. ICRP 60 was adopted in 1990; a revision is expected to appear in 2005. (*Author's comment:* I.e., some 3 years after the Roskilde seminar. Actually, ICRP 60 was not superseded by ICRP Publication 103 until 2007.) The new recommendations will

- emphasize egalitarian values more than utilitarian ones
- be holistic rather than anthropocentric
- be formatted as a relatively concise set of actual recommendations underpinned by separate publications elaborating on the detail

The initiative represents a genuine attempt to simplify the system of protection to one that is more coherent and easily explicable.

In 1977 ICRP quantified the process of optimization from single radiation sources and adopted, implicitly, a utilitarian ethical policy when it recommended the use of cost-benefit analysis which aims to answer the question, "How much does it cost, and how many lives are saved?" This involved calculating collective dose and thereby emphasized the protection of society over that of individuals. So ICRP modified the principle of optimization by introducing the concept of a constraint. This is an individual-related criterion, applied to a single source in order to ensure that the most exposed individuals are not subject to excessive risk.

The recommendations for justification given in ICRP 60 require that the practice should do more good than harm. This procedure implies a quantified balance of costs and benefits, but in practice, governments, physicians, or individuals do not make decisions about courses of action in a predominantly quantitative way. A qualitative approach is more common and usually more appropriate.

The responsibility for judging justification usually falls on governments or government agencies. In medical exposure of patients, using a generically justified technique, the responsibility falls on the relevant medical practitioners. For non-medical exposures, it is the ability to take action to control the individual dose from a particular source (natural or artificial) that is the important issue.

The first consideration in the proposed system of protection is to provide, for each source where action is practicable, a minimum level of health protection for individuals by means of setting Protective Action Levels. The need for protective action is influenced solely by the individual dose, and not by

the number of exposed individuals. Control at the source will always be preferred, but where it is feasible only to modify the pathways by which people are exposed, consideration can also be given to the development of protective action levels.

The second consideration stems from the recognition that there is likely to be some risk to health, even at small doses. This introduces a moral requirement, for each controllable source, to take all reasonable steps to restrict both the individual doses to below the action level and the number of exposed individuals. Under ICRP 60, the optimization of protection provided that criterion.

A set of suggested basic protective action levels was presented. They do not apply to justified medical exposures. Protective action levels can be considered as establishing a minimum level of health protection, which may be applicable globally. However, for any particular source there is a need to reduce the doses to a level that is as low as is reasonable under the prevailing circumstances. The residual doses, after application of the protective action levels, should be kept "as low as reasonably practicable" (ALARP). The process of optimization in the future may best be carried out by stakeholder involvement to determine or negotiate for the best level of protection under the circumstances. The achievement of consensus would replace the previous formal cost-benefit analysis.

ICRP is rethinking its anthropocentric policy, i.e., that if humans are protected to the degree thought necessary, then other species are adequately protected. Radiological protection of the environment may need to be considered in its own right, leading to a more holistic system. ICRP needs a more comprehensive system that should be in line with control of other pollutants, transparent, and with proper scientific references.

### **The R&B program**

- Where does NKS stand today?  
Status report by Magnus von Bonsdorff, former NKS chairman
- Principles and processes: The R&B program  
Magnus von Bonsdorff, former NKS chairman
- Expectations of the Owners Group  
Ole Harbitz, NRPA, Norway, and Lars Gunsell, SKI, Sweden
- Expectations of the nuclear industry  
Karl-Fredrik Ingemarsson, FKAB, Sweden, and Heikki Raumolin, TVO, Finland
- The NKS-R&B program  
Program managers Timo Okkonen, STUK, Finland, and Sigurður Emil Pálsson, IRSA, Iceland
- NKS in the future: An introduction  
Helge Smidt Olsen, new NKS chairman

The former NKS chairman **Magnus von Bonsdorff** presented his paper in two parts. The first part highlighted the state of NKS at the end of the sixth 4-year program. As stated in the second part, the transition to the new R&B program from 2002 onward was intended to bring about a number of important administrative and organizational changes.

In his first presentation, Magnus von Bonsdorff touched upon the importance of seriously rethinking the objectives of NKS and developing a long-term strategy. In addition to well-known criteria such as the Nordic perspective and the technical / scientific contents of the program, a definition is needed of the actual added value that NKS is intended to generate for its owners, participating organizations and end users. NKS should be the perfect Nordic forum for achieving true harmonization among relevant authorities as regards, e.g., emergency response and crisis information. Mutual understanding of the Nordic neighbors' national criteria and routines is not enough in the long run. Concrete common directives would serve to avoid confusion in critical regional or international situations. A general observation is that NKS interest seems to a certain degree have shifted from hardware centered questions to softer issues like human behavior. It might also be of interest to incorporate activities on

societal issues in order to avoid misunderstandings and misconceptions in the nuclear debate. The value of competence building should not be ignored, especially as regards the young generation actively looking for interesting career alternatives.

In his second presentation, Magnus von Bonsdorff introduced the new dynamic concept of the two major fields of research, R&B, and some of its advantages over the older, more static system of relatively inflexible 4-year programs. The background and merits of the two program managers were introduced. Both the scientific structure and the NKS organization and many of its administrative routines will be simplified and made more cost effective. (*Author's comment:* More on this in sections to follow.) New ways of boosting the nuclear industry's interest in NKS work and attracting more of its experts must be created. The speaker recommended that NKS, its structure, work and results be evaluated every four years or so. (*Author's comment:* The years 2002 – 2005 were evaluated in 2006; see below. By the same token, the following four years, 2006 – 2009, should have been evaluated in 2010. Perhaps it is time to start preparing for an evaluation late in 2011?) In conclusion, the former chairman looked to the future with great confidence and expressed his thanks for the invaluable spirit of cooperation that helped shape his eight years as chairman.

Then two speakers presented the owners' expectations on the new NKS structure and the coming R&B activities.

**Ole Harbitz** of NRPA, Norway said that the financiers expect the produced results to be useful, cost-effective and flexible. Originality, scientific importance and quality are decisive parameters for NKS activities, with the objective of producing relevant new knowledge. Radioecological studies concerning previous incidents and fallout should be continued, especially as regards regions of specific Nordic interest (including arctic and marine environments) and other nuclides than cesium. Studies of accumulation in the food chains and transfer of radionuclides in seminatural ecosystems should also be included. Dose assessment models should be further developed. Since four of the Nordic countries face decommissioning of nuclear facilities, NKS-R should deal with the challenges that await.

NKS should strive to improve and encourage education, new competence, recruiting, increased Nordic cooperation and harmonization of views in the nuclear field. Young scientists need knowledge, international experience and networking. Organizations involved in NKS work must supply ample competence and capacity to carry out the planned NKS activities. Supporting MSc programs could be one way of increasing the present level of education. The Nordic dimension must not be forgotten – at least three Nordic countries should participate in all major activities.

One of the corner stones of NKS is improved emergency preparedness. Dialog and interaction between emergency preparedness, radioecology and communication must be prioritized. Several decision support systems are used (e.g., ARGOS and RODOS). Differences between the systems could be assessed and needs for development identified. Radioecological tools for estimation of transport – uptake – dose should be studied in terms of validation, sensitivity analysis and (perhaps) harmonization. Joint exercises are valuable, including late-phase scenarios and food production. Studies of nuclear threats in Nordic surroundings must be continued. Policies for coordinated crisis management and exchange of information are important. A virtual Nordic command center might be developed, the starting point being a common password protected webpage. Various types of measurements should be harmonized and standardized.

Continued owners group interest in NKS work demands that all proposals for new activities are more specific as to dissemination of information and implementation and use of the results. A special responsibility rests with the involved authorities, in that they must set aside the resources needed to participate in the NKS activities and be prepared to implement the results. The authorities – not NKS – are the owners of the results and should coordinate the way the results are put to use, e.g., via the Nordic Directors Group.

NKS work must take similar activities on an international scale into consideration, be it ICRP, IAEA, OECD/NEA, EU, regional (Barents Sea or Baltic Sea) or bilateral, in order to fill in gaps and avoid overlaps. Can NKS contribute an added Nordic value? Environmental impact assessments and IAEA "Joint Convention" work may serve as examples.

**Lars Gunsell** of SKI, Sweden, said that a very simple answer would be that

- the new NKS program is carried out according to plans and the owners' intentions
- the changes in structure and forms of work lead to improvements
- the owners decide on the direction and way ahead; whereas the Board approves the programs and activities and assume responsibility for the fulfillment of the expectations

By initiating and supporting research, competence building and exchange of information NKS should contribute to improved nuclear safety and emergency preparedness. The results of the work should be easy to recognize and assess. The end users should get more involved in the NKS work, and the results should be used and implemented more frequently than before. It is important that the plans for increased flexibility are carried out in practice, and maintained over the years.

On a higher level, it is hoped that NKS contributes to a common view as regards nuclear safety and emergency preparedness among all involved decision makers and experts at the relevant authorities and other institutions. NKS should encourage Nordic cooperation, and its work should be characterized by transparency and mutual trust. This is especially important since two of the countries have rather extensive nuclear programs. The Nordic perspective becomes all the more important when it comes to competence building – it is impossible for a single country to have the necessary competence, experience and knowhow. Finally, NKS could play an important role in a world of increased global networking and international cooperation. For the Nordic region, EU is the obvious partner.

The expectations of the nuclear industry were presented by **Karl-Fredrik Ingemarsson**, FKAB, and **Heikki Raumolin**, TVO. Unfortunately, their presentations were not retrievable when writing this report, which indicates that their manuscripts were never sent to the Secretariat for filing.

The NKS-R and NKS-B programs are presented at some length in the following sections; therefore, the presentations of the program managers have been omitted here.

The new NKS chairman, **Helge Smidt Olsen**, shared some of his views on the development and future work of NKS in a short-term perspective. What are the current issues that will have to be addressed? How should NKS be organized to improve quality, efficiency and relevance of its work? It is necessary to be attentive to the wishes of the owners, to deliver and disseminate results of high standard and to strive for more cost-effective structures and routines. The evaluation reports for the last two 4-year programs offer a number of good recommendations, and some of them have already been implemented. The future of NKS is highly dependent on the future of nuclear power in Finland and Sweden as well as internationally. Hence, the degree of acceptance of nuclear power as a sustainable and necessary source of energy will be important. So will the authorities' need for quality control and good inspection tools. This applies to nuclear safety as well as radiation protection, radioecology and emergency preparedness. Some claim that the international deregulation of energy markets might lead to greater focus on economy and increased profits, as opposed to safety research and safety measures. This should increase the demand for joint research activities, such as offered by NKS. But NKS must actively work to get this fact across to the nuclear industry. Issues on radiation vs. the environment are a matter of global concern. (*Author's comment:* This is in line with the presentation on new ICRP recommendations above.) NKS should follow this debate closely. It is also important to contribute to the education of young scientists and to promote work in the field of nuclear energy and nuclear safety as important and attractive career openings. Maintaining and building of competence should therefore be a prioritized area. To sum up, there will be no shortage of tasks for NKS in the future.

After this, the Nordic secretary closed the seminar.



At the Crossroads

Photo: Torkel Bennerstedt

## The R&B Program: Toward Increased Flexibility

### A New Structure

#### Program Areas

Nuclear safety and emergency preparedness have been major Nordic priorities for many years. As the contents of the programs have changed over the years, Board discussions on structure and organization have been frequent, in quest for the optimal overall solution. The minutes from the Board meeting in Helsingør, Denmark on Sept. 3, 1992 offer an evidence of this: would it be possible to exchange the rather static 4-year programs for something more dynamic? It was a fairly general discussion, but nevertheless an early precursor of what was to come some ten years later.

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

Therefore, in 2001 the NKS Board adopted a dynamic scientific framework program, divided into two main areas, each led by a program manager:

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

The NKS-R and NKS-B frameworks form part of the policy document in Appendix 6.

The new NKS program, starting in 2002, marks a radical departure from the type of work done in the previous program periods. Now there is no more a 4-year framework for activities. The new framework requires potential participants to be active, not only in defining interesting studies, but also to initiate Nordic cooperation where appropriate and to make sure that the proposed work is relevant for the Nordic authorities and that the results are likely to be used.

It will be an iterative process to adjust the framework and working procedures in the new program. It will be a challenge for all (the Board, program managers and participants) to utilize as fully as possible the opportunities that the new structure provides and at the same time to preserve the best elements of the old structure.

Practical work began in 2002. Financial support is to be given fairly evenly to NKS-R and NKS-B in a long-time perspective.

**“Why not the other way around?”**

**(Motto of Ulf Bäverstam, former Swedish owner representative)**

## Comments from the Nordic Directors Group

The directors of the Nordic radiation and nuclear safety authorities meet regularly, at least once a year, to discuss issues of mutual interest. They are referred to as the Directors Group and their meetings as the Directors Meetings. One of the issues of mutual interest is NKS and its activities.

At the NKS Board meeting at SSI, Sweden, on May 7, 2002 (see minutes in Appendix 2) the Icelandic owner reported the following from a recent meeting of the Directors Group:

- The Nordic secretary informed on the newly adopted NKS program and its structure.
- The Directors were positive toward the program and supported the plans for technical and scientific activities. It is of the utmost importance that the structure of all NKS activities is such as to ensure efficiency and cost effectiveness.
- Some concern was raised as to the transparency and legal aspects of the NKS administrative structure as well as ethical aspects related to the composition of the NKS Board.
- The Directors Group supported the ongoing discussion on NKS structure and activities and stressed the need for a thorough discussion of the long-term strategy of NKS among the consortial partners (owners of NKS).

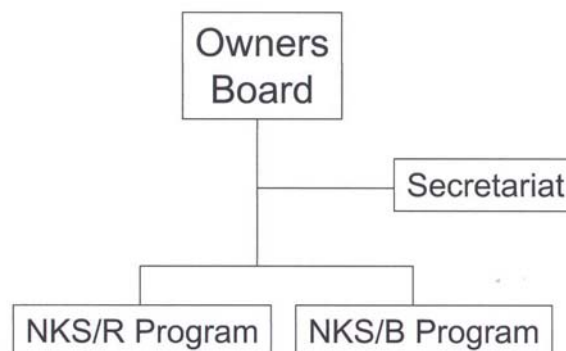
## Basic Definitions

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

The contents, time frames and budget of the program and its many activities are decided by the Board, in accordance with the **NKS-R and NKS-B frameworks** as outlined below. All activity proposals are assessed against a set of criteria established by the Board. Changes in work plans are made when called for. Activities may be expanded, reduced, or cancelled; new activities are added. The program is constantly renewed through a regularly occurring procedure of **Call for Proposals**, which is open to all relevant Nordic organizations. When an activity has been finished and the final report accepted by the Board, the results will be disseminated and can be implemented by the end users.

Presently, all major activities are handled by two program managers, one responsible for reactor safety (NKS-R), one for emergency preparedness (NKS-B).

## New Organization of NKS





Self-explanatory as it is, bordering on the simplistic, the figure offers an almost sublime presentation of NKS, especially when compared to the previous schemes adopted at the start of the fifth and sixth 4-year programs, respectively.

## **The Administrative Support Function**

Central NKS administration has been slimmed and trimmed, expenses cut, routines made simpler and more transparent. In the early days NKS published semi-annual, annual and status reports, plans for next year's work and address lists. A pre-project that could last up to six months was carried out before the projects were launched. Reference groups followed the ongoing work and reported to the Board. All technical, administrative and other reports were printed and postage paid to distribute them. This is all long since gone. Later, the secretary of the Board, the Bureau and the Nordic secretary were abolished. Tougher rules for reimbursement of Board members' travel expenses were introduced.

Board decisions were traditionally made only at formal meetings. If an agreement could not be reached, the question would be adjourned until next meeting. With time, if a document had to be revised or additional facts retrieved before a decision could be made, the question was discussed in an iterative process between meeting, until everyone was satisfied. This was cumbersome and time consuming. So a new approach was tested in a couple of instances, in the form of a Silent Procedure, where one person distributes a proposal and anyone not protesting before a certain date is considered to have accepted the proposal. Now this has become a relatively normal routine. It speeds up things and simplifies life for all involved.

In spite of the many administrative changes, the Secretariat was kept intact. Since FRIT took over the Secretariat in 1996 there has been a constant development of their services, both in quality, quantity and types of tasks. New media took over the old paper-based routines. Documents for the next Board meeting were no longer distributed via snail mail but only in electronic form. There was of course the inevitable initial grunt from some, but after a short while it became the accepted and natural mode of operation. Now, new media as the Internet, email, electronic forms of reporting (webpage, newsletters, CD, DVD) have taken over almost completely. The Secretariat was very quick to recognize the advantages of modern technology, and together with one of the project leaders they led NKS into the simpler, faster, more cost-effective future.

In addition to this, traditional secretarial work and auditing continued as before.

## **The NKS-R Framework: Reactor Safety**

**Program manager:** Timo Okkonen, STUK → Petra Lundström, Fortum → Nici Bergroth, Fortum → Jesper Kierkegaard, Vattenfall → Patrick Isaksson, Vattenfall ( → Karoliina Myllymäki, Fortum in 2011)

This section is based on the presentation given by the initial NKS-R program manager, Timo Okkonen, STUK, at the transition seminar held in Roskilde, Denmark, in March 2002 (see separate chapter above).



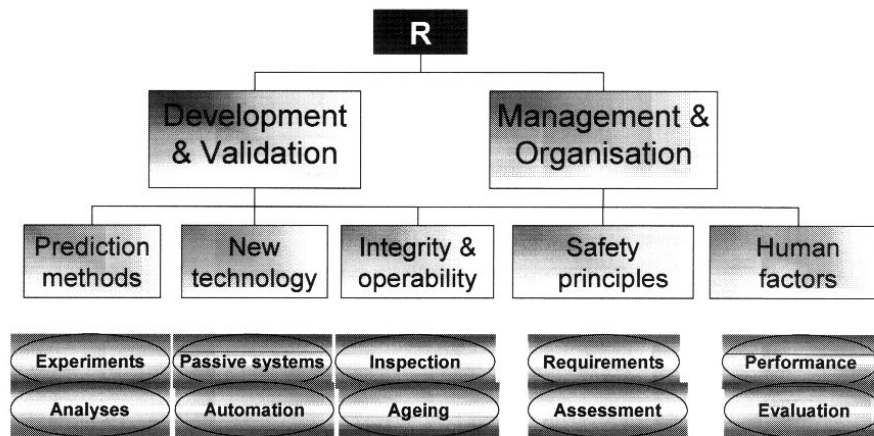


Figure of the NKS-R program: research areas and a few possible candidate seminars. It shows the general focus of the research activities; whereas seminars are foreseen to cover the whole range of the NKS-R framework.

When preparing the initial NKS-R work, it was noted that the framework included some general points of focus; however, it was quite flexible when it came to detailed activities. The top-level goals of the NKS-R program were foreseen to involve the following:

- **S:** Safety advancements  
New R&D results and scientific / technological progress in safety assessment, validation of new technology, and safety / quality management, as relevant to the Nordic reactor applications
- **E:** Exchange of information  
Cross-national communication of knowledge and experiences in the reactor safety field, focused on Nordic interests and networking
- **C:** Competence and education  
Contributions to the competence buildup and education in the reactor safety field in the Nordic countries

All the above goals can be seen to involve the Nordic dimension, and the full set of NKS-R activities will be steered to benefit all Nordic countries. There will be two main types of activities: research and seminars. The research activities should typically show merits of type S (see the goals above), and in addition to this, even E and/or C. The seminars are expected to be stronger on the E and C sides; and, in fact, even a lonely but strong E may provide a good justification for a seminar to be held. The seminars may vary from small meetings or workshops to larger events, and also educational events (courses).

The NKS-R program is planned to involve two main themes (see the figure above):

- |        |                                                                                                                                                                                                                                        |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DELI   | Development & Validation of assessment methods and new technology. This theme covers the challenges related to plant safety assessment and the introduction of new technology into the plants.                                         |
| MANGAN | Management & Organization of safety and quality assurance. This theme covers the challenges related to the implementation and assessment of effective safety and quality management, and to human performance in different situations. |

Under these two main themes, five main topics have been identified:

1. Prediction methods  
*Experimental and analytical methods*, primarily for the prediction of plant response to disturbances and accidents. Within this topic, there are questions associated with uncertainties that need to be further explored, such as the BWR suppression pool behavior under accident conditions, and the containment response in severe accidents.

2. New technology  
Evaluation of and experiences from new technical solutions and new technology, such as *modern automation technology and passive systems*. Such development offers both new opportunities and new challenges, ranging from the validation of new technology to the successful performance of plant modernization projects and their safety reviews. Just like the topic below, the application of new technology is associated with both of the main NKS-R themes (i.e., involves both technical questions and questions related to safe and efficient project management).
3. Integrity and operability  
Evaluation of and experience from verification and *inspection* methods, including *aging* aspects related to plant components (mechanical, electrical etc.). The importance of this topic increases with plant aging – involving great challenges with inspecting the critical structures (physical release barriers) and verifying the operability of important plant systems and related components (i.e., process / electric / automation functions needed to protect the integrity of the physical release barriers). This topic involves connections to both of the main NKS-R themes; for example, via development and validation of inspection techniques, and via management and organizational aspects of ensuring the fitness of systems, structures and components.
4. Safety principles  
Methodologies for achieving a harmonized, well-balanced *requirement* level and management of safety aspects during plant operation, maintenance and testing / inspection. The development of safety *assessment* methodologies makes it possible to (re)consider the way of ensuring a high safety level, from both the principal (regulatory requirements) and the operational (utility implementation) standpoint. Within this topic, the combination of the traditional defense-in-depth principles and the risk-informed approach is of great interest.
5. Human factors  
This topic covers a wide range of challenges from the *evaluation of human performance* in critical activities (“administrative safety barriers”), to assurance of effective safety and quality management under changing conditions (“management of change”).

The research activities are foreseen to coincide with the above-mentioned themes:

The DELI area:

- Pool behavior, focused on BWR suppression pool behavior.
- Melt behavior, focused on the core melt behavior in a severe accident, and in particular on the effectiveness of the containment barrier.
- Potential other parts to be decided upon based on detailed activity proposals; e.g., structural aspects or new safety analysis methods.

The MANGAN area:

- Decisions and activities during operation and shutdown, focused on the management and evaluation of critical decisions and activities.
- Design and technology, focused on the ways of minimizing human errors through design, including testing and inspection methods / tools.
- Potential other parts to be decided upon based on detailed activity proposals; e.g., interface issues and requirement specification in projects or new analysis methods.

Seminars are treated similarly to research activities, i.e., they are decided upon based on specific proposals.

## **The NKS-B Framework: Emergency Preparedness**

**Program manager:** Sigurður Emil Pálsson, IRSA → Justin P Gwynn, NRPA

This section is based on the presentation given by the initial NKS-B program manager, Sigurður Emil Pálsson, IRSA at the transition seminar held in Roskilde, Denmark, in March 2002 (see separate chapter above).

The aim of the NKS-B program is to strengthen radiological emergency preparedness in the Nordic countries. Apart from activities directly targeted on emergency preparedness this also includes activities in related areas such as radioecology and effective communication and information management.

Two main aspects are given highest priority; namely maintaining and building up

1. competence
2. close informal Nordic networks between scientists as well as authority officials in emergency preparedness related disciplines

Potential activities should fall into any of the following three main areas and their sub-areas which constitute the NKS-B framework:

- Emergency preparedness – in general; and specific tools
  - Improving exchange of information and communication techniques
  - Decision support (handbooks on countermeasures, application of current radioecological knowledge in emergency preparedness)
- Measurement strategy, technology and quality assurance  
(this can include laboratory, mobile and whole-body measurements)
  - Quality assurance and improvements in the application of current technique
  - Testing the usefulness of new techniques, helping to create Nordic cooperation in their use
- Radioecological studies of relevance for emergency preparedness
  - Nordic land use: effects of fresh fallout, long-term effects, effects of countermeasures
  - Studies for improvements of marine dose assessment models (i.e., transport with ocean currents, sedimentation processes, uptake in biota and pathways to man)
  - Syntheses of earlier radiological studies of Nordic interest (e.g., workshop / seminar)

The evaluation process will involve assessing, e.g.,

- how well the proposal falls within the defined NKS-B framework above
- building up of competence and maintaining it in the future
- value for cooperation of the Nordic authorities, including NKS criteria
- potential use of results and information – demonstration of interest by potential end users and authorities is an advantage
- how well it falls within the focus defined jointly at the time and also by the countries the potential participants represent
- the scientific and pedagogical merits of the proposal

The ongoing work in the program will form a type of a core for activities. New proposals will, all else being equal, have more chances of being accepted if they are linked to the ongoing core activities.

A proposed activity can involve one, two or all of these three fields:

Studies	The studies can be of various types, including research, assessments and exercises. The studies should maintain and build up competence and thus be of high enough standard to be published in refereed journals. Studies can also be linked to work of PhD/MSc students.
Seminars	The aim of the seminars should be to continue and build on the type of networking already established in previous periods. A seminar should be preceded by preparation work by participants and should result in a report afterwards. – Care should be taken to use other related Nordic seminars for exchange of information and networking, as appropriate.
Education	Competence in radioecology / environmental radiation can be strengthened through education in different ways, e.g., by <ul style="list-style-type: none"> <li>– organizing and supporting joint Nordic MSc-level courses</li> <li>– supporting individual PhD / MSc research projects</li> </ul>

Other forms of educational activities can also be considered, for example

- Workshops of various types, with invited lecturers, preferably producing proceedings in refereed journals
- Training, exchange visits between research centers

## Call for Proposals

During an annual procedure of Call for Proposals the R&B program managers invite the Nordic nuclear community to submit activity proposals and apply for NKS funding. In later years it has happened that there have been two calls in one year.

The applications are scrutinized by the program managers, who prepare an evaluation where the proposals are assessed for compliance with NKS criteria, with the involvement of Board members. This ensures balanced priorities and secures national interests. Based on the outcome of the evaluation the program managers make proposals to the Board on funding. The Board decides which activities are accepted, how much NKS funding will be supplied, and whether any special conditions should be met.

## The First Set of Activities

As a part of the preparations for the first period of R&B activities, the program managers communicated with board members, potential participants (organizations as well as key persons), arranged meetings, and distributed questionnaires, thus announcing the framework of coming activities in as many ways as possible. This was something new. Up till now, participating and supporting organizations and individuals had been used to pre-projects, directed by the Board. Now the participants were expected to take the initiative: to propose activities, make plans, suggest budgets, recruit colleagues and coworkers – with the Board assessing the proposals.

This led to some interesting results. In the case of NKS-R, for example, the program manager found much to his surprise that Sweden was not that eager to propose areas of work or volunteer manpower or other resources. The Finns, on the other hand, were more than willing to give it a go. In spite of a number of reminders, visits and personal calls to the Swedish stakeholders, the program manager was finally forced to present a first work plan that involved mostly Finnish organizations and experts, with a few Swedish and other Nordic participants on the side. The Board urged the program manager to keep inviting especially the Swedes, and try to distribute the funds more evenly between countries and organizations. But it was hard to change the direction of a ship already set in motion. It would take a couple of years to open the eyes of all of the Nordic countries to what possibilities lay ahead.

For a first period each program manager had DKK 2 million at his disposal. The list of initial NKS-R activities looked like this:

- PREPOOL (pre-project)
- Contextual assessment of maintenance culture safety and efficiency in Finland and Sweden
- Safety management: Existing case studies from a non-nuclear context as references for an investigation of assessments of nuclear safety management
- 3D transient methodology for the safety analysis of boiling water reactors
- Barriers, control and management – An analysis of concepts with applications in nuclear plant safety
- PREMELT (pre-project)
- Independent review of CCF models used in calculations for high-redundant systems in nuclear power plants of the Nordic countries (i.e., Finland and Sweden)
- Traceability and communication of requirements in digital I&C systems development
- Framework for a systematic approach and documentation for risk-informed decision making (pre-project)

The NKS-B program manager was well-known from the start in the academic circles and authorities involved in NKS work on radioecology and emergency preparedness during the last 4-year programs. So he probably found it a lot easier to evoke a positive response when asking for proposals. Generally speaking, B-type activities have always tended to be more Nordic than the more bilateral R-type

activities. There is nothing strange about this: Finland and Sweden are the only countries with nuclear power reactors; the reactors in Denmark and Norway were intended for other purposes, and the reactors closest to Iceland sail the seas at some distance.

This is the list of initial NKS-B activities:

- Urban contamination seminar
- Additional funding of a PhD course in radioecology
- Emergency management and radiation monitoring in nuclear and radiological accidents
- New indicator organisms for environmental radioactivity
- Improving regional impact assessments
- Communication technology and emergency preparedness
- Nordic-EU collaboration on design and evaluation of the RESUME 2002 exercise
- Nuclear threats in the vicinity of the Nordic countries - A base of knowledge

## Results of the R&B Programs 2002 – 2005

	<b>Program managers</b>
NKS-R	Reactor safety Timo Okkonen, STUK → Petra Lundström, Fortum → Nici Bergroth, Fortum → Jesper Kierkegaard, Vattenfall → Patrick Isaksson, Vattenfall
NKS-B	Emergency preparedness Sigurður Emil Pálsson, IRSA → Justin P Gwynn, NRPA

### General

During the first years of NKS-R work, most participating organizations and persons came from Finland (for a number of reasons). After a couple of years, Patrick Isaksson abandoned Timo Okkonen's system of Deli and Mangan; whereas Justin Gwynn kept the initial system for NKS-B activities, created by Sigurður Emil Pálsson.

A much closer cooperation than earlier was established between R&B under the leadership of Patrick Isaksson and Sigurður Emil Pálsson. This continued under Patrick Isaksson and Justin Gwynn.

On the average, R activities were generally fewer, larger and more costly than B activities.

NKS-B focused more on dissemination of information, networking, education of young scientists and strives for a wider Nordic participation than NKS-R. The downside to this has been some delays in final reporting of a few NKS-B activities.

The NKS-R and NKS-B budgets for the period 2002 – 2008 are listed in Appendix 5. For more detailed information on NKS-R and NKS-B activities and funding, please turn to Appendix 7 and Appendix 8, respectively.

It is far beyond the scope of the present report to reiterate the purpose, contents and results of each and every R&B activity. A selected number of activities are presented below. The information is based on abstracts, summaries etc. of the activities in question, as available in technical and final reports at the NKS website, including the evaluation report, NKS-145, presented in a later chapter in greater detail.

## NKS-R Summary for 2002 – 2005

Below follows a brief review of the eight NKS-R activities that received the largest NKS funding in 2002 – 2005 (see budgets in Appendix 5). To this should be added the value of in-kind contributions, worth approximately as much as the NKS funding. The numbers of the items in the table below are the same as those used in the chapter on the evaluation of the first four years of R&B activities.

### 1. BWR condensation pool experiments

**NKS-104 DeliPool:** BWR suppression studies were started in 2002 as a pre-project, PrePool, and later continued as DeliPool. POOLEX experiments were conducted at LUT and analyzed by VTT. A coupled fluid-structure calculation was performed. The motion of the wall of a test pool during a rapid bubble collapse was solved and taken into account during the CFD calculation. A fluid-structure interaction analysis was also conducted, in which the stationary state of the pool due to a gravity load was calculated. In addition, methods for estimating pressure loads in a water pool during steam injection were investigated. The Method of Images (MOI) for calculating the pressure loads during a steam bubble collapse was implemented and tested for the POOLEX experiment. The first version of the homogeneous two-phase model was implemented and tested in the quasi-stationary situation, where the steam that was blown down into a water pool was condensing inside the vertical blowdown pipe.

### 2. Assessment of maintenance culture safety and efficiency in Finland and Sweden

**NKS-108 MainCulture:** The activity started in 2002 and was concluded in 2005 with VTT as the leading organization. Of all NKS-R activities in 2002 – 2005, MainCulture received the highest NKS funding, DKK 1900k. Change management has emerged as an important topic in safety-critical organizations. A lot of knowledge on change management exists, but still many projects fail and the safety consequences of various changes are unclear. It seems that the problems of change management are interdisciplinary. There is also empirical evidence that change has been experienced as stressful in nuclear power plants. The cultural perspective taken in this activity strives to combine technical approaches with human resources approaches. It raises new questions that are not usually explicitly taken into account in change management. Financial pressure, generation changes etc. have forced many organizations to downsize, outsource or reorganize.

### 3. Safety management

**NKS-88, NKS-95 SafetyManagement:** The activity was conducted at Stockholm University in 2002 – 2005. The objectives were to create a theoretical framework, to use this framework for analyses of non-nuclear industries, and to investigate the potential relevance of the results for the nuclear power industry and nuclear regulators. The purpose was also to exchange knowledge between researchers in Nordic countries in the field of safety management and safety culture. Further studies are needed to develop a frame of reference for describing safety management across industries and activities; and to collect data illustrating good and bad safety management. A living system framework is outlined and related to the concepts used in organizational management. Some findings of potential relevance for safety management in the nuclear power domain are identified.

### 4. Barriers, control and management

**NKS-87, NKS-113, NKS-114 BarriersControlManagement:** The activity was conducted by DTU in 2002 – 2004. The objective was to investigate how formalized concepts can be used to define concepts that can be used in design and assessment of nuclear power plant safety systems and procedures. Multilevel Flow Modeling (MFM) has proven to be an effective modeling tool for reasoning about plant failure and control strategies, and is currently exploited for operator support in diagnosis and on-line alarm analysis. The purpose of the activity is to show that such a theoretical foundation for modeling goals and functions of control systems can be built from concepts and theories developed by Von Wright and to show how the theoretical foundation can be used to extend MFM with concepts for modeling control systems.

## **5. Experiments on ruthenium behavior in severe accident conditions**

**NKS-92, NKS-100, NKS-118 Ruthenium Releases:** This was an experimental activity conducted by VTT. It started in 2002 and continued beyond 2005. During routine reactor operations, ruthenium (Ru) will accumulate in the fuel in relatively high concentrations. In a steam atmosphere Ru is not volatile, and it is not likely to be released from the fuel. However, in an air ingress accident during reactor power operation or during maintenance, Ru may form volatile species. Oxide forms of Ru are more volatile than the metallic form. Radiotoxicity of Ru is high both in the short and long term. The results of this activity imply that under oxidizing conditions during reactor core degradation, Ru releases increase as oxidized gaseous species are formed. A significant part of the released Ru is then deposited on reactor coolant system piping; but in the presence of steam and aerosols a substantial amount of Ru may be released into the containment atmosphere.

## **6. Traceability and communication of requirements in digital I&C systems development**

**NKS-91, NKS-103, NKS-115 TACO:** The activity was conducted by IFE in 2002 – 2005. On the basis of experiences in the Nordic countries, TACO aimed at identifying the best practices and most important criteria for ensuring effective communication in relation to requirements elicitation and analysis, understandability of requirements to all parties, and traceability of requirements through the different design phases. It is expected that TACO will provide important input to the development of guidelines and establishment of recommended practices to these activities. TACO objectives were concretized in a pre-project, and the work was presented at two Industrial Seminars in 2003 and 2004. To facilitate the utilization of the TACO results, the follow-up activity MORE was carried out in the years to follow; see the section NKS-R Summary for 2006 – 2008 below.

## **7. Nordic thermal hydraulic and nuclear safety network**

**NKS-107 NOTNet:** The activity was carried out in 2004 under the leadership of VTT, and in 2006 it resulted in a new Nordic cooperation in thermal hydraulics called Northnet. The idea of the network is to combine the resources of different research teams in order to carry out more ambitious and extensive research programs than would be possible for the individual teams. The end users were engaged in the activity from the beginning. The aim of the network is to benefit the partners involved in nuclear energy in the Nordic countries (power companies, reactor vendors, safety regulators and research units).

## **8. Ex-vessel coolability and energetics of steam explosions in Nordic boiling water reactors**

**NKS-112 ExCoolSE:** This was an experimental activity conducted by KTH since 2004. It was preceded by a preparatory activity called PreDeliMelt. Severe reactor accidents involve melting of the core and release of radioactivity. Intensive research has been performed for years to evaluate the consequences of the postulated severe accidents. They pose a difficult set of phenomena and consequences to understand and predict. In the PreDeliMelt activity several critical issues were identified. Some Nordic NPPs have adopted the Severe Accident Management Strategy (SAMS) which employs the deep subcooled water pool in lower dry-well. The success of SAMS largely depends on the issues of steam explosions and formation of a debris bed and its coolability. Research plans are proposed to investigate the remaining issues, specifically on the ex-vessel coolability of corium during severe accidents.

## **NKS-B Summary for 2002 – 2005**

Below follows a brief review of the eight NKS-B activities that received the largest NKS funding in 2002 – 2005 (see budgets in Appendix 5). To this should be added the value of in-kind contributions, worth approximately as much as the NKS funding. The numbers of the items in the table below are the same as those used in the chapter on the evaluation of the first four years of R&B activities. At least four Nordic countries participated in all the NKS-B activities presented below.

1. **Intercomparison of laboratory analyses of radionuclides in environmental samples**  
**NKS-144 Labinco:** 38 laboratories participated in an intercomparison exercise carried out in 2004 and 2005 on laboratory analyses of radionuclides in environmental samples and food. It involved artificial and naturally occurring radionuclides including alpha and beta emitters. The analytical results compare well across many of the laboratories. However, the results indicate that there is room for improvement of the analytical quality at most laboratories. It is also noteworthy that the results on total alpha and total beta radioactivity in lake water show quite poor agreement, which is a matter of implication for national drinking water screening programs.
2. **Radiochemical analysis in emergency and routine situations**  
**NKS-124, NKS-129 RadChem:** An accurate determination of radionuclides from various sources in the environment is essential for assessment of the potential hazards and suitable countermeasures. Reliable chemical separation and detection techniques are needed for accurate determination of alpha and beta emitters. Rapid analytical methods are needed in case of an accident. The objective of RadChem was to compare and evaluate radiochemical procedures used in Nordic laboratories. To gather information on the procedures in use, a questionnaire was sent to 16 laboratories. After this, RadChem focused on laboratory work in order to improve existing procedures and develop new ones. In addition, an intercomparison exercise was performed.
3. **Nordic collaboration on the use of mass spectrometers for the analysis of radioisotopes**  
**NKS-134 NorCMass:** This activity was performed in 2003 – 2005. The purpose was to identify and work on problems in isotope ratio and ultra trace measurements of primarily plutonium and uranium isotopes and Np-237 using ICP-MS. The activity also included an educational part aiming to describe fundamental aspects and practical steps for radioisotope measurements using ICP-MS. The activity was separated into 12 stages including an initial workshop, studies and measurements to produce reference material, a number of workshops, two seminars, production of a Guideline Book and planning of a practical training course in isotope ratio measurements.
4. **Improving radiological assessment of doses to man from terrestrial ecosystems**  
**NKS-98, NKS-110, NKS-123 EcoDoses:** The activity started in 2003 and was continued after 2005. The aim was to improve the radiological assessments of doses to man from terrestrial ecosystems. Nordic data for bomb-test and Chernobyl fallout were reviewed. Based on this, an improved model for estimating radioactive fallout was developed and effective half-lives were calculated. The data were used to compare ARGOS modelling results with observed concentrations. The EcoDoses data base was extended and the radioecological sensitivity of Nordic populations were investigated. ARGOS and RODOS include foodchain modules and parameters that need to be adjusted in order to produce reliable predictions for Nordic areas.
5. **New indicator organisms for environmental radioactivity**  
**NKS-140 Indofern:** Of all NKS-B activities in 2002 – 2005, Indofern received the highest NKS funding, DKK 3030k. The objective was to identify new indicator organisms and biomarkers for assessment of environmental radioactivity in normal and emergency situations. New useful organisms accumulating effectively certain radionuclides in various Nordic ecosystems (forest, fresh water, marine) were found, and their indicator value was compared to those of the earlier known indicators. The activity yielded new data on the occurrence and transport of radionuclides in a wide scale of Nordic ecosystems. A summary of Indofern, together with summaries of the work done in all participating laboratories, were presented at the NKS-B Summing up Seminar in Tartu, Estonia, in 2005, which was a forum for presentation and discussion of the entire NKS-B program in 2002 – 2005.
6. **Decision support handbook for remediation of contaminated inhabited areas**  
**NKS-175 UrbHand:** Phase 1 was performed in 2004 – 2005, after which a second phase for 2006 – 2007 was planned. An early version of the handbook was followed by the final product in July 2008. It is aimed at providing Nordic decision makers and their expert advisors with background material for the development of an optimized, operational preparedness for situations where airborne radioactive matter has contaminated a Nordic inhabited area. The focus is on the mitigation of long-term problems. It should be stressed that the information given in the handbook is compre-



hensive, and many details require careful consideration well in advance before implementation of countermeasures in a specific area. Training sessions are therefore recommended. The handbook describes the current relevant Nordic preparedness (dissemination routes) in detail, and suggests methods for measurement of contamination and prognoses of resultant doses, and data for evaluation of countermeasures and associated waste management options.

#### 7. **Nordic network of meteorological services engaged in nuclear emergency preparedness**

**NKS-147 MetNet:** The activity was conducted in 2003 – 2005, with a continuation into 2006. A draft report was followed by the final version in March 2007. The activity was intended as a forum of exchange of scientific information concerning atmospheric dispersion modelling as well as being a Nordic web-based backup facility for long-range atmospheric dispersion calculations and for exchange of real-time and forecast model results. A backup facility for the network was established regarding exchange of operational real-time long-range dispersion model calculations. Technical problems at one institute will not influence the calculations or presentations from the other participants, which makes the system robust. The activity fulfilled its main harmonization goal by bringing the Nordic emergency modelling toward more unified approaches of the presentation of the results and introduced a voluntary unification of the model output formats. Most of the Nordic models are capable of producing ARGOS compatible results.

#### 8. **Emergency management and radiation monitoring in nuclear and radiological accidents**

**NKS-137 EMARAD:** The activity started in 2002 and was prolonged into 2006. The management of various nuclear or radiological emergencies requires that the authorities have pre-prepared plans and various background material at their disposal. The purpose of EMARAD was to produce and gather data and information foreseen to be useful in preparing emergency procedures and radiation monitoring strategies. The deliverables of the activity were:

- A website hosted by STUK containing most of the data and reports produced in EMARAD
- Downloadable NPP accident consequence data for Nordic or neighboring NPPs (10 plants, 32 scenarios); and programs to process the downloaded data
- Demos, documents, publications, scientific articles and presentations at international conferences

### **Major Seminars, Exercises and Other Events 2002 - 2005**

#### **NKS-R activities:**

- 3D BWR Transient analysis methodology, Otaniemi, Finland, April 2003
- NKS-R cosponsored international conference: VALDOR 2003 (VALues in Decisions On Risk). Stockholm, Sweden June 2003
- Nordic seminar on nuclear regulatory work on reactor safety, Stockholm, Sweden, November 2003
- Nordic seminar on nuclear automation (in collaboration with IAEA and OKG), Oskarshamn, Sweden April 2004
- Knowledge management in Nordic NPPs, Halden, Norway, October 2004
- Nordic-group conference on safety management, Lund, Sweden, October 2004
- Seminar on experience from Nordic safety improvement programs toward nuclear power plants in Russia, Central and East European countries. Halden, Norway Nov. 2004
- Second TACO industrial seminar: Traceability and communication of requirements in digital I&C systems development, Helsinki, Finland, December 2004

#### **NKS-B activities:**

- Mini-seminar on airborne and carborne gamma spectroscopy, DEMA, Denmark, October 2002
- **RESUME 2002: NKS – EU exercise in mobile measurements (AGS and CGS), Scotland 2002.**
- MGS course in advanced methods for processing AGS and CGS data and similar sets of spectral data. Lyngby, Denmark Nov. 2002
- ComTech mini-seminar, STUK, Helsinki, Finland, February 2003

- NKS-B sponsored conference on radioactive contamination in urban areas ((UrbContSem). Risø, Denmark May 2003
- Mini-seminar on radioecology and measurement techniques, Risø, Denmark, September 2003
- RADSEM, Risø, Denmark, August 2004
- Mini-seminar on malicious use of radioactive material, Stockholm, Sweden, May 2005
- CommTech mini-seminars, SSI, Stockholm, Sweden, May/June 2005
- SAMPSTRAT mini-seminar on the theory of sampling. Risø, Denmark August 2005
- Summary seminar of the 2002 – 2005 program. Tartu, Estonia Oct. 2005
- Seminar on emergency preparedness, STUK, Helsinki, Finland, November 2005

#### Other activities:

- NKS + BKAB: Second seminar on Quality in Radiation Protection Work. Malmö, Sweden February 2004. (*Author's comment:* For scope and objectives, see the chapter on the 1998 – 2001 program, the first Malmö seminar under the heading “Additional activities”.)
- NKS session at the XIV Regular Meeting of NSFS on the theme Radiological Protection in Transition, Rättvik, Sweden Aug. 2005. Presentation of NKS, quality in radiation protection, the R&B programs and some NKS-B activities. A number of other NKS-related activities were presented in other sessions, e.g., on radioecology.
- Nordic NKS – DD – BKAB seminar on decommissioning of nuclear installations, with invited speaker from OECD/NEA, Risø, Denmark Sept. 2005.



Annette Lemmens at the Registration Desk, Risø  
Photo: Lena Bennerstedt

#### Relation Between the Directors Group and NKS

The Nordic Directors discussed at their meeting in Norway on **June 2 – 3, 2003** the relation between the Directors Group and NKS, and if maybe it was time for the Directors Meeting to take over the steering function of the NKS Owners Group. The outcome of this discussion was reported to the NKS Board meeting in Reykjavík on **November 13, 2003** as follows:

The Directors consider the NKS to be an important forum for Nordic collaboration. Recent changes in administrative structure and program are welcomed and further efforts toward an optimal administration of the NKS program are encouraged. The Directors had a fruitful and lively discussion of the future relations between the NKS and the Directors meetings. Different views exist between the Directors and NKS. Thus, no steps will be taken toward a merger of the NKS administrative structure

and the Directors meetings. **The Nordic Directors Group therefore concluded that the Directors meetings and the NKS will for the foreseeable future continue to be two separate arenas with no formal links.**

The NKS Board took note of this conclusion. Even though there are now no formal links between the two, NKS and its activities continue to be on the agenda for the Directors Meetings.

## **Feedback From Program Managers and Activity Leaders**

On Nov. 13, 2003 the Board instructed the Bureau to send a questionnaire to all activity leaders in order to poll the general opinion on the new program structure, organization and administrative support. Furthermore, the program managers were asked whether they could take on additional tasks, mostly of an administrative nature, as a measure to cut down on central administration.

The results were presented to the Board at its meeting on May 5, 2004. All respondents were happy with the new structure and the present routines. The program managers saw no possibility to take on new tasks under the present contract.

## **Evaluation of the R&B programs 2002 – 2005**

**See the evaluators' report NKS-145: Evaluation of NKS Activities During 2002 – 2005**

Following a Board meeting in November 2005, NKS research work during the years 2002 – 2005 and its results were evaluated against a set of criteria defined by the NKS Board. The evaluation encompassed the NKS-R (reactor safety) and NKS-B (emergency preparedness) programs and was conducted by two persons per program; see below. Below follow some of their findings.

### **Evaluators of NKS work 2002 – 2005**

NKS-R:	Risto Sairanen, STUK Per Persson, consultant to SKI
NKS-B:	Per Hedemann Jensen, DD Tore Lindmo, NTNU

The mode of work of the two evaluation teams was adapted to the special conditions of the program at hand, one being aimed more at the nuclear industry and the other at a more academic surrounding; in both cases, however, with great involvement of relevant national authorities. The findings of the evaluators are summarized below. For the full text please refer to the report NKS-145. Financing and participating organizations, end users, deliverables, quality aspects, cost-benefit issues, time schedules, budgets and related issues are discussed in the report; however, for obvious reasons the present report covers but a small fraction of that information. Finally, the sections on NKS-R and NKS-B, respectively, include conclusions and recommendations for future work; the most important of which are included here.

If activity spending in each of the Nordic countries is compared with the financial contributions from the respective countries, it is obvious that Sweden has a significantly lower “return” than other NKS countries.

### **NKS-R: Reactor Safety**

**Risto Sairanen (STUK) and Per Persson (Consultant to SKI)**

#### **General**

In the case of NKS-R, the criteria were translated into a list of 15 questions by the evaluators. Answers to the questions were collected from three sources:

- Interviews with persons from Finland and Sweden having experience of working with NKS-R
- A survey sent to end users of the NKS-R research results, and to activity participants
- Review of NKS deliverables by the evaluators

Considering the limited level of funding, the achievements of the NKS-R work in 2002 – 2005 have been very good. Only a few delays have been observed. In a vast majority of cases the activity leaders have conducted their activities according to plans and in a cost-effective way. The end users have considered the results applicable. All finished activities have fulfilled the formal NKS requirement of producing final documentation.

Some NKS objectives have not been completely fulfilled in NKS-R. Building of Nordic networks has been only occasionally achieved. Most of the activities have been mainly conducted by the leading organization. Contacts with power plants and with other established Nordic cooperation groups have been scarce in some cases.

The NKS-R evaluators recommend that the Nordic cooperation aspect should be enhanced in the future. Contacts with other established Nordic cooperation groups, with the end users and with NKS-B should also be reinforced.

Distribution of the NKS-R results should be improved, e.g., by arranging seminars presenting the results of the program activities.

Education activities, especially for the younger generation, could be a regular feature of NKS-R. (*Author's comment:* As they already are in NKS-B.) The education could efficiently utilize the facilities available in various Nordic countries.

NKS-R work 2002 – 2005 resulted in nine seminars and 28 reports in the NKS series alone. In addition, numerous reports have been published in scientific journals, at conferences and as national research publications. The seminar participants have considered the NKS-R seminar activity useful.

### **The results of the survey and interviews**

The NKS evaluation criteria were reformulated into 15 questions. The information from the survey answers and from the interviews is summarized below. Some of the questions could be answered by giving a score.

- 1 How well is the NKS-R research program known?  
The program is quite well known, at least within the organizations and among the persons who answered.
- 2 To what extent are the results utilized?  
The numerical results show a considerable spread, but the overall score is fairly good. It was pointed out that the NKS-R activities normally are a part of a larger entity, e.g., a national research project. Utility representatives pointed out that in order to ensure that the results are in a form that they can use, the utilities should be involved in the activities from an early stage.
- 3 How useful have the NKS-R seminars been?  
Arranging seminars is a very important NKS activity, and the NKS-R seminars have been successful. It was recommended to arrange general NKS-R seminars approximately every four years. The internal seminars for activity leaders that had been held were considered necessary for the conduction of the program.
- 4 Has the NKS-R program created and maintained Nordic networks in reactor safety?  
This question received the most complex response. The numerical grades were fair. It was noted that there had been a lack of contacts to established Nordic cooperation groups like NPSAG and APRI. In most NKS-R activities the main work has been conducted by the leading organization. But there are cases where networking has undoubtedly been good. It was suggested that each activity should have participants from at least two countries.

- 5 Has the NKS-R program built new competence or transferred competence within the Nordic countries?  
The numerical results were good. It was suggested that organized education as a series of seminars and/or regular education might be supported by NKS.
- 6 Has the program provided possibilities for young scientists?  
The score was quite good. Participation of young scientists is one of the evaluation criteria for applications. Therefore it has been considered in most activities. It was suggested that NKS could initiate some activity focused on young scientists.
- 7 What has been the scientific level?  
The survey results gave rather high scores on this question. The interviewees considered the scientific level high in the areas they were familiar with. There was also a recommendation to encourage some visionary work, even if it does not produce any immediate results.
- 8 Has the program been balanced?  
Generally, the program was considered well balanced. An increase in seminar activity and information meetings was requested; on the other hand it was pointed out that there is a limit to the number of seminars that can be attended; and that there is a need for a Nordic seminar. The current NKS method of working has decreased the direct influence of the governing bodies. The weight of NKS-R decommissioning is increasing, which was considered positive. It is important to involve utility representatives more, in order not to render the activities “academic”.
- 9 Are the priorities the correct ones? Are any important activities missing?  
The Call for Proposals procedure does not rank the topics. Perhaps NKS should specify the research objectives more precisely. More weight should be put on the applicability of the results by defining the end users and involving them before submitting the proposal. It was recommended that NKS reviews the whole program at certain intervals and changes the structure if considered appropriate.
- 10 How relevant are the proposal evaluation criteria?  
The persons actually involved in the application process were satisfied with the criteria, which well reflect the objectives of the NKS-R program. As regards the Nordic dimension, even if the research has been conducted by a single organization, the results have been applicable for more than one country.
- 11 Did the activities that were selected for funding have clear goals? Did the activity leaders follow the work plans and timetables?  
The questions were put to the program managers, and the answer was yes on both counts, with some exceptions, where funding was frozen until the task was finished.
- 12 Has the program been conducted in a cost-effective way?  
What are the positive and negative experiences from the NKS-R 2002 – 2005 work?  
The main comment was that NKS-R produces good results with a small budget. Some end users felt that the NKS organization is heavy considering the volume of the program.
- 13 What was the positive and negative experiences from the NKS-R 2002 – 2005 work?  
The work was considered interesting, giving a good opportunity to learn of different research topics and meet Nordic colleagues. The method of working was considered generally efficient. Concerning large experimental activities it was stressed that it is difficult to secure enough funding to carry out “real research”.
- 14 Is the overall quality of the results satisfactory?  
This question remains unanswered in the evaluation report.

- 15 What are your recommendations for future work?
- Strive for a better distribution of NKS-R activities and results
  - A stronger connection to the needs of the power plants is necessary
  - Connect to existing Nordic and EU work groups
  - A review every 4 – 5 years is needed

### Summary evaluations of selected NKS-R activities

The eight NKS-R activities that had received the largest NKS funding in 2002 – 2005 were reviewed by the evaluators and by persons from the Finnish and Swedish regulatory organizations. Activity reports published in the NKS series were the main source of information.

1. *BWR condensation pool experiments*

Title: Condensation pool experiments    Acronym: PrePool / DeliPool

Leader: VTT                      Report: NKS-104                      Funding: DKK 1385k

The connections to other Nordic organizations were few. The activity included experiments and analyses. It appears that the objectives and results of the study are rather limited. The study would have benefited from more extended comparisons with the experimental or analytical solutions. The scientific content is judged to be moderate.

2. *Assessment of maintenance culture and efficiency in Finland and Sweden*

Title: Maintenance culture safety and management of change                      Acronym: MainCulture

Leader: VTT                      Report: NKS-108                      Funding: DKK 1900k

There was an essential Nordic dimension in the activity, and networks were formed; and the researchers were young. This unique activity has a considerable new value with regard to the organizational changes which have been made during later years at Swedish and Finnish nuclear power plants as a consequence of the deregulation of the electric power market. It has been judged that there is a substantial use of the study both by the plants and the authorities because of creation of deepened knowledge.

3. *Safety management in non-nuclear contexts with potential relevance for the nuclear power industry and regulators*

Title: Safety management                      Acronym: SafetyManagement

Leader: Stockholm University                      Reports: NKS-88, NKS-95                      Funding: DKK 720k

The activity had an essential Nordic dimension. The research topics are in two highly current fields: safety management and safety culture related to nuclear power. The findings are new. Several of the participants were young researchers. The main achievement was the writing of the book “Nordic perspectives on safety management in high reliability organizations”. This book can be used in education (competence development) and in that way it is useful for the end users.

4. *Barriers, control and management*

Title: As above                      Acronym: BarriersControlManagement

Leader: DTU                      Reports: NKS-87, NKS-113, NKS-114                      Funding: DKK 695k

The main theoretical novelty is the application of Von Wright’s action concepts to the plant modification and review processes. The work done within the activity gives interesting theoretical insights to the concepts routinely used in nuclear safety work. On the other hand, the methods are quite far from being applicable to practical cases. Significant additional work would have been required for the method to have added value in practice.

5. *Experiments on ruthenium behavior in severe accident conditions*

Title: Ruthenium releases                      Acronym: RutheniumReleases

Leader: VTT                      Reports: NKS-92, NKS-100, NKS-118                      Funding: DKK 900k

Ruthenium can be released in situations where air comes in contact with the reactor core. The work is thus of interest for all light-water reactors. The reports are of high international standard. Substantial parts of the work have been done by PhD students. Though the subject as such and the results of the work have a Nordic dimension, VTT and the end user STUK were the only participants. The activity results have been discussed in international, not in Nordic fora.

6. *Traceability and communication of requirements in digital I&C systems development*

Title: TACO

Acronym: Digital Requirements

Leader: IFE

Reports: NKS-91, NKS-103, NKS-115

Funding: DKK 950k

Only three organizations participated, and the number of young scientists was low. The results have been presented at industrial seminars in Finland and Sweden. It was pointed out that this type of fora for dissemination of information should also be used in other NKS activities. The subject is interesting and important. The developed structure is new but should be tested in some practical case in order to evaluate its usefulness. The scientific level is average or slightly above. The activity produced distinct and measurable goals in the requirements documentation scheme itself. They can serve as platforms for a structured requirements representation and tracing in lifecycle oriented project work. Future NKS work in the area is warranted, but more emphasis should be placed on practical implementation / utilization of results in actual power plant and/or regulatory work.

7. Nordic thermal hydraulic and nuclear safety network

Title: As above

Acronym: NOTNet

Leader: VTT

Report: NKS-107

Funding: DKK 300k

The work documents the background for a decision to start a new network. The resources and needs for research on thermohydraulics in Finland and Sweden are reviewed. A possible plan for work structure in the form of three roadmaps with feedback from the stakeholders is described. Potential funding sources outside NKS are reviewed. Planning of the network began, and in 2006 several Nordic organizations signed a cooperation contract for what is now called Northnet.

8. Ex-vessel coolability and energetics of steam explosions in Nordic boiling water reactors

Title: As above

Acronym: ExCoolSE

Leader: KTH

Report: NKS-112

Funding: DKK 980k

ExCoolSE was an experimental activity conducted by KTH, and was preceded by the activity PreDeliMelt. ExCoolSE deals mainly with two questions related to Nordic BWRs: coolability of a molten core; and steam explosions. The same questions are considered within the cooperation project APRI (Accident Phenomena of Risk Importance) in which SKI and the Swedish nuclear power industry are involved. The ExCoolSE report is of high international quality and the questions raised are central for Nordic BWRs. The activity has contributed to the maintenance of Nordic competence within the field, and has involved young scientists – most of them PhD students.

### **Conclusions and recommendations by the NKS-R evaluators**

Most of the interviewed persons and survey answers seem to be satisfied with the current way of working within NKS-R. There were no wishes to return to the old system, applied prior to 2002.

The scientific level of the 28 NKS-R reports is considered to be on an international level. Some of the nine seminars received a very positive feedback. Another type of NKS-R seminar activity has been internal seminars for activity leaders. These are also considered very useful for effective conduction of the program. There has been no general NKS-R seminar to give information on the total program results for a larger public. Such seminars should be arranged at certain intervals, e.g., 2 – 4 years.

The Call for Proposals procedure and schedule is not known to everyone, even though the information is available on the website since 2002. Some comments seem to refer to the old “top – down” system in which the initiating agent was NKS, whereas the initiative now comes from proposals of a fairly free format. Several persons commented that it would be easier to submit a proposal if only NKS would better specify what it expects from the activities.

VTT received by far the largest share of NKS funding in 2002 – 2005, almost 50% of the total. The current Call for Proposals procedure seems to favor large national research organizations (VTT, IFE) compared to the universities.

There are some NKS objectives that have not been completely fulfilled, e.g., the Nordic dimension and building of Nordic networks. Weak contacts with the power plants were mentioned in the survey and the interviews. Surprisingly, NKS-R contacts with the NKS-B part have been almost non-existent. No activities with joint objectives or joint participation have been initiated in 2002 – 2005. Young scientists have been involved in the activities to some extent. The generation shift is a concern for the Nordic countries; therefore development of competence is an important factor for all. Organized education could be considered.

It is recommended to evaluate the program regularly, e.g., every 4 – 5 years. (*Author's comment: This would mean 2011 next time.*)

## **NKS-B: Emergency Preparedness**

**Per Hedemann Jensen (DD) and Tore Lindmo (NTNU)**

### **General**

The NKS-B activities have been evaluated against activity proposals and against their scientific merits. The quality of the deliverables varies considerably. Also, the cost-effectiveness, i.e., the “return of the investment”, in the different activities varies, as do the scientific perspectives of the activities. Many of the activities, however, have the potential of being further developed within Nordic research programs.

Activities on **measurement technology** have been a very valuable part of the NKS-B program portfolio. Nordic countries possess expert competence in this field, which is also appreciated on the European level. Nevertheless, radiological measurements constitute an expertise mastered only by a few institutions in each of the Nordic countries. Activities within NKS therefore constitute an opportunity to further develop and maintain this competence as well as to work out common protocols and procedures that will ensure coordinated actions within the Nordic countries in case of an emergency. The activities on field measurements and laboratory-based analyses are highly relevant, and very valuable results have been obtained from both field exercises and laboratory intercomparisons.

The purpose of the **radioecology** activities has been to establish reliable data for prediction of possible dose to humans from different ecosystems, to be used in decision-support systems, and to search for new organisms accumulating radionuclides in various ecosystems. From the published reports on NKS activities in this field, it is not always clear how the results will be utilized in a systematic manner to further strengthen the expertise within these two areas of radioecology.

The **emergency preparedness** activities have been well anchored. In general, all activities have been relevant for emergency preparedness and they fulfill the criteria set up in the NKS-B program. The activities have contributed to maintaining and building up competence and to maintaining and building Nordic networks between scientists in emergency preparedness disciplines. Transverse collaboration between closely related activities seems to have been rather low but might be improved in the further work on integrating the activity results into broader decision-support systems.

All 25 NKS-B activities were evaluated by applying ten criteria that emerged from the NKS Board guidelines:

- Whether the activity falls within the NKS-B framework
- Nordic competence and network building and maintenance
- The scientific and pedagogical merits of the activity
- The application and scientific perspectives of the activity
- At least three Nordic countries involved
- Potential use of results and information
- Activity results of adequate quality
- Activity in accordance with plans and budget
- Cost-effectiveness of total budget
- Relevance for authorities and others



Each of these criteria was graded by a score ranging from A: very good to E: very poor. These scores were weighted to obtain an overall grade for each activity.

Activity reports published in the NKS series were the evaluators' main source of information. The evaluations of the eight activities that had received the largest funding are summarized below.

### Summary evaluations of selected NKS-B activities

1. *Intercomparison of laboratory analyses of radionuclides in environmental samples*

Acronym: Labinco      Area of work: Measurement technology      Grade: A

Leader: Risø      Report NKS-144      Funding: DKK 350k

Some laboratories still seem to have some difficulties and some types of measurements are clearly more difficult than others. Nevertheless, it seems that the laboratories are performing better than they have typically done in the previous intercomparisons. This activity would have benefitted from integration with RadChem (see below). Labinco has helped maintain and extend the competence in radioecological data acquisition, analysis and modelling. It gets a very high pedagogical merit through a focus on methodological skills. The results represent scientific knowledge of very high merit, and they are of value for participating laboratories and authorities. All five Nordic countries participated.

2. *Radiochemical analysis in emergency and routine situations*

Acronym: RadChem      Area of work: Measurement technology      Grade: B

Leader: IFE      Reports NKS-124, NKS-129      Funding: DKK 415k

Accurate determination of radionuclides from various sources in the environment is essential for assessment of the potential hazards and suitable countermeasures in case of releases. Reliable radiochemical separation and detection as well as rapid analytical methods are needed. Valuable information was provided by the laboratories on their practice regarding the specified analyses, making it possible to analyze and compare radiochemical separation procedures. A comparison with Labinco (see above) would have been of value. RadChem has helped maintain and extend the competence in radioecological data acquisition, analysis and modelling. The pedagogical merits are very high through a focus on methodological skills. The results may lead to higher quality and standardization of laboratory practices, which is of value also to involved authorities. Four Nordic countries participated.

3. *Nordic collaboration on the use of mass spectrometers for the analysis of radioisotopes*

Acronym: NorCMass      Area of work: Measurement technology      Grade: B

Leader: Risø/Lund      Reports NKS-134, NKS-135, NKS-136      Funding: DKK 610k

The aim of the activity was to stimulate and expand Nordic competence in radioisotope measurement technology and radiochemistry. To achieve this, guidelines have been produced and workshops on mass spectrometric measures have been carried out. A Nordic network has been created, improving, e.g., determination of trans-uranium elements. The activity appears to have had good pedagogical merits. The results are oriented toward practical routine surveillance as well as emergencies. The scientific perspectives are judged to be limited. The results are relevant for laboratories and authorities. Three Nordic countries participated.

4. *Improving radiological assessment of doses to man from terrestrial ecosystems*

Acronym: EcoDoses      Area of work: Radioecology      Grade: B

Leader: NRPA      Reports NKS-98, NKS-110, NKS-123      Funding: DKK 1010k

EcoDoses may be seen as a natural continuation of previous BOK-2 work. The aim of EcoDoses was to improve the radiological assessments of doses to man from terrestrial ecosystems. It has helped maintain and extend the competence in radioecological data acquisition, analysis and modelling. The integration with EU and other international projects was insufficient. Very valuable results for science and authorities were obtained. All five Nordic countries participated.

5. *New indicator organisms for environmental radioactivity*

Acronym: Indofern      Area of work: Radioecology      Grade: B-

Leader: STUK                      Reports NKS-140, NKS-143                      Funding: DKK 3030k  
 The objective was to search for new useful organisms accumulating effectively certain radionuclides in various Nordic ecosystems (terrestrial, fresh water, marine), and compare their value as indicators with those known earlier. The aim was to get more information on nuclides like Sr-90, Pu and Am and the most abundant discharges from nuclear power plants. The activity has helped maintain and extend the competence in radiological data acquisition, analysis and modelling. The integration with EU and other international projects was insufficient. Vast amounts of potentially useful data have been collected. Valuable results for science and authorities were obtained. All five Nordic countries participated.

6. *Decision support handbook for remediation of contaminated inhabited areas*

Acronym: UrbHand                      Area of work: Emergency preparedness                      Grade: B-  
 Leader: Risø                      Report: Version 1 of handbook                      Funding: DKK 410k

The handbook contains data for remediation techniques that can be used in urban environments. Simple schemes can be used for assessing external doses and avertable doses for different remediation strategies. In phase 2 it should be considered if parts of the EMARAD material could be included in the handbook. The activity has contributed to extend the competence in using clean-up data from full-scale experiments in the former Soviet union. The results and information in the handbook are relevant in nuclear and radiological accident situations when urban environments have been contaminated. The handbook could be made more userfriendly. It is relevant for authorities that take part in the decision making process. Four Nordic countries participated.

7. *Nordic network of meteorological services engaged in nuclear emergency preparedness*

Acronym: MetNet                      Area of work: Emergency preparedness                      Grade: B-  
 Leader: DMI                      Final activity report                      Funding: DKK 590k

MetNet aims at creating a network of Nordic meteorological services engaged in nuclear preparedness and response through operational real-time calculations of long-range atmospheric dispersion and deposition of radioactive materials released to the atmosphere in nuclear accidents. Exercises demonstrated the importance of a Nordic network for real-time atmospheric transport calculations and that NKS MetNet partners can act as an operational unit in an emergency. Good data can be delivered within a few hours. The scientific merits appear to be limited. The results of the activity are relevant for authorities and others engaged in assessing the consequences of a nuclear accident. All five Nordic countries participated.

8. *Emergency management & radiation monitoring in nuclear and radiological accidents*

Acronym: EMARAD                      Area of work: Emergency preparedness                      Grade: A-  
 Leader: STUK                      Reports NKS-137, NKS-142                      Funding: DKK 1140k

EMARAD consists of two major parts: pre-calculated consequences of accidents at nuclear power plants; and monitoring strategies that are needed in the management of different nuclear and radiological emergencies. The activity has contributed to extend the network between Nordic experts on consequence analysis, radiation monitoring and emergency preparedness. There are several scientific merits of the activity, e.g., the development of programs for the processing of nuclear accident consequence data and aspects related to malicious use of radioactive materials. The pedagogical merit is the website with various data that can be used in all the Nordic countries. The results of the activity are relevant for authorities and others engaged in the assessment of the threats of nuclear facilities to the Nordic countries and the consequences of nuclear or radiological accidents. Of special importance is the emphasis on the systematic approach to defining a proper monitoring strategy. All five Nordic countries participated.

## Conclusions and recommendations by the NKS-B evaluators

To improve decision-support systems, critical analyses to identify which data are most needed to strengthen system performance should be made and the data be acquired through focused activity work. The search for new accumulating indicators should be limited to a few species relevant for the Nordic countries and the effort then focused on a systematic long-term monitoring of such species.

Challenges for future NKS work on emergency related activities will be:

- Careful considerations on the balance between research-oriented and more practical routine-oriented activities
- More clear communication of the activity results
- Integration of such results into decision-support systems
- Better integration of NKS activities with relevant EU activities
- Inclusion of university departments in research activities

It might be questioned whether preparation of databases and handbooks is a natural part of NKS research programs. If so, updating is necessary in order not to render them obsolete. It is unclear if this aspect has been considered at the onset of such activities.

As described above, a weighted score of the fulfillment of NKS criteria was calculated for all NKS-B activities. Comparing the cumulative weighted grades between the three NKS-B groups of activities it was found that the groups ranked in the following order:

1. Measurement Technology
2. Emergency Preparedness
3. Radioecology

The weighted grades for all NKS-B activities are better than or equal to B-.

In general, the NKS-B program was judged to be fairly good. However, it is recommended that the future composition of the NKS-B program should be reconsidered. New subprograms like decommissioning of nuclear facilities and radioactive waste treatment – still within the context of radiological protection – might be added or substitute some of the existing subprograms.

In future NKS-B activities a balance between research oriented and more practical / routine oriented activities should be considered carefully. Also more clear communication of the activity results, integration of activity results into decision support systems, better integration of NKS activities with relevant EU activities, and inclusion of university departments in research activities should be further examined.

The scientific seminars and workshops organized within the NKS-B program were very useful instruments to communicate the results of the activities more widely, to build networks between Nordic scientists and attract young scientists, and also to perform courses in different disciplines like internal dosimetry, spectral data processing and sampling strategies. It is highly recommended that this activity should be continued and strengthened in the next framework program. (*Author's comment:* There is no longer such a thing as a fixed framework (cf. next paragraph); it can be maintained for a longer or shorter period, changed gradually or drastically at any time, as decided by the Board.) The seminars might be even more efficient if they were organized transversely between related activities within the program but also between the R and B programs.

The process of evaluating NKS activities needs a careful reevaluation. When the 4-year program structure was left and more continuous programs were introduced, the former evaluation procedure more or less lost its validity. Without a fixed deadline for the final activity reports to be evaluated, the evaluation process becomes rather difficult, especially when tying the outcome of the evaluation process to a fixed date status seminar. It is therefore recommended that the NKS activity reports (final or intermediate) to be evaluated are sent to the evaluators in due time before the status seminar, and that no later-stage activity reports should enter the evaluation process. Alternatively, the evaluation process could be a “rolling” process, i.e., each activity would be evaluated in line with its completion. Such a prolonged evaluation could however be considered more inconvenient for the evaluators.

## Continued R&B Work 2006 – 2008

It is far beyond the scope of the present report to reiterate the purpose, contents and results of each and every R&B activity. A selected number of activities are presented below. The information is based on abstracts, summaries etc. of the activities in question, as available in technical and final reports at the NKS website. Another source of information has been reports from various seminars, especially NKS-201 from the joint R&B seminar in Stockholm, Sweden March 2009. The seminar proceedings may, in turn, make reference to one or more technical or final reports. Activities not presented at the joint seminar have been excluded here. Activities carried out in 2002 – 2005 and evaluated in 2006 are presented in the chapter on 2002 – 2005 work, even if the final report appeared in 2006 or later.

### NKS-R Summary for 2006 – 2008

#### Notes on some NKS-R activities

##### ***NKS-151 Ruthenium Releases: Ruthenium Behavior in Severe Nuclear Accident Conditions***

During routine nuclear reactor operation, ruthenium will accumulate in the fuel in relatively high concentrations. In a steam atmosphere ruthenium is not volatile and is not likely to be released from the fuel. In a severe accident it is possible that air gets into contact with the reactor core. In an air ingress accident during reactor power operation or during maintenance, ruthenium may form volatile oxides, which may be released into the containment. In order to estimate the gaseous ruthenium species it is of interest to know how they are formed and how they behave. To this end a number of experiments were performed. A significant part of the released ruthenium will be deposited on reactor coolant system piping. However, in the presence of steam and aerosol particles, a substantial amount of the ruthenium may be released in gaseous form into the containment atmosphere. Oxide forms of ruthenium are more volatile than the metallic form. Radiotoxicity is high both in the short and long term.

##### ***NKS-160 ExCoolSE: Ex-Vessel Corium Coolability and Steam Explosion Energetics in Nordic Light Water Reactors***

ExCoolSE, performed under the Melt-Structure-Water Interactions project (MSWI) at KTH in Stockholm, Sweden, placed the focus on assessment of ex-vessel melt risks in Nordic BWR plants with external cavity flooding. While combining both experimental and analytical studies, attention was paid to scaling, simulation and support for plant safety analysis. Covering topics of importance to in-vessel corium coolability, steam explosion energetics and ex-vessel corium coolability, those MSWI phenomena were investigated that had the largest impact and significant uncertainties on the quantification of ex-vessel steam explosions and ex-vessel debris coolability. Substantial advances in process modeling and new insights into related mechanisms were gained from the study of corium pool heat transfer in the BWR lower head; debris bed formation; steam explosion energetics; thermal hydraulics and coolability in bottom-fed and heterogeneous debris beds. An advanced three-dimensional simulation tool was developed and validated for analysis of heat transfer in a BWR lower plenum. An assessment of corium retention and coolability in the reactor pressure vessel lower plenum by means of water supplied through the control rod guide tube cooling system was performed. The analysis results revealed the limit of coolability for the control rod guide tube and uncovered possible vulnerabilities for in-vessel melt retention. Results of experiments and related analyses strongly suggest that porous beds formed in ex-vessel from a fragmented high-temperature debris is far from homogeneous. Both high porosity and heterogeneity are central to the bed's enhanced dryout heat flux and therefore improved coolability. Calculation results of bed thermal hydraulics and dryout heat flux with a two-dimensional thermal-hydraulic code gave the first basis to evaluate the extent by which macro and micro inhomogeneity can enhance the bed coolability. For steam explosion risk in reactors, a revisited study of the material property effect on steam explosion energetics showed that corium high density, high melting point and low conductivity are central to mechanisms in premixing that govern corium low explosivity. Overall, ExCoolSE advanced the knowledge of melt-structure-water interactions, reducing conservatism in quantification of ex-vessel melt risks in Nordic BWRs.

##### ***NKS-178 MORE: Management of Requirements in NPP Modernization Projects***

The overall objective was to improve the means for managing the large amounts of evolving requirements in Nordic NPP modernization projects. The activity has facilitated the industrialization of

the research results from TACO (see above) and practical application of improved approaches and methods for requirements engineering and change management. The main results of MORE are:

- Increased knowledge on handling of requirements during modernization projects.
- Input and recommendations to the implementation of the TACO traceability model in a prototype tool (TRACE) on issues regarding the handling of requirements.
- Continuation of a Nordic network of experts within the area of dependable requirements engineering issues.
- Expansion of this network to also include researchers from Europe – and contacts with Korea and Japan.
- A Workshop on Dependable Software Engineering (WDSE) in Seattle, Washington, USA in 2008.

***NKS-179 AutoNewTech: Levels of Automation and User Control: Evaluation of a Turbine Automation Interface***

The study was performed during the annual operator training at the Studsvik nuclear power plant simulator facility in Nyköping, Sweden. Seven NPP turbine operators from the Oskarshamn 3 plant were interviewed concerning their use of the automatic turbine system. The results show that during manual control the operators experience loss of speed and accuracy in performing actions together with difficulty of dividing attention between performing a task and overall monitoring, as the major problems. The positive aspects of manual operations lie in increased feeling of being in control when performing actions by hand. As the level of automation gets higher, the need for feedback increases which means that information presentation also becomes more important. The presentation of the conditions that manage the automatic sequences are often experienced as difficult to perceive. The use of the semiautomatic step-mode is often preferred.

***NKS-194 WERISK: Extreme Temperatures and Enthalpy in Finland and Sweden in a Changing Climate***

Though risks caused by harsh weather conditions are taken into account in the planning of nuclear power plants, some exceptional weather events or a combination of different events may prevent normal power operation and simultaneously endanger safe shutdown of the plant. Extreme weather events could influence, for example, the external power grid connection, emergency diesel generators (blockage of air intakes), ventilation and cooling of electric and electronics equipment rooms and the seawater intake. Due to the influence of an intensified greenhouse effect the climate is changing rapidly during the coming decades and this change is expected to have an influence also on the occurrence of extreme weather events. WERISK examined extreme temperatures. Enthalpy is a parameter that combines air temperature and air humidity, and it is used in the design of air conditioning systems. Therefore, the WERISK analysis includes the return levels of enthalpy. In frames of extreme value theory the concept of return level is used to convey information about the likelihood of rare events. In this case the probabilities of rare events are expressed in terms of T-year return values. The T-year return value is defined as the threshold that is exceeded once every T years. The time T is referred to as the return period. The influence of climate change on extreme temperatures is analyzed based on regional climate model simulations. The largest increase of the 50-year return level of daily maximum temperature is found in south-western Finland and southern Sweden. By the end of this century the increase can be 3 – 5 degrees Celsius. The largest change in the return levels of daily minimum temperature can be found in north-eastern Finland at the end of this century. This change can even be more than 10 degrees.

***NKS-197 WASCO: Wire System Aging Assessment and Condition Monitoring***

Nuclear facilities rely on electrical wire systems to perform a variety of functions for successful operation. Many of these functions directly support the safe operation of the facility. Therefore, the continued reliability of wire systems, even as they age, is critical. Condition monitoring of installed wire systems is an important part of any aging program, both during the first 40 years of the qualified life and even more in anticipation of the license renewal for a nuclear power plant. Wire testing methods were developed at the Halden reactor project and experiments were performed in collaboration with Norwegian and Spanish companies and a US research institute, comparing several cable condition monitoring techniques. The Halden method is based on frequency domain reflecto-

metry, which resulted in the development of a system called line resonance analysis. It can be used on-line to detect any local or global changes in the cable electrical parameters as a consequence of insulation faults or degradation. On-site tests at Barsebäck and Ringhals NPPs have been performed and analyzed.

**(NKS-201) POOL:** *Experiments and Modeling of Pressure Suppression Pools*

In a hypothetical loss-of-coolant accident a large amount of vapor is released after a break of a main steam line into the drywell compartment of a boiling water reactor. When the pressure increases in the drywell compartment, air and vapor flow through vent pipes into a wetwell compartment. The vent pipes are submerged in a pressure suppression pool, which changes a large volume of vapor into a small volume of water. In the POOL activity, the thermal hydraulic phenomena and the pressure loads in the drywell and wetwell compartments are studied. Experiments are performed with the pressurized PPOOLEX facility at the Lappeenranta University of Technology, Finland. PPOOLEX consists of down-scaled models of drywell and wetwell compartments. VTT performed computational fluid dynamics and finite element modeling of the experiments. Modeling of thermal stratification experiments of the water pool was done at the Royal Institute of Technology (KTH) in Stockholm, Sweden.

**(NKS-201) SafetyGoal:** *Probabilistic Safety Goals for Nuclear Power Plants*

SafetyGoal was initiated by NKS and NPSAG to deal with the use of probabilistic safety criteria for nuclear power plants. The activity is related to an OECD/NEA task on probabilistic safety criteria in member countries. The issues discussed include consistency in judgment in application of safety goals, safety goals related to PSA level 2, and safety goals related to other man-made risks in society. Safety goals usually have a dual function, as they define an acceptable safety level at the same time as they have a wider and more general use as decision criteria. Target values for PSA results are in use in most countries with nuclear power. The values are defined either by the regulator or the utility. Since the start in the 1980s, PSA models have expanded considerably, both regarding operating status and classes of initiating events. The level of detail of the analyses has also increased. There is a growing interest in PSA applications. This has led to an increased interest and need to make judgments concerning the acceptability of risk contributions calculated with PSA.

**NKS-202 StratRev:** *Stratification Issues in the Primary System: Review of Available Validation Experiments and State-of-the-Art in Modeling Capabilities*

The objective was to review available validation experiments and state-of-the-art in modeling of stratification and mixing in the primary system of light water reactors. Workshop presentations from various utilities showed that stratification issues are not unusual and can cause costly stops in the production. It is desirable to take actions in order to reduce the probability for stratification to occur, and to develop well-validated and accepted tools and procedures for analyzing upcoming stratification events. The ultimate goal is to establish Best Practice Guidelines that can be followed both by utilities and authorities in case of an event including stratification and thermal loads. An extension of the existing Best Practice Guidelines for computational fluid dynamics in nuclear safety applications developed by OECD/NEA is thus suggested as a relevant target for a continuation project.

**NKS-204 NROI:** *Experimental Study on Iodine Chemistry (EXSI: Containment Experiments with Elemental Iodine)*

The behavior of iodine during a severe accident has been studied in several experimental programs, ranging from large-scale tests to numerous separate effect studies. Oxidation of iodine in gas phase has been one of the greatest remaining uncertainties. In this study the possible formation of iodine oxide aerosols due to radiolytic oxidation of gaseous iodine was experimentally tested and the reaction products were analyzed. The experimental facility at VTT and the measuring technology were sophisticated and unique in the area of nuclear research as well as in the field of aerosol science. The results from the experiment show an extensive particle formation when ozone and gaseous iodine react with each other. The formed particles were collected on filters, while gaseous iodine was trapped in bubblers. The particles were iodine oxides and the size of the particles was approximately 100 nm. The transport of gaseous iodine through the facility decreased when both gaseous iodine and ozone were fed together into the facility.

***NKS-208 PODRIS: Studies on the Effect of Flaw Detection Probability Assumptions on Risk Reduction at Inspection***

The aim of PODRIS was to study the effect of POD (probability of detection) assumptions on failure probability using structural reliability models. The main interest was to investigate whether it is justifiable to use a simplified POD curve, e.g., in risk-informed in-service inspection (RI-ISI) studies. The results indicate that this is the case. Another aim was to compare various structural reliability calculation approaches for a set of cases. Through benchmarking one can identify differences and similarities between modeling approaches, and provide added confidence on models and identify development needs. Comparing the leakage probabilities calculated by different approaches at the end of plant lifetime (60 years) shows that the results are very similar when inspections are not accounted for. However, when inspections are taken into account the predicted order of magnitude differs. Further studies would be needed to investigate the reasons for the differences.

***NKS-213 MOSACA: Safety Culture: Dimensions and Evaluation***

The report presents results from an interview study that examined the characteristics of the safety culture as developed by the Nordic nuclear branch. The study also tested the theoretical model of safety culture developed by the authors. The interview data were collected in Sweden and Finland. Interviewees represented the major actors in the nuclear field (regulators, power companies, expert organizations, waste management organizations). The study gave insight into the nature of safety culture in the nuclear industry. It provided an overview on the variety of factors that people in the industry consider important for safety. The respondents rather coherently saw such psychological states as motivation, mindfulness, sense of control, understanding of hazards and safety and sense of responsibility as important for nuclear safety. Some of the respondents described a certain Nordic orientation toward safety. One characteristic was a sense of personal responsibility for safety. However, there was no clear agreement on the existence of a shared Nordic nuclear safety culture. Sweden and Finland were seen different for example in the way the cooperation between plants and nuclear safety authorities was arranged and research activities organized. There was also perceived differences in the way everyday activities like decision making were carried out in the organizations. There are multiple explanations for the differences. Swedish industry has been driven by the strong supplier. In Finland the regulator's role in shaping the culture has been more active. Other factors creating differences are, e.g., national culture and company culture and the type of the power plant. Cooperation between Nordic nuclear power organizations was viewed valuable yet challenging from a safety point of view. The report concludes that a good safety culture requires a deep and wide understanding of nuclear safety including the various accident mechanisms of the power plants as well as a willingness to continuously develop one's competence and understanding. An effective and resilient nuclear safety culture has to foster a constant sense of unease that prevents complacency yet at the same time is has to foster a professional pride and a feeling of accomplishment to maintain work motivation and healthy occupational identity.

***NKS-223 RiskEval: Interpretation and Risk Evaluation of Technical Specification Conditions***

RiskEval was financed by NKS and NPSAG. The aim was to publish a guidance for evaluation of technical specification (TS) conditions with PSA. The activity covered PSA quality; how to verify that the PSA model is sufficiently robust and sufficiently complete; general requirements on methods; and acceptance criteria for evaluation of changes in the TS conditions. TS are part of the safety documentation for Finnish and Swedish NPPs. Any changes therefore have to be reported and approved by the national regulatory body. As PSA has developed over the years, it has proved to be a useful tool for evaluating many aspects of TS from a risk point of view, and in that way making the PSAs as well as the decision tools better. This also means that it will be possible to take credit for safety system over-capacity as well as inherent safety features and strength of non-safety classed systems. However, PSA is only one of the tools that shall be used in an evaluation process of TS changes (strengthening / relaxation). PSA is an excellent tool to be used to verify the importance, and thereby possibly relaxation, of the TS requirements. But since PSA is only one tool in the evaluation, it is not sufficient in itself for defining which equipment shall or shall not have TS requirements. Phase 1 of RiskEval studied several risk-informed TS evaluation projects performed internationally. Several seminars with participants from the Finnish and Swedish nuclear community discussed methods and important aspects on risk-informed TS evaluation.

## **NKS-B Summary for 2006 – 2008**

### **Notes on some NKS-B activities**

#### ***NKS-173 BIODOS: Biodosimetry Applications in Emergency Preparedness***

The aim of BIODOS was to establish improved methods for biodosimetry that has specific application in emergency preparedness. Under this activity, the PCC (premature chromosome condensation) assay for biological assessment of radiation exposure was established in the involved laboratories. The range of work covered included assay optimization, analysis optimization, development of scoring criteria for PCC rings, comparison of the method to the classical cytogenic approach, and development of a PCC ring dose response curve. The results include an optimized approach for preparation and evaluation of the PCC assay for fast biological assessment of radiation dose which could be potentially applied in a triage manner in the event of a significant accident involving many persons. BIODOS has further served to build an informal network between the three involved organizations in order to provide capabilities in the event of an emergency and to expand the capacity of the individual laboratories. The work was continued in BIOPEX; see below.

#### ***NKS-175 UrbHand: Decision Support Handbook for Recovery of Contaminated Inhabited Areas***

The handbook provides Nordic decision makers and their expert advisors with required background material for the development of an optimized, operational preparedness for situations where airborne radioactive matter has contaminated a Nordic inhabited area. The focus is on mitigation of long-term problems. The information given in the handbook is comprehensive, and many details require careful consideration well in time before implementation of countermeasures in a specific area. Training sessions are therefore recommended. The handbook describes the current relevant Nordic preparedness (dissemination routes) in detail, and suggests methods for measurement of contamination and prognoses of resultant doses, and data for evaluation of countermeasures and associated waste management options. A number of non-technical aspects of contamination in inhabited areas, and of countermeasures for its mitigation are discussed, and a series of recommendations on the application of all the handbook data in a holistic countermeasure strategy are given. A part of the handbook development has been a dialog with end user representatives in each of the Nordic countries, to focus the work on the specific needs of the users.

#### ***NKS-176 SPECIATION: Speciation Analysis of Radionuclides in the Environment***

SPECIATION focused on further development of speciation methods for radionuclides; and investigation of speciation of radionuclides in the environment. The laboratory work included

- Further development on the speciation of I-129 and I-131 in water samples
- Speciation methods for I-129 and I-131 in air
- A dynamic system for fractionation of Pu and Am in soil and sediment
- Investigation on reabsorption of Pu during the fractionation of Pu in soil and sediment
- Speciation of I-129 in North Sea surface water
- Partition of Cs-137 and I-129 in Nordic lake sediments, pore-water and lake water
- Sequential extraction of Pu in soil, sediment and concrete samples
- Pu sorption to Mn and Fe oxides in geological materials
- Investigation of the adsorbed species of lanthanides and actinides on clay surfaces

A seminar on speciation and hot particles was arranged and two articles were submitted for publication in an international journal.

#### ***NKS-177 NordRisk: Nuclear Risk from Atmospheric Dispersion in Northern Europe***

Within NordRisk an NKS atlas was developed, describing risks from hypothetical long-range atmospheric dispersion and deposition of radionuclides from selected nuclear risk sites in the northern hemisphere. A number of case studies of long-term long-range atmospheric transport and deposition of radionuclides has been developed, based on two years of meteorological data. Radionuclide concentrations in air and radionuclide depositions have been evaluated and examples of long-term averages of the dispersion and deposition and of the variability around these mean values are provided.



***NKS-180 HOT II: Overview of Sources of Radioactive Particles of Nordic Relevance***

HOT II shows that there are many existing and potential sources of radioactive particle contamination of relevance to the Nordic countries. Following their release, radioactive particles represent point sources of short and long term radioecological significance, and the failure to recognize their presence may lead to significant errors in the short and long term impact assessments related to radioactive contamination at a particular site. Thus, there is a need of knowledge with respect to the probability, quantity and expected impact of radioactive particle formation and release in case of specified potential nuclear events (e.g., a reactor accident or an act of terrorism). Furthermore, knowledge with respect to the particle characteristics influencing transport, ecosystem transfer and biological effects is important.

***NKS-186 BIOPEX: Emergency Preparedness Exercise for Biological Dosimetry***

As a continuation of BIODOS (see above), the BIOPEX activity aimed at testing and validating the newly established dose calibration curve for PCC rings, a specific chromosome aberration for use in biodosimetry in large casualty emergency preparedness. The testing of the PCC ring technique was performed by direct comparison to the conventional dicentric assay, both conducted with a triage approach that gives a crude dose estimate through analysis of a relatively small number of cells. The results indicated that both triage assays were capable of discerning non-exposed cases and that in the uniform irradiations, the dose estimates based on data from both assays were fairly consistent with the given dose. However, differences were observed depending on the dose level. At doses about 5 Gy and below, dicentric scoring resulted in more accurate whole-body dose estimates than PCC rings. At very high doses PCC rings appeared to give more accurate dose estimates. With respect to the technical aspects, scoring of the PCC rings is easier and therefore somewhat faster but may be more sensitive to quality aspects. In conclusion, the study demonstrated that the PCC ring assay is suitable for use as a biodosimeter, especially for estimation of very high doses.

***NKS-187 GAPRAD: Filling Knowledge Gaps in Radiation Protection Methodologies for Non-Human Biota***

The background and rationale to GAPRAD relate to a lack of information on naturally occurring radionuclides in terrestrial and aquatic systems that have direct applicability for use in environmental impact assessments. Results from field activities are presented for some Nordic terrestrial, freshwater and brackish water systems. The data mainly concern activity concentrations of Po-210 in environmental media and selected biota allowing concentration ratios to be derived where appropriate. Furthermore, details in relation to Po-210 uptake and biogenetics in humans based on experimental work conducted within GAPRAD are presented.

***NKS-188 REMSPEC: Analysis of Remotely Accrued Complex Gamma Ray Spectra: A Proficiency Test***

REMSPEC was an exercise using synthetic gamma ray spectra to simulate the type of data that may be encountered in the early phase of a nuclear accident. The aim was to provide the participants with an opportunity to exercise without the practical difficulties involved in using live samples. An HPGe spectrum was synthesized containing a range of typical fallout isotopes and distributed, along with calibration information, to the participant laboratories. These were required to submit results within three hours of receipt of the data, with the option of submitting further results within one week. The results provided by the laboratories indicate that they were all able to identify and quantify virtually all the constituents of the spectrum. They also indicated that there remained some problems with aspects such as true coincidence summation and using file formats with which the laboratories might not be familiar.

***NKS-192 LUCIA: Assessing the Impact of Releases of Radionuclides into Sewage Systems in Urban Environments: Simulation, Modeling and Experimental Studies***

LUCIA was established to provide more knowledge and suitable tools for emergency preparedness purposes in urban areas. The design of sewage plants and their wastewater treatment systems is rather similar in the five Nordic countries. One plant from each country was selected for assessing the impact of radionuclide releases from hospitals into the sewage system. Measurements and model predictions of doses to potentially exposed members of the public were carried out. The results from the dose assessments indicate that in case of routine releases annual doses to the three hypothetical groups of

individuals are most likely insignificant. Estimated doses for workers are below 10  $\mu\text{Sv}/\text{year}$  for the two studied nuclides, Tc-99m and I-131. If uncertainties in the predictions of activity concentrations in sludge are considered, then the probability of obtaining doses above 10  $\mu\text{Sv}/\text{year}$  may not be insignificant. The models and approaches developed can also be applied in case of accidental releases. A laboratory intercomparison exercise was organized to compare analytical results among the participating laboratories, using the nuclides in question. A simplified process oriented model of the biological treatment was also proposed in order to estimate the concentrations and the retention time of the sludge in different parts of the treatment plant, which in turn can be used as a tool for dose assessments.

#### ***NKS-193 REIN: Long-Term Decline of Radiocesium in Fennoscandian Reindeer***

REIN was established to synthesize the available information on contamination levels and effective half-lives for Cs-137 in reindeer in Finland, Norway and Sweden. Several studies of radiocesium contamination in reindeer have been carried out in the Nordic countries over the last 50 years. However, the current (2009) slow decline in concentrations, which will maintain the consequences of the Chernobyl deposition for Swedish and Norwegian reindeer husbandry for at least another 10 – 20 years, has not previously been observed or predicted. In the Chernobyl affected areas Cs-137 concentrations in reindeer initially declined by effective half-lives of 3 – 4 years, whereas the current decline appears to be mainly governed by the nuclide's physical half-life (30 years). The high transfer of nuclides to reindeer, the geographical extension of reindeer herding and the special position of the Sami population in Finland, Norway and Sweden, demonstrate the need for maintaining competence and further developing the common basis for Nordic fallout management and emergency preparedness related to this food chain.

#### ***(NKS-201) PardNor: Parameters for Ingestion Dose Models for Nordic Areas***

PardNor addressed shortcomings in modeling of ingestion doses for Nordic decision support. Nordic preparedness authorities apply in principle either the ARGOS or the RODOS decision support system for consequence prognoses and optimization of countermeasure strategies. In both of these systems the integrated ingestion dose module is identical with the ECOSYS model developed in Germany shortly after the Chernobyl accident. However, a review has revealed that a number of ECOSYS parameters do not reflect the current state-of-the-art knowledge, and do not adequately represent Nordic conditions. Default ECOSYS parameters produce ingestion doses in Nordic areas that can be wrong by orders of magnitude. In PardNor new data were collected, thus enabling reliable use of ECOSYS scenarios involving contamination of Nordic food production areas. Analyses have been performed for each Nordic country to determine the sensitivity of the ingestion dose end-point in ECOSYS to variation in 9 selected, potentially important parameters (human dietary components and animal fodder components). This parametric sensitivity was found to vary considerably between the Nordic countries, reflecting considerable differences in diet and domestic production, and highlighting the importance of identifying appropriate location-specific parameters. The conditions for deposition and interception to vegetation would over a certain time span be very different in different Nordic areas. Also the influence on ECOSYS dose estimates of resuspension enrichment factors, leaching rates, fixation rates and desorption rates was investigated, identifying new data sets where needed.

### **Major Seminars, Exercises and Other Events 2006 Onward**

#### **Joint R&B activities:**

- Mini-seminar on the revision of R&B frameworks, Risø, Denmark May 2007
- Joint summary seminar. Stockholm, Sweden March 2009.
- Mini-seminar on the findings of the latest evaluation. SKI, Stockholm, Sweden Nov. 2006

#### **NKS-R activities:**

- Seminar on dependable requirements engineering of computerized systems at NPPs. Halden, Norway Nov. 2006.

#### **NKS-B activities:**

- YoungRad seminar for young scientists in the fields of radiophysics, radiochemistry, radioecology, radiation protection and related fields. Helsinki, Finland Dec. 2006.

- BIOPEX: Emergency preparedness exercise 2008 for biological dosimetry.
- FOREST seminar: Toward improved understanding of radionuclide transfer in forests and preparedness to handle contaminated forests. Helsinki, Finland Oct. 2008.
- NordTheat seminar. Asker, Norway Oct. 2008.

### **Revised R&B Framework Programs for 2008 and Beyond**

New frameworks for the NKS-R and NKS-B programs were adopted by the Board in November 2008. Many of the features of the initial R&B framework will be recognized. For examples of possible program contents, activities and other details, see the policy document in Appendix 6. For later updates, please turn to [www.nks.org](http://www.nks.org).

#### **NKS-R Framework: Reactor Safety**

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

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

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

The following main research areas are judged to be of current interest:

- Reactor physics and thermo-hydraulics
- Modernization, introduction of new techniques and new demands
- Aging of nuclear facilities
- Severe accidents
- Probabilistic methods
- Organization, man and safety culture
- Phase-out and decommissioning of nuclear facilities
- Common seminars for reactor safety and emergency preparedness

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

#### **NKS-B Framework: Emergency Preparedness**

The aim of the NKS-B program is to strengthen Nordic work concerning

- radiological emergency preparedness
- management of radioactive waste and discharges
- radioecology and environmental assessments

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

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

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

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

The NKS-B program is structured into three basic areas: research, seminars and education. Research work should be focused on maintaining and building up competence. Seminars should aim at building and maintaining both competence and networks. Education should help building competence in the individual countries with the aim of reaching the common goals.

When evaluating proposals for activities they will be judged against how well they comply with the framework as well as against their scientific and pedagogical merits.

The following main research areas are judged to be of current interest:

E	Emergency preparedness (in general as well as specific tools)
W	Waste and discharges
R	Radioecological assessments
M	Measurement strategy, technology and quality assurance

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

### **Joint R&B activities**

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

- decommissioning and waste management
- common seminars covering both R and B activities
- information and communication activities targeting media and the general public

# Concluding Personal Reflections

## Conclusions and Recommendations

- Don't lose the Nordic touch in the name of international cooperation or as a result of making English the working language. The Nordic added value is just that: an added *value*.
- Make sure that the results of NKS activities are properly reported to end users, financiers and participating organizations, and that the results are implemented where relevant and applicable.
- It is time for a new evaluation of the last years of NKS work – very soon.
- Revise the policy document, which is from 2008 (both the Swedish and English versions).
- Cooperation with Estonia, Latvia and Lithuania has proven to be valuable, as is cooperation between the Nordic countries and all Baltic Sea states.
- Conferences, seminars and workshops can be rewarding and cost-effective ways of networking and dissemination of information.
- Exercises are valuable but the larger they get, the more resources they demand. This is especially true for international or Nordic emergency preparedness exercises (like INEX, NORA and ODIN); it is equally true for RESUME type measurement or surveillance exercises. Smaller calibration and intercomparison exercises and meteorological and similar table-top exercises are rewarding and cost-effective.
- Remind all new program managers of the NKS policy not to accept non-EU participation in NKS activities without careful scrutiny, in order to avoid unwanted arrivals in the Schengen area.
- Shift to only one website, all in English, except perhaps old minutes of Owners Group and Board meetings, or the administrative handbook (a translation might not have top priority).
- Keep the Call for Proposals process as timely, simple and fast as possible, for the sake of applicants as well as NKS.
- Always include the full budget as an Appendix to the Board minutes and specify all appropriations in the minutes (full title, acronym, budget and any conditions for each activity). This makes life easier for the auditor, evaluators and other persons in need to know.
- Keep close tabs on the economy – no more “luxury problems” where steadily growing sums of funds are transferred from one year to the next; or the occurrence of opposite situations like the one with the inadvertent overspending of SOS-1 money.
- National in-kind contributions should be included in an overall estimate of the total NKS budget. It is this figure that the administrative costs should be compared to; not just the monetary contributions by the owners and others.
- Old NKS numbered documents, presently available only as print-outs at the Secretariat, should be scanned and fed into the electronic archives for future reference. New such documents should be filed electronically as they appear, together with old and new NKS photographs.
- All documents published on the webpage before board meetings should be saved in the electronic archives, especially financial reports, budgets and material on Calls for Proposals and the program managers' status reports and recommendations. The material might best be kept on the password protected webpage.

## Points to Ponder

- Have the conclusions and recommendations of previous evaluations influenced the continued work?
- What happened to the owners' decision to specify contributions etc. in euros? It seems to have been forgotten.
- The current way of handling proposals and applications for NKS funding is on the right track. But since the R&B programs at one time or another get a preliminary budget frame for planning purposes, the program managers are well aware of the financial restrictions for the next year or so. Is it then necessary to have a fixed period during which to submit applications? Or could the Call for Proposals be extended to the entire year, as long as a set of simple instructions on the website

are followed? The applications shall answer some basic questions: Who is supposed to do what why when where how at what cost, who picks up the tab and who benefits from it all? The program managers could have the applications assessed as they appear and mail the application together the assessment and a suggested decision to the Board for an email discussion and final decision, perhaps in a Silent Procedure. Only the controversial proposals would then have to wait until the next physical Board meeting.

- Consider the very sound and important recommendations given in the last paragraph of the 2006 NKS-B evaluation as regards the evaluation process. Perhaps it should be a standing agenda point for each meeting that the Board should discuss in depth the results of activities that have been finished and a final report published since last meeting? The Board should also decide who should do what in order to communicate the results to end users and other interested parties, and make sure the results are being considered for implementation. Every 4 years or so there should be an evaluation of results, reports, processes, usefulness, practicability, efficiency etc. At that time the Board or Owners Group might also want to scrutinize the NKS structure and administrative support function and rethink the plans for the future.
- Is it perhaps time to do away with the old principle of equal sharing of NKS funds between the R and B parts? Why not let the number of relevant applications and the proposed funding guide the Board's decision? Chances are the distribution will be 50-50 over time anyway. And if not, does that not reflect a reality that should not be ignored?
- What happened to the agreed exchange of information with EU? Is that taken care of by the activities?
- One agenda point at every board meeting is the mutual exchange of information between the organizations. So why (just to give an example) weren't the other Nordic countries informed on the large Swedish exercise that started just before the unfortunate Fukushima event in 2011?
- Have the owners or the board ever considered a change of auditor to prevent personal ties and avoid complacency? There is no obvious reason for a change, but it seems appropriate to at least discuss this matter from time to time, perhaps when evaluating NKS work and activities.
- The Secretariat and R&B program managers could handle a significantly larger volume of research funds at approximately the same administrative cost. Increased contributions to NKS would lower the relative size of the administration.
- There are hidden administrative costs (e.g., the program managers' and chairman's pay) that perhaps should be considered when discussing overhead costs.



The Great Language Divide: English or Scandinavian? Photo: Torkel Bennerstedt

### Areas of Discussion Throughout the Years

- NKS structure and research work: Under constant discussion, in order to make participation and support more attractive for both financiers, researchers and end users.
- Size of "administration" (a concept that has never been defined by the Board): For the first time evaluated in 2006, and under constant scrutiny ever since.
- Cost effectiveness: Undefined popular topic of discussion.
- Number and size of projects / activities: Constant decisions to make them fewer and larger; but often forgetting this when deciding on new or revised programs.

- Joint or separate Owners Group and Board meetings? At present NKS is back where it started, with separate owners' meetings, and a report at the board meetings.
- Size and composition of the Board: No significant changes have been made, in spite of some suggestions from individual owner representatives and the evaluator of NKS' organization.
- Working language: That issue finally seems to be settled once and for all. English it is.
- Scope, objectives and fields of NKS work: From 4-year classics to R&B.
- Waste issues – in or out? There was a time when especially the Finns were totally against all waste projects, since they claimed to have all knowledge and international cooperation they needed. Their interest in sharing this knowledge with their Nordic neighbors was nil. With new owner representatives and a totally new nuclear program, this has changed for the better.
- Should NKS engage in information projects? The answer has varied, but presently it seems to be a firm no, given prior experience and results.
- R or B? At times it may be difficult to decide whether a proposed activity belongs to R or B; see for instance the minutes of the Board meeting on May 6, 2003, regarding nuclear vessels.
- Cooperation with the Baltic states: Many are for it, others more or less indifferent. The present position seems to be that cooperation with the Baltic countries is OK if it is relevant, NKS is in charge and the Baltic participation does not require NKS funding.
- Support to young researchers, PhD and MSc work: For many years this type of support was more of a mantra than an actual fact. Now with the possibility of travel grants and other initiatives on the part of R&B program managers, the situation seems to be improving.

### **Some Final Business**

- Have the NKS results been put to practical use by the financiers and other potential end users? Implementation and feed-back from end users and others tend to be neglected – or at least: the end users have failed to report back to the NKS Board any implementations that have been made. Seemingly, it has been more important to get good grades from the evaluators than positive feed-back from the end users. Why not arrange an NKS Footprints Seminar?
- It could be useful to gather a seminar with former project leaders and program managers lecturing on their experiences of NKS work and what it has meant to their careers and their special field of study. Has it been of value when moving on to EU projects or new positions, nationally or internationally? What can future generations learn from this? (This seminar could be part of the NKS Footprints Seminar suggested above.)
- Just as a reminder, an excerpt from the evaluation of SBA-2 (the information project 98-01): As for NKS information activities in general, the proper authorities and financiers should define what services are required from NKS – any actions should be end-user driven. (I.e., the initiative should not come from the information officers. Any proposed information activity should undergo the same scrutiny as any other activity.) Future plans – if any – should be more concrete than has been the case earlier.
- Only once in all his years as Nordic secretary, the author of this report has come across a case of non-compliance with a board decision. From the minutes of the Board meeting at NRPA on Nov. 21, 2002: "The chairman proposed and distributed a chart to be used by the program managers for presenting plans vs. results in their status reports. The chart was accepted by the Board." In spite of this clear message and several reminders at later meetings, the proper charts were never used. The board not as much as reprimanded the program managers.
- At the board meeting in Helsinki on May 6, 2003 the chairman reported that NKS had received an offer from London International Television to produce a 5-minute documentary / commercial on NKS at a cost of GBP 30,000. The board decided that NKS should not engage in this sort of undertakings.

## **Signing Off, At Long Last**

It's been a mighty experience, writing this history of NKS. A true trip down Memory Lane. An assorted bouquet of the finest Nordic flowers. Happy smiles at good times and clever quips – NKS is a lot of fun, too, admit it!

With all its errors and shortcomings, my story depicts 15 years of diligence and inspiration on the part of hundreds of people from a handful of small countries on the Arctic rim. Work beyond self. Including, disparate, mind boggling. Thoughts keep crisscrossing my mind. And it all boils down to one word that characterizes the collective NKS effort: dedication.

That's great. You're great. Keep on keeping on.

Torkel Bennerstedt  
TeknoTelje HB  
Torhamn, Sweden

### **STRONGER LESSONS**

**Have you learn'd lessons only of those who admired you,  
and were tender with you, and stood aside for you?  
Have you not learn'd great lessons from those who reject you,  
and brace themselves against you?  
or who treat you with contempt, or dispute the passage with you?**

**Walt Whitman: Leaves of Grass (From Annex 1, 1888)**



Torhamn

Photo: Torkel Bennerstedt



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Directives for the pre-projects of the 94-97 program.

NKS(94)7: Pre-project report of the 94-97 program.

NKS(97)FR10: Final Summary Report of the Nordic Nuclear Safety Program 1994 – 1997 / Sammanfattning av det nordiska forskningsprogrammet för kärnsäkerhet. (Eds.: Torkel Bennerstedt, Annette Lemmens).

NKS(98)2: Utvärdering av NKS-programmet 1994 – 1997 (Antti Vuorinen) (Evaluation of the NKS program 1994 – 1997).

NKS(98)1: The final report of the program group for the 1998 – 2001 program.

NKS-5: Plans for the NKS Program 1998 – 2001 (including directives and report of the reference and pre-project groups plus the final report of the reference group).

NKS 68: Final Summary Report of the Nordic Nuclear Safety Program 1998 – 2001 / Sammanfattning av det nordiska forskningssamarbetet för kärnsäkerhet (Ed.: Torkel Bennerstedt).

NKS-69: Samordningsfunktionen. Slutrapport for Nordisk Kernesikkerhedsforsknings projekt SEK. (Torkel Bennerstedt, Finn Physant, Annette Lemmens.) November 2002. (Final report of the administrative services project SEK 1998 – 2001.)

NKS-66: Facklig utvärdering av NKS-programmet 1998 – 2001 (Gustaf Löwenhielm, Raimo Mustonen) (Evaluation of the scientific NKS program 1998 – 2001).

NKS-67: Evaluering av organisasjonen – NKS-programmet 1998 – 2001 (Martin Høiby) (Evaluation of the NKS organization 1998 – 2001).

Material on the new R&B program.

NKS(05)4: Reactor Safety Part of the NKS Program. NKS-R Framework.

NKS(05)6 Rev.: Directives for the Evaluation of NKS Work in 2002 – 2005 (see Appendix 1 in NKS-145).

NKS-145: Evaluation of NKS Activities During 2002 – 2005 (Risto Sairanen, Per Persson, Per Hedemann Jensen, Tore Lindmo).

Other relevant NKS numbered documents, e.g., various technical and final reports. See also separate Appendices for minutes of Consortial and Board meetings.

# Appendices

Appendix 1	Brief Summary of NKS Owners Group Meetings
Appendix 2	Brief Summary of NKS Board Meetings
Appendix 3	Overview of NKS Programs and Evaluations 1977 – present
Appendix 4	Economic Contributions to NKS in DKK
Appendix 5	NKS Budgets in DKK
Appendix 6	NKS Policy, Framework and Procedures
Appendix 7	NKS-R Activities and Funding
Appendix 8	NKS-B Activities and Funding
Appendix 9	Author’s Remarks
Appendix 10	List of Some Important NKS Documents
Appendix 11	Acronyms and Abbreviations Used in This Report

## Appendix 1: Brief Summary of NKS Owners Group Meetings

(Including minutes from the meetings of the NKS Consortium)

The following meetings of the Consortium / Owners Group have been documented.

(DK = Denmark; FI = Finland; IS = Iceland; NO = Norway; SE = Sweden)

Date		Host and/or Venue	NKS Doc. No.
Nov. 16, 1993		Arlanda / Stockholm, SE	NKS(93)15
Sept. 2, 1994		SKI, Stockholm, SE	NKS(94)15
Feb. 24, 1995		BRS, Bernstorff Slot, Gentofte, DK	NKS(95)4
Jan. 11, 1996		STUK, Helsinki, FI	NKS(97)4
Jan. 30, 1997		SKI, Stockholm, SE	NKS(97)16
Sept. 4, 1997	*	DEMA, Snekkersten, DK	NKS(97)19
Feb. 5, 1998		NRPA, Østerås, NO	NKS(98)5
Sept. 17, 1998		IVO, Helsinki, FI	NKS(99)4
Feb. 10, 1999		DEMA, Bernstorff Slot, Gentofte, DK	NKS(99)13
Sept. 15, 1999		SKI, Stockholm, SE	NKS(99)15
Feb. 9, 2000		NRPA, Østerås, NO	NKS(00)3
May 3, 2000	**	Arlanda / Stockholm, SE	NKS(00)14
Nov. 8, 2000	***	VTT, Innopoli, Otaniemi, FI	NKS(00)19
March 8, 2001	*	SKI, Stockholm, SE	NKS(01)6
May 21, 2001	*	IRSA, Reykjavík, IS	NKS(01)11
May 22, 2001	****	IRSA, Reykjavík, IS	NKS(01)12
Nov. 7, 2001	***	Kongrescenter Roskilde, DK	NKS(01)17
March 20, 2002	*	Hotel Prindsen, Roskilde, DK	NKS(02)5
May 6, 2002		SSI, Stockholm, SE	NKS(02)12
Nov. 20, 2002		NRPA, Østerås, NO	NKS(02)15
May 5, 2003		KTM, Helsinki, FI	NKS(03)5

Legend (applies to the table above as well as the summaries below):

- \* Extraordinary Owners Group meeting
- \*\* Extraordinary joint Owners Group and Board meeting
- \*\*\* Status Seminar followed by a joint Owners Group and Board meeting
- \*\*\*\* Joint Owners Group and Board meeting

Starting in May 2005, news from the Owners Group meetings are included in the minutes of the Board meetings. Hence, no separate documentation from the owners are available after that date.

The agenda normally included the following points:

- 1 Standard items (practical questions for the meeting; news from the participants' organizations; minutes of the last meeting; next meeting)
- 2 Financial plans, contributions and follow-up
- 3 Policy questions, structure and administrative matters
- 4 Overview of the technical and scientific work of the NKS program
- 5 Additions to or changes in the technical / scientific work
- 6 Spring: auditor's report
- 7 Information and communication issues, dissemination of results
- 8 Any other business

This Appendix highlights some of the most important issues and decisions of the 1994 – 2003 Owners Group meetings. Items 3, 7 and – to a certain extent – 5 and 8 are normally the only ones that are included here, since the others are normally reported elsewhere in this document. The owners' yearly financial contributions from 1998 and onward are found in a separate appendix together with funding

from other sources (Appendix 4). NKS budgets are summarized in Appendix 5. Technical / scientific results are reported under separate headings in the main text.

The complete minutes are available on the NKS website. So are the results of NKS research – in the form of reports, information on seminars etc.

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**Nov. 16, 1993** **Arlanda / Stockholm, SE** **NKS(93)15**

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The 1993 meetings are beyond the scope of this report. but since this meeting was important for the work in 1994 and onward, it is nevertheless included.

- Magnus von Bonsdorff participated in the meeting as new chairman of NKS.
- Franz Marcus will act as Nordic secretary the first half of 1994, and support the new Nordic secretary in the second half.
- Torkel Bennerstedt and Thomas Eckerød were invited to the meeting and were interviewed as possible candidates for the post. It was decided to negotiate a contract with Torkel Bennerstedt, and plans for his work in 1994 were outlined.

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**Sept. 2, 1994** **SKI, Stockholm, SE** **NKS(94)15**

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- The 1994 – 1997 program as presented in NKS(94)7 may start as planned. AFA-1 and EKO-3 need some additional planning.
- NKS has earlier commented reports etc. from the Nordic Council of Ministers in questions regarding nuclear safety. The Nordic secretary is to inform the Council that in the future such requests should be sent to pertinent national authorities, not NKS.
- A contract will be signed with Franz Marcus for continued services in 1995 (25% of a full time).

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**Feb. 24, 1995** **BRS, Bernstorff Slot, Gentofte, DK** **NKS(95)4**

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- Since both SKI and SSI help finance NKS work Sweden was allowed two representatives in the Owners Group.
- The owners endorsed the Board's acceptance of the project plans for 1995. The financial support to NKS in 1995 was confirmed, along with the budget. Funding was granted for projects in reactor safety (RAK-1 and RAK-2), radioactive waste (AFA-1), radioecology (EKO-1, EKO-2, EKO-3 and EKO-4), and information (SAM-4).
- Funds were allocated for the historic review to be written by former Nordic secretary Franz Marcus.

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**Jan. 11, 1996** **STUK, Helsinki, FI** **NKS(97)4**

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- The national contributions to NKS will be the same as last year. The extra funding provided by NRPA, SKI and SSI in 1995 is not available in 1996. The Swedish funding is handled by SKI but is shared equally by SKI and SSI.
- It was confirmed that Sweden has two representatives in the Owners Group.

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**Jan. 30, 1997** **SKI, Stockholm, SE** **NKS(97)16**

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- As recommended by the NKS Board the project plans for 1997 were adopted.
- The budget was accepted once the amount for EKO-3 has been checked.
- The Nordic secretary and the Reference Group leaders may make smaller adjustments between the RAK projects and the EKO projects, respectively.

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**Sept. 4, 1997** \* **DEMA, Snekkersten, DK** **NKS(97)19**

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- Former STUK Director General Antti Vuorinen was invited to this extraordinary meeting in his capacity of evaluator of the **1994 – 1997** program.

- The owners declared their willingness to finance a continued Nordic cooperation program, granted that the proposed project plans are found to be of relevance for the end users. The economic support in 1998 is expected to be of the same order as in 1997.
- The owners are to participate in future Board meetings. This will facilitate dissemination of information between the two groups and be practical from a number of aspects. (*Author's comment: Cf. the minutes from Feb. 5, 1998.*)
- The Bureau was urged to continue its work in planning for the next 4-year program, and it was decided to appoint a program committee chaired by Sigurður Magnússon. Its work should focus on scientific issues but may also address structural and organizational issues. Directives for the Committee will be written by the Nordic secretary and the SKI representative.
- Future project leaders are to report directly to the Board.
- Still ongoing activities within the **1994 – 1997** frame will not receive additional funding from the owners and is to be reported to the Board in mid 1998.
- A joint seminar for the entire **1994 – 1998** program will be arranged in Stockholm in March 1998.

**Feb. 5, 1998**

**NRPA, Østerås, NO**

**NKS(98)5**

The **1994 – 1997** program:

- It was noted that the final reporting from EKO-3 and EKO-4 is delayed.
- The evaluation report, NKS(98)2, is expected by mid March. The owners were informed on the status and the evaluator's recommendations.
- Since the total costs for coordinating NKS work (Nordic secretary, Secretariat, printing and dissemination of reports etc.) may seem conspicuously high, it was decided that this issue should be discussed in the final 1994 – 1997 administrative report. Some of the costs are actually directly attributable to the scientific and technical work. The administrative support from the Secretariat and the Nordic secretary is to be evaluated in about two years.

The **1998 – 2001** program:

- It was expected that unused funds in the order of DKK 1 million will be transferred from 1997 to 1998. The amount is available for new projects, developed through proper pre-projects. If the proposals are not accepted by the owners and the Board, a refund will be made to the owners. (*Author's comment: Cf. Sept. 15, 1999.*)
- Six pre-projects were launched: SOS-1, SOS-2, SOS-3, BOK-1, BOK-2, SBA. The work is to be reported at a seminar in September. The six owners are to name one pre-project leader each. The pre-project work is to be supervised by a special reference group, chaired by Sigurður Magnússon. The SKI and SSI representatives are to write directives for the reference group in cooperation with the Nordic secretary. The reference group was given the mandate to start activities that should not wait until the Board meeting in the fall, or that are well-known and well planned. A total budget of DKK 2.4 million was allocated for the pre-projects and the reference group.
- The scientific reference groups linked to the different 4-year programs were abolished, effective from the start of the coming 4-year program.
- All NKS projects and groups are urged to be more cost effective. The terms of the contracts with the Nordic secretary and the Secretariat will be reviewed halfway into the new 4-year program.
- It was decided that the owners are also members of the Board. Each country may appoint up to three national experts (Sweden four) as members of the Board. (*Author's comment: Cf. the minutes from Sept. 4, 1997.*)

**Sept. 17, 1998**

**IVO, Helsinki, FI**

**NKS(99)4**

- The routines regarding the audit of NKS bookkeeping shall be reviewed.
- The owners confirmed a number of issues discussed at the previous Board meeting; the final reports and evaluation report regarding the 1994 – 1997 program; and the start of the new 1998

– 2001 program. An evaluation of the new program will be made halfway into the 4-year period. No organizational changes were made.

- It was decided that the owner representing SSI will outline a new Letter of Intent on future cooperation between the owners of NKS.

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**Feb. 10, 1999**                      **DEMA, Bernstorff Slot, Gentofte, DK**                      **NKS(99)13**

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- A new Letter of Intent between the owners has been signed.
- The owners shared the Board's views concerning the **1994 – 1997** program, the policy document, the role of the Bureau and the status of the project work (see Board meeting minutes for details). The SOS-3 budget was confirmed.
- Board members were urged to take active part in implementing and disseminating the results of NKS work. The implementation is to be reported at the midway seminar.

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**Sept. 15, 1999**                      **SKI, Stockholm, SE**                      **NKS(99)15**

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- The owners decided to investigate the legal possibilities to transfer unused NKS funds from one program period to the next and from one year to the next. A report is to be compiled by the Secretariat. (*Author's comment: Cf. March 7 – 8, 2001.*)
- It was further decided to adjust the economic and administrative routines (to the extent possible, national laws and regulations taken into account) in accordance with the suggestions and recommendations made in the audit report for 1998. The Nordic secretary is to report the results of the investigations to the owners during the fall and suggest changes.
- The owners agree that discussions on the next NKS research period (be it 3, 1+3, 1+4 years or whatever) should start in 2001.
- The possibility to use unspent funds to support young scientists will be explored at a later stage.

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**Feb. 9, 2000**                      **NRPA, Østerås, NO**                      **NKS(00)3**

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- The views of the Board regarding the **ongoing program** were confirmed. (*Author's comment: See the corresponding Board meeting minutes.*)
- National processes will be initiated to identify relevant uses of the financial balance from last year and planning for the **next 4-year program**. The project leaders will receive an invitation from the Nordic secretary to participate in the process. The outline of the next program is to be discussed at an extraordinary Board meeting at Arlanda in May 2000.
- The owners should contact present and potential national (external) financiers of NKS (*tilläggsfinansiärer*) to discuss their financial support and participation in NKS work.

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**May 3, 2000**    **\*\***                      **Arlanda / Stockholm, SE**                      **NKS(00)14**

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This was an extraordinary joint Owners Group and Board meeting; see Appendix 2 on Board meetings for details.

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**Nov. 8, 2000**    **\*\*\***                      **VTT, Innopoli, Otaniemi, FI**                      **NKS(00)19**

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A status seminar was followed by a joint Owners Group and Board meeting; see Appendix 2 on Board meetings for details.

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**March 7 – 8, 2001**    **\***                      **SKI, Stockholm, SE**                      **NKS(01)6**

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This was an extraordinary meeting.

The **1998 – 2001** program: The SOS, BOK and SBA annual reports were accepted.

The **next program**:

- ❖ Documents NKS(01)2 and NKS(01)4 served as input in the discussions regarding the new NKS structure and future program. The following principles were laid down:

- The work will be divided into **two areas**: the **NKS-R** program (**reactor safety** including waste and development issues); and the **NKS-B** program (**emergency preparedness** including radioecology and emergency preparedness related information/communication; B stands for *Beredskap*, which is Scandinavian for emergency preparedness).
  - A program manager will be appointed for each program.
  - NKS funds are to be divided about equally between R and B.
  - Each program will consist of 5 – 10 large ongoing activities. New activities will be added as old ones are completed.
  - The rigid 4-year programs are thus replaced by a flexible system of activities of varying duration, scope and participants.
  - A certain degree of competition will be introduced; how this is to be achieved is yet to be defined.
  - All activities and budgets will be decided by the Board. New activities may be initiated by external groups, the program managers or the Board itself. The procedure for submitting applications and evaluating proposals is yet to be determined.
- ❖ The Norwegian and Swedish owners accepted to outline the scientific profile of the R&B programs, and the Bureau was asked to draft a document to be used when recruiting the program managers. The Bureau was also instructed to produce a graphical presentation of the new organization and NKS structure.

Other matters:

- The size of the Board was discussed. No changes were suggested.
- The future relations between NKS, the Nordic Directors Group and NEP are to be discussed at a later stage.
- An estimate of the administrative costs of NKS as part of the overall budget is to be made. A reasonable figure would be in the order of 15%.
- Helge Smidt Olsen was elected **new chairman** of NKS by a unanimous vote. He will take over after Magnus von Bonsdorff starting Jan. 1, 2002.

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**May 21, 2001      \*                      IRSA, Reykjavík, IS                                      NKS(01)11**

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This was an extraordinary meeting.

- The owners were of the opinion that the Board should normally decide in questions regarding new activities, and that only activities recommended by the program manager should be considered.
- The owners went on to unanimously appoint Timo Okkonen program manager of NKS-R and Sigurður Emil Pálsson of NKS-B.

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**May 22, 2001      \*\*\*\*                      IRSA, Reykjavík, IS                                      NKS(01)12**

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This was a joint Owners Group and Board meeting; see the minutes of that meeting in Appendix 2.

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**Nov. 7, 2001      \*\*\*                      Kongrescenter Roskilde, DK                                      NKS(01)17**

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A Status Seminar was followed by this joint Owners Group and Board meeting. Please refer to Appendix 2 for the minutes of the meeting.

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**March 20, 2002      \*                      Hotel Prindsen, Roskilde, DK                                      NKS(02)5**

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This was an extraordinary meeting.

- The proposed new Owners Group Letter of Intent (“contract”) was accepted with some minor changes and was signed the next day.
- It was decided that from now on all contributions to NKS should be specified in **euros**, not in DKK or the various national currencies.

- The Secretariat is to present a list of all administrative written or oral agreements now governing practical NKS work.

**May 6, 2002**

**SSI, Stockholm, SE**

**NKS(02)12**

- As requested by the Nordic Directors Group and suggested in the organizational and administrative evaluation of the 1998 – 2001 program, the long-term structure and goals of NKS are to be discussed during the rest of the year. The work will be initiated and coordinated by the SSI representative.
- It was decided that future Owners Group meetings should once again be separated from the Board meetings.
- The Bureau suggested administrative changes saving some DKK 0.6 million per year. In addition to this, Board members' travel cost refunds were discussed. The owners were not aware of the generous terms for refunds and decided that owners and Board members are to be refunded on rare occasions only.
- The Nordic secretary presented a list of written and oral agreements as requested.

**Nov. 20, 2002**

**NRPA, Østerås, NO**

**NKS(02)15**

- The Nordic secretary pointed out that the new NKS structure has led to a situation where nobody has a full grasp of the total scientific and administrative work. This was of little concern to the owners, who stressed the central role of the Board, both individually and as a group, and the key position of the program managers in networking, producing and disseminating results.
- The number of working hours and travels put in by the Nordic secretary have decreased as stipulated in his new contract with SKI.
- The owners noted with some concern the accumulation of unused funds, mostly due to delayed invoicing from the participating organizations, and stated that measures need to be taken to remedy this.
- The strategy discussion initiated at the last meeting had not resulted in any reactions from any of the owners. The Swedish owners are to produce a short background material to be used by the Board in its deliberations. Meanwhile, NKS work will proceed up to and including in 2004.
- The final version of the **1998 – 2001 scientific evaluation** will be handed over to the Board for discussions and implementation, as appropriate.
- It was decided that the NKS chairman is welcome to participate in future owners' meetings.

**May 5, 2003**

**KTM, Helsinki, FI**

**NKS(03)5**

- The final reports from the **1997 – 2001** program will be available on a CD-ROM, together with all older technical reports, final reports, evaluations etc. The owners expressed their thanks to the Secretariat for this comprehensive coverage of NKS and NKA work.
- The **present program**: Since Timo Okkonen has left his position with STUK, Petra Lundström of Fortum was appointed new NKS-R program manager. Sigurður Emil Pálsson continues as program manager of NKS-B.
- The Swedish draft strategy paper needs more work before a Board discussion can take place.



## Appendix 2: Brief Summary of NKS Board Meetings

The following Board meetings were held and documented in the period 1994 – 2008:

(DK = Denmark; FI = Finland; IS = Iceland; NO = Norway; SE = Sweden)

Date		Host and/or Venue	NKS Doc. No.
Feb. 8, 1994		Bolkesjø, NO	NKS/RE(94)1
June 7, 1994		Vantaa, Helsinki, FI	NKS/RE(94)2
Sept. 2, 1994		SKI, Stockholm, SE	NKS/RE(94)3
Feb. 24, 1995		DEMA, Bernstorff Slot, Gentofte, DK	NKS/RE(95)1
Sept. 20, 1995		IFE, Halden, NO	NKS/RE(95)2
Jan. 11, 1996		STUK, Helsinki, FI	NKS/RE(96)1
Aug. 27, 1996		IRSA, Reykjavík, IS	NKS/RE(96)2
Jan. 30, 1997		SKI, Stockholm, SE	NKS/RE(97)1
Sept. 4, 1997		DEMA, Snekkersten, DK	NKS/RE(97)2
Feb. 05, 1998		NRPA, Østerås, NO	NKS/RE(98)1
Sept. 17, 1998		IVO, Vantaa, FI	NKS/RE(98)2
Feb. 10, 1999		DEMA, Bernstorff Slot, Gentofte, DK	NKS(99)9
Sept. 15, 1999		SKI, Stockholm, SE	NKS(99)17
Feb. 9, 2000		NRPA, Østerås, NO	NKS(00)5
May 3, 2000	*	Arlanda, SE	NKS(00)14
Nov. 8, 2000	**	VTT, Innopoli, Otaniemi, FI	NKS(00)19
May 22, 2001	***	IRSA, Reykjavík, IS	NKS(01)12
Nov. 7, 2001	***	Kongrescenter Roskilde, DK	NKS(01)17
March 19, 2002	****	Hotel Prindsen, Roskilde, DK	NKS(02)4
May 7, 2002		SSI, Stockholm, SE	NKS(02)11
Nov. 21, 2002		NRPA, Østerås, NO	NKS(02)16
May 6, 2003		KTM, Helsinki, FI	NKS(03)4
Nov. 13, 2003		IRSA, Grand Hotel Reykjavík, IS	NKS(03)7
May 5, 2004		SIS, Herlev, DK	NKS(04)5
Nov. 9, 2004		SKI, Stockholm, SE	NKS(04)10
May. 12, 2005	‡	Hotel Olavsgaard, Lillestrøm, NO	NKS(05)3
Nov. 17, 2005		IRSA, Grand Hotel Reykjavík, IS	NKS(05)8
May 11, 2006		Dipoli, Otaniemi, FI	NKS(06)5
Nov. 10, 2006		SSI, Stockholm, SE	NKS(06)9
May 11, 2007		Risø, Roskilde, DK	NKS(07)6
Nov. 16, 2007		NRPA, Østerås, NO	NKS(07)11
May 7, 2008		DEMA, Kastellet, Copenhagen, DK	NKS(08)5
Nov. 19, 2008		IRSA, The Culture House, Reykjavík, IS	NKS(08)8

Legend (applies to the table above as well as the summaries below):

- \* Extraordinary joint Owners Group and Board meeting
- \*\* Status Seminar followed by a joint Owners Group and Board meeting
- \*\*\* Joint Owners Group and Board meeting
- \*\*\*\* Extraordinary Board meeting
- ‡ From this meeting on, an oral report from the Owners Group meeting is given to the Board and included in the minutes of the Board meeting. The Owners Group meetings are to take place the day before the Board meeting. (At an Owners Group meeting on Sept. 4, 1997, it was decided that the owners will participate in future Board meetings. This will facilitate dissemination of information between the owners and the Board and be practical from a number of aspects. The Owners Group meetings could however be held at any date, irrespective of the date of the Board meetings.)

The agenda has varied slightly over the years, depending on the present structure of NKS work. Normally the agenda has included the following points:

- 1 Standard items (practical questions for the meeting; news from the participants' organizations; minutes of the last meeting; next meeting)
- 2 Economic status report
- 3 Policy questions, structure and administrative matters
- 4 Reports from project leaders / program managers;
- 5 Fall: Call for Proposals; decision on new projects / activities and next year's budget
- 6 Spring: auditor's report
- 7 Information and communication issues, dissemination of results
- 8 Any other business

This Appendix highlights some of the most important issues and decisions of the 1994 – 2008 Board meetings. Only items not reported elsewhere in this document are presented here.

The complete minutes are available on the NKS website. So are the results of NKS research – in the form of reports, information on seminars etc.

**Feb. 8, 1994**

**Bolkesjø, NO**

**NKS/RE(94)1**

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Organizational matters:

- New chairman of the Board: Magnus von Bonsdorff.
- New secretary of the Board: Helge Smidt Olsen.
- New Nordic secretary: Start of a 12-month transition period from Franz Marcus to Torkel Bennerstedt.
- NKS funding by the Nordic Council of Ministers ceased in 1989. The ties between NKS and the Council should be cut not for this reason alone but for several others as well: scientific, political and practical. E.g., NKS can no longer assist with expert opinions on various (sometimes politically raised) nuclear issues as has happened in the past.

The **1990 – 1993** period: The final reports of the projects of BER, KAN, RAD, SIK and SAM are all delayed. So is the annual report for 1993. The evaluation of the old program should be reported no later than June 1994.

The **1994 – 1997** period:

- The pre-project work regarding preparations for the next 4-year period is underway (phase 1: planning has been reported). Pre-project leaders and participants were appointed.
- The role and mandate of the reference groups were discussed. The Board confirmed that the objective is to prioritize and lead the scientific work of the various projects and report to the Board.
- A special working group called the Bureau was formed. Participants: the chairman of the Board, the secretary of the Board and the Nordic secretary.
- The secretarial functions will remain with Risø for the time being.

**June 7, 1994**

**Vantaa, Helsinki, FI**

**NKS/RE(94)2**

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Several of the final reports for the **1990 – 1993** program are delayed. NKS lacks means to put pressure on the project leaders. Two of the evaluation reports are still missing. The ones that have been finished contain some constructive criticism, which will be passed on to the new project leaders,

The administrative routines are to be reviewed and a new version of the administrative handbook published. This is done to emphasize that final reports are an integrated part of the total project work and thus must be prioritized from the start.

Decisions regarding the **1994 – 1997** program:

- Motivation and priorities regarding some projects must be clarified.
- The results should be presented in a form that makes them directly applicable, e.g., handbooks and directives.
- Specified parts of the projects can be started now. Later instructions from the Board are to be followed.
- Chairpersons and members of the reference groups were appointed, together with the project leaders of the new RAK, AFA and EKO projects.
- Appointed project leaders:  
 RAK-1: Kjell Andersson, Karinta-Konsult, Sweden  
 RAK-2: Ilona Lindholm, VTT Energy, Finland  
 AFA-1: Karin Brodén, Studsvik RadWaste, Sweden  
 EKO-1: Sigurður Emil Pálsson, IRSA, Iceland  
 EKO-2: Tone D Bergan, IFE, Norway  
 EKO-3: Jens Hovgaard, DEMA, Denmark → Anneli Salo, Consultant, Finland  
 EKO-4: Eldri Naadland Holo, NRPA, Norway
- The overall program might be too large to handle, given budget and personnel constraints. This will be discussed at the next meeting.

**Sept. 2, 1994**

**SKI, Stockholm, SE**

**NKS/RE(94)3**

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- The **1990 – 1993** evaluation report will be published shortly and sent to relevant organizations. The evaluators have applied various structures and methods in their work and focused on different aspects. Thus, the results are somewhat disparate. One of the chapters gives recommendations for the future organization of NKS work. It is suggested that a midway evaluation of the projects is performed after about two years. Furthermore, it is suggested that a certain portion of the budget for every project be withheld until the final report has been delivered.
- The **1994 – 1997** program: The Board expressed its satisfaction with the RAK-1, RAK-2, EKO-1 and EKO-4 plans. Further information was requested for AFA-1, EKO-2 and EKO-3. NKS will write contracts with the respective project leader's organization, stating the terms of the work. The responsibility for the projects rests with the organizations, not the project leaders personally. The mandate of the reference groups is to follow the work, not to lead or steer it. In order to make NKS work more flexible, detailed budgets for 1996 and 1997 will not be decided until the first two years' results have been evaluated.
- The earlier Board decision to avoid NKS involvement in questions raised by the Nordic Council of Ministers in what could be felt to be political or sensitive matters was confirmed.

**Feb. 24, 1995**

**DEMA, Bernstorff Slot, Gentofte, DK**

**NKS/RE(95)1**

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- The evaluation report for the **1990 – 1993** period has been printed and distributed. 4 of 16 of the final project reports for the period are still missing.
- Re the **1994 – 1997** program: The project plans for AFA-1, EKO-2 and EKO-3 were approved. Thus, the entire program had been accepted. Work has already begun in most projects and subprojects.
- It was decided that the annual report for one year and the plans for next year are combined in one report.
- It was decided to write a policy document for NKS work, including a set of project criteria that have to be fulfilled. The Board's winter meeting will be held in mid-January, starting next year. The contracts with the project leaders' organizations are all in place.
- Franz Marcus presented a plan for a book on the history of Nordic nuclear cooperation. The idea was accepted in principle, but the economic issue remains unsolved.

**Sept. 20, 1995**

**IFE, Halden, NO**

**NKS/RE(95)2**

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There are still three final reports missing from the **1990 – 1993** period. A folder introducing NKS and its work will be published in Scandinavian languages and English.

The **1994 – 1997** program:

- All projects follow the adapted time schedule. A detailed division of EKO-4 into subprojects and tasks was accepted. A new project, EKO-5, suggested and financed by the Swedish Rescue Services Agency, SRV, was approved.
- RAK-1 has produced a paper on possible future cooperation with EU. The Board recommended other project leaders to follow suit and decided to develop informal contacts with EU (DG-XI and DG-XII). The Nordic secretary was requested to contact EU in order to facilitate future discussions on possible modes of exchange of information. At a later stage, the NKS chairman could head a small NKS delegation to Brussels for joint discussions.
- EKO-1 communicates with its participants via a WWW Home Page. This pilot project will be followed closely by the Board and might serve as an inspiration to all projects and – indeed – NKS itself.

Other matters:

- The Nordic Directors Group reportedly expressed their satisfaction with NKS work at its last meeting.
- From now on, a summary final report will be published as soon as the final reports have been approved by the Board. The summaries (in Scandinavian languages and English) are identical with the summaries published in the full reports. (*Author's comment:* Cf. Jan. 30, 1997.) The target group consists of any and all persons and organizations interested in the results of NKS work. The distribution of the full final reports will be limited to the inner NKS circle.
- NKS will not finance cooperation projects with countries in eastern Europe. (*Author's comment:* Cf. Aug. 27, 1996.)
- The work with a policy document and the Nordic history is now underway.

**Jan. 11, 1996**

**STUK, Helsinki, FI**

**NKS/RE(96)1**

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- Criteria for midway and post-program evaluations of NKS projects were approved.
- The **1990 – 1993** period: Three final reports are still missing.
- The **1994 – 1997** period: The Board had ordered a critical review of the ongoing projects, which was now reported. Some delays had occurred and the great number of subprojects was questioned. So was the value of some of the subprojects. Adjustments of subproject plans were made as needed. In most cases cost-effectiveness, compliance with budgets and plans and achieved results were in line with the Board's expectations. Consequently, the plans for continued work in 1996 were approved.
- The heads of the information department of relevant authorities had submitted an application for an information project. It was accepted in part by the Board and added to the EKO program. There was a general attitude that information issues should be closer integrated with the projects in the next NKS four-year program.
- The Board confirmed a decision at an earlier meeting to publish the annual reports and the plans for next year as *one* report.
- Franz Marcus' Nordic history will be published by the Nordic Council of Ministers in their report series. (*Author's comment:* Due to the strained relations to the Nordic Council, the book was finally published by NKS.)

**Aug. 27, 1996**

**IRSA, Reykjavík, IS**

**NKS/RE(96)2**

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- There are still three final reports missing from the **1990 – 1993** period.
- Re the ongoing program, **1994 – 1997**: The critical review presented at the last Board meeting turned out to be helpful. Most projects (including their subprojects) are progressing as planned, and work with the final reports has been initiated. Both the reference groups and the Board play an important role in quality control of the reports. The draft policy document presented by the Bureau is to be revised and a new draft to be presented at the next Board meeting, together with draft evaluation directives. The chairman will contact DG-XII in order to pave the way for a visit by a small NKS delegation, and the Nordic secretary is to propose a policy for EU-

NKS contacts. The object is to inform about NKS and discuss a possible contact forum for the coming 4-year NKS period.

- Re the **next 4-year program**: The Board, reference groups and project leaders are to suggest new projects and areas of interest. The Bureau was asked to compile the proposals and suggest a procedure for the upcoming planning process.
- The Board stated that NKS should seriously consider a wider cooperation with eastern Europe. Nothing was said about scope, timeframe or costs. (*Author's comment*: Cf. Sept. 20, 1995 above.)

**Jan. 30, 1997**

**SKI, Stockholm, SE**

**NKS/RE(97)1**

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The **1994 – 1997** program:

- NKS work is by and large progressing according to plans.
- Parts of the information project (SAM-4) were questioned and additional guidelines given for the final report.
- The recriticality work of RAK-2.1 will be continued as an EU project in 1997 – 1998.
- The annual project reports for 1996 were approved.
- The Nordic secretary presented revised guidelines for the final reports. All Summaries are to be compiled in a new type of report (Summary Final Report, in English and one Scandinavian language) together with a brief introduction by the Nordic secretary. (*Author's comment*: Partly a restatement – see Sept. 20, 1995.)
- It was pointed out that all NKS activities shall be performed in such a fashion that they cannot be misinterpreted as regulations or recommendations issued by national authorities. (*Author's comment*: Cf. Feb. 5, 1998, third bullet point.)
- The draft evaluation criteria presented by the Bureau were discussed and a few changes made.
- It was decided to ask professor Antti Vuorinen, former head of STUK, to perform the evaluation, and his first reaction was “not disinterested”.
- It was decided to arrange an NKS seminar to report on the present program and discuss the new program.

The next NKS program (**1998 – 2001**):

- The Bureau introduced two drafts, one with directives for the planning and one on the collection of proposals.
- Each owner will arrange a national meeting with all interested parties to formulate a national proposal for discussions with the reference groups and the Bureau.
- The Nordic secretary was asked to invite all NKS participants to propose new projects or areas of work, compile the proposals and distribute them to the owners and the Board.
- The Board will then decide on the new NKS program.

Other matters:

- The Bureau was given mandate to finish the work with the new policy document.
- It was reported that the Nordic Directors Group at their last meeting expressed a positive attitude toward NKS and its work.
- The NKS chairman, Nordic secretary and Franz Marcus will meet with EU representatives shortly to discuss modes of exchange of information and coordination.

**Sept. 4, 1997**

**DEMA, Snekkersten, DK**

**NKS/RE(97)2**

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The **1990 – 1993** program: The final report from the BER-6 project (Reclamation of contaminated urban and rural environments following a severe nuclear accident (Per Strand et al.) is now ready after a historically long delay.

The **1994 – 1997** program:

- A few minor delays are expected in the RAK projects.

- AFA work proceeds as planned.
- EKO-5, initiated by SRV, is finished after less than two years, including the final report.
- Some delays are reported for a couple of the EKO- projects; likewise for SAM-4, which started later than the rest of the projects.
- During 1997, the Nordic secretary and the Secretariat have focused their attention on the final reports and seminars of the various projects; planning for the evaluation of the present program; planning for the next NKS program; and new media and modes of communication.
- At least six summing-up seminars are planned; one of which is a joint seminar for all NKS projects.
- The final reports will be distributed as a CD-ROM and (for those requesting it) in print.
- Antti Vuorinen, who had accepted the task of evaluator of the present program, reported on his work.

The **1998 – 2001** program:

- The work done by the Bureau in defining the framework of the new program is to be continued.
- The owners were urged to nominate a program committee to work out the details of the new program in cooperation with the Bureau.
- The chairman and Nordic secretary were given renewed mandate for the upcoming period.
- There will be no reference groups next period.

The Nordic history by Franz Marcus will undergo a language check before publication; apart from that, it is almost finished.

**Feb. 5, 1998**

**NRPA, Østerås, NO**

**NKS/RE(98)1**

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The **1994 – 1997** program:

- Most final reports are finished and several of the final project seminars have been held. Invitations for the joint final seminar have been distributed.
- Antti Vuorinen presented his draft evaluation report. He will recommend that NKS funds fewer but larger projects and focuses on training of young scientists and competence building.
- The Board stressed that the role of NKS is to give recommendations to authorities and the industry; NKS has no mandate to issue rules or standards. (*Author's comment: Cf. Jan. 30, 1997, sixth bullet point.*)
- A meeting with EU will be arranged in the spring.

The **1998 – 2001** program:

- The draft structure presented by Sigurður Magnússon (two major programs, SOS and BOK, with a number of flexible activities that may run for one or more years) was received positively by the Board.
- The Nordic secretary was asked to draft directives for the pre-project work.
- A number of pre-project leaders and other participants will work out the details of the program.
- A special reference group for the pre-projects will be appointed by the owners. The group was given the mandate to initiate certain project activities.
- The pre-project work is to be reported at a seminar before the next Board meeting.

Other matters:

- Franz Marcus' Nordic history is ready to be printed.
- The graphic profile of NKS was approved.
- There is a growing interest in the NKS website; the number of hits is steadily increasing.
- A short report from the last meeting of the Nordic Directors Group was given and the Nordic secretary was invited to future meetings as an observer.

The 1994 – 1997 program:

- Final reports on EKO-2, EKO-4 and SAM are still missing. Thanks were conveyed to those project leaders who had finished their reports.
- The Nordic secretary presented a summary of the full evaluation report by prof. Vuorinen. The conclusions and recommendations of the evaluation were discussed. Some of them have already been implemented in the new program, others will follow as the program evolves.

Contacts with EC:

- Information was given on the joint NKS-EC seminar. NKS cannot expect EC funding, but a communication channel has been established to try to avoid NKS overlaps of EC projects.
- New project leaders will be instructed to keep abreast with EC projects and developments.
- EC does not find the existence of regional cooperation programs controversial.

The 1998 – 2001 program:

- After some minor changes, the project plans for SOS-1 and SOS-2 were approved as presented. The costs for SOS-3 have to be better motivated; other than that, the plans were accepted.
- Certain subprojects were shifted around between BOK-1, BOK-2 and SBA; and SBA was divided into two projects.
- The following project leaders were appointed:
 

SOS-1:	Kjell Andersson, Karinta-Konsult, Sweden
SOS-2:	Kaisa Simola, VTT Automation, Finland
SOS-3:	Karin Brodén, Studsvik, Sweden
BOK-1:	Bent Lauritzen, Risø, Denmark
BOK-2:	Sigurður Emil Pálsson, IRSA, Iceland
SBA-1:	Inger Margrethe Eikermann, NRPA, Norway
SBA-2:	Vibeke Hein, BRS, Denmark
- The Nordic secretary heads the Secretariat at FRIT. The secretarial services of the SEK program (formerly SAM) are expected to continue much as before.
- The Board pointed out that focus must be on research rather than investigations and compilation of facts, in order to warrant continued funding from the owners' research funds.
- The Board stressed the importance of coordination between the various projects, specifically including careful planning of seminars, dates and venues.

The 1994 – 1997 program: The EKO-2 and EKO-4 final reports are still missing, together with a number of reports from RAK-1 and EKO-5 subprojects.

The 1998 – 2001 Program:

- The Board expressed concern regarding the slow start of some of the projects. This was not the project leaders' fault, it was pointed out, but rather a consequence of the preparation phase (program group and pre-projects).
- The ongoing work was approved, and a contact person in the Board was appointed for each of the project leaders.
- The document "This is NKS" presented by the Nordic secretary was approved.
- The Board decided not to formally invite EU to the upcoming midway seminar, but that Nordic EU delegates could receive an informal invitation.
- The Board expects project leaders to establish contact with EU experts as needed and plans to follow up on the contacts of yesteryear.

It was noted that SEK and FRIT will leave Risø and move to CAT across the road. It was confirmed that FRIT/SEK is responsible for the NKS archives and reference library.

The **next NKS program**: It was decided that the Bureau shall prepare a document before the next Board meeting, outlining some ideas for the planning procedure and program structure.

The **1994 – 1997** program: The EKO-2 and EKO-4 final reports are still missing. The Board expressed its dissatisfaction with the unacceptable and lengthy delays.

The **1998 – 2001** program:

- The chairman thanked for the fine presentations given at the status seminar the day before. The Board agreed that this is an effective form for updating the Board and triggering discussions. NKS work, by and large, proceeds according to plans.
- Actions were taken to adjust some details, and further information on certain subproject issues were requested. SBA-2 has been inactive for the past six months due to lack of project participants. Anders Jörle was appointed new project leader of SBA-2.
- A midway seminar with tentative evaluation of the achievements so far in this period will be held in the fall of 2000. The Bureau will draft directives for the seminar and evaluation.
- It was decided to send the the final reports for the 1994 – 1997 program and the plans for 1998 – 2001 to EU.
- The new organizational chart of NKS, presented by the Bureau, was accepted.
- SEK was urged to check with the auditor whether it is legally possible to transfer funds from one 4-year program to the next. (*Author's comment:* Cf. Feb. 9, 2000, last bullet point; and Nov. 8, 2000, fifth bullet point.)

Feb. 9, 2000

NRPA, Østerås, NO

NKS(00)5

The **1994 – 1997** program: The EKO-4 final report has been published. The EKO-2 report is still missing.

The **1998 – 2001** program:

- All annual project reports were approved. The objectives of SOS-1 and its target groups need to be more clearly identified. SOS-2 is running well but appears to be too ambitious and needs to be limited in scope. SOS-3, BOK-2 and SBA-1 work was approved. BOK-1 work is on schedule, except for one subproject. Revised plans for the SBA-2 information project were presented, discussed and approved. The project leader was urged to keep in contact with the SBA-1 and SOS-1 projects.
- A midway seminar with tentative evaluations of current results will be arranged in Helsinki on Nov. 7 – 8, 2000. The evaluations will be performed by the project leaders' contact persons in the Board.
- Funds are available for additional project work and may be applied for.
- The Board understands that NKS funds will be transferred from one year to the next and from one program period to the next. (*Author's comment:* Cf. Sept. 15, 1999, last bullet point; and Nov. 8, 2000, fifth bullet point.)

May 3, 2000 \*

Arlanda, SE

NKS(00)14

The **1998 – 2001** program:

- Since the BOK-1.6 subproject reports no action or results it will be cancelled after another month unless there are definite signs of viability and improvement.
- A number of proposals for new subprojects and activities were accepted, and the project plans and budgets were changed accordingly. The Nordic secretary was granted a budget for promoting Nordic – Baltic cooperation, as needed.
- The status seminar (with evaluation and a study to a Triga reactor) in November was discussed. The Bureau will revise the draft agenda.
- The presented directives for the evaluation of the current program are to be revised by the Bureau but can be used tentatively in the ongoing planning process. The Nordic secretary is to coordinate the work to name national candidates for the evaluation group. The Bureau is to propose a budget for the entire evaluation process.



The **next NKS program**: Names of suggested planning group participants shall be sent to the Secretariat.

**Nov. 8, 2000 \*\***

**VTT, Innopoli, Otaniemi, FI**

**NKS(00)19**

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The **1998 – 2001** program:

- As suggested by the project leader of SBA-2 the information project will be discontinued.
- The midway evaluations presented at the status seminar the day before will be taken into account when planning for the next NKS program. The project leaders are to assure that the Board's views as manifested in the discussion following the seminar are considered in the continued work.
- The Board is positive to a proposed joint NSFS – NKS seminar. The Bureau was granted a small budget for this purpose.
- A transition seminar for final reporting of the present program and plans for the next will be held in Denmark in 2002.
- The Board is aware that there will be unused funds at the end of the 4-year period. The amount in question will be transferred to the next program period. The owners will decide how the funds are to be used. (*Author's comment*: Cf. Sept. 15, 1999, last bullet point; and Feb. 9, 2000, last bullet point.)
- The Board confirmed its decisions in May regarding new subprojects and budgets, and added a number of new subprojects and budget items.
- Directives for the final reporting 1998 – 2001 as suggested by the Bureau were accepted.
- Evaluators of the present scientific program: Raimo Mustonen, STUK, and Gustaf Löwenhielm, SKI. The directives proposed by the Bureau were adopted with minor changes.
- Evaluator of NKS organization and administration: Martin Høiby, NRPA. The directives proposed by the Bureau were adopted with minor changes.

The **next NKS program**: A memo from the Bureau outlining a new scientific program structure and a slimmer and more flexible *modus operandi* met with the Board's immediate approval and will be discussed further. The Bureau suggested that two major areas of work be identified: Emergency preparedness including radioecology; and Reactor safety including decommissioning and waste. A revised memo will be discussed at the next Board meeting. An extra Owners Group meeting will be held shortly to discuss the new program; the chairman and the Nordic secretary will be invited to participate.

As Helge Smidt Olsen leaves the NKS Board, the owners appointed Sigurður Magnússon as new secretary of the Board.

**May 22, 2001 \*\*\***

**IRSA, Reykjavík, IS**

**NKS(01)12**

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The **1998 – 2001** program:

- The agenda of the seminar the day before the Board meeting included presentations and discussions of project status, final reporting, and the scientific and organizational / administrative evaluations. The discussions were continued at the Board meeting. The Board expressed its satisfaction with the presented drafts of the final reports.
- The apparent overspending of SOS-1 funds has to be investigated and necessary action taken. The Nordic secretary is to report back to the Board in two weeks.
- The Board redirected funds from the inactive information project (SBA-2) and a BOK-2 subproject.
- The Nordic secretary reported on the great number of seminars that have been held or are being planned and a couple of large international exercises (Baltic Nuclear and Barents Rescue) with NKS participation. An international seminar in Oslo on ethics and environmental issues is planned for October; NRPA was urged to make sure that the Board's intentions regarding contents and lecturers are observed.
- The chairman summed up the evaluation reports. The conclusions and recommendations will feed back into the discussions on the coming program.

**The next NKS program:**

- The revision of the Bureau document on the new NKS structure and program is to be continued.
- The Board was informed that the owners had appointed the two program managers: Timo Okkonen, STUK (NKS-R) and Sigurður Emil Pálsson, IRSA (NKS-B).
- The presented guidelines for the reactor safety (NKS-R) and emergency preparedness (NKS-B) programs will be handed over to the program managers. NKS-R work will prioritize, e.g., thermohydraulics and human factors. The importance of involving the nuclear industry was stressed. In NKS-B the close link between emergency preparedness and radioecology will be stressed.
- A planning group of ten persons (the owners, the program managers, the chairman and the Nordic secretary) will work out a proposal of initial activities and present it to the Board.

**Nov. 7, 2001 \*\*\***

**Kongrescenter Roskilde, DK**

**NKS(01)17**

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This was Magnus von Bonsdorff's last meeting as chairman of NKS. He will be succeeded by Helge Smidt Olsen.

**The 1998 – 2001 program:**

- SOS-1 finances: The Nordic secretary reported on the actions taken during the summer and fall. The Bureau had ordered an investigation by the auditor, and the results were now discussed by the Board. This problem would not have occurred had the project leader been more diligent in following up the expenditures; and the Nordic secretary was too late in realizing the seriousness of the situation. The information from the Secretariat to the project leader had been correct, but it was understandable that he could miss the warning signals, given the format for presenting the figures. The figures were there for everyone to see, also the Board, but nobody reacted in the early phases of the development; and the Nordic secretary did not sound the alarm as early as could be expected. However, the internal system of checks and follow-up worked, although a bit late. The secretarial routines and formats for presenting economic reports will be revised. SOS-1 was granted additional funding, and the project leader will reduce his fee so the total cost will match the given budget.
- The Nordic secretary was instructed to – in cooperation with the Secretariat – make the written economic reports to the Board and the project leaders more transparent.
- The Board was reluctant toward future seminars on ethical/philosophical issues and environmental radiation protection, and consensus seminars in general.
- The final reports should focus on Nordic added value of the efforts; achievements and practical results; and the participants' in-kind support should be estimated.
- The administrative evaluation has been completed. The scientific evaluation awaits the final reports of the projects.

**The next NKS program:**

- The R&B frameworks as presented at the previous status seminar were accepted after a few modifications.
- There are distinct differences between R and B as regards end user value and implementation (authorities and industries).
- The Bureau will review the central organization and administrative routines to better fit the needs of the new NKS structure.
- The Board members were encouraged to suggest guidelines and priorities regarding future activities and fields of work.
- The program managers are to work out detailed program proposals in cooperation with the Nordic secretary, to be discussed at the next (extra) Board meeting.
- The document "This is NKS" is to be revised by the Bureau in accordance with the recommendations in the administrative evaluation report.
- It was decided that organizations from Baltic Sea countries can participate in NKS activities at their own expense if it benefits NKS and its goals.

This was Helge Smidt Olsen's first meeting as chairman of NKS. Olli Vilkkamo will for some time fill in for Timo Haapalehto.

The new **R&B program**:

- The R&B program managers can be called on to participate in (parts of) the Board meetings; they are also free to participate if they wish.
- The program managers' outlines of the structural framework and initial activities were well received. The Board stressed the importance of transparent assessments of proposed activities in accordance with NKS criteria and demanded total control of the financial situation. The Swedish owners pointed out that proposed activities should be cleared with relevant end users and co-financiers. Nine R and eight B activities were approved by the Board.
- A new draft Owners' Letter of Intent was discussed and will be completed at the next Owners Group meeting.
- The Nordic secretary informed on the seminar "NKS today and tomorrow".

The **1998 – 2001** program:

- The Nordic secretary delivered a short status report on the final work within the 1998 – 2001 program.
- The Finnish owner reported on the somewhat delayed scientific evaluation.

The **R&B program**:

- Report from the last meeting of the Nordic Directors Group: The group is satisfied with the new program structure and initial activities and stressed the importance of efficiency and cost effectiveness. There is a need for a thorough discussion among the owners as to legal aspects and the long-term strategy of NKS.
- To clarify the roles of the owners and the Board, respectively, a separation of Owners Group meetings and Board meetings is called for.
- The owners agree to a great degree with the administrative evaluation and its conclusions; the owners are however divided on the issue of the size of the Board. Discussions on the long-term NKS strategy have been launched.
- The Bureau suggested annual cost cuts of some DKK600k which met with the Board's approval.
- The chairman pointed out that well over 80% of available financial resources are spent on R&B work. Hence, the potential for savings in absolute numbers and increase in cost effectiveness should be greater in scientific activities than in administration. The Board was therefore urged to assess all new R&B proposals from this point of view.
- The program managers shall ensure that all activities are embraced by the potential end users and that the expected results are realistic.
- The program managers delivered status reports and the Board accepted a number of new activities.
- It was decided that on certain conditions MS and PhD courses and work can be supported by NKS.
- The draft program and administrative handbooks were discussed; revised versions are to be distributed shortly.
- The Nordic secretary presented a list of written contracts and oral agreements regulating NKS work.
- The total NKS budget for 2002 as presented by the Bureau was accepted.
- Only about 60% of the budget for the seminar "NKS today and tomorrow" had to be used.

The **1998 – 2001** program:

- The SBA-1 and BOK-2 final reports are still missing.

- The scientific evaluation will be finished shortly.

**Nov. 21, 2002**

**NRPA, Østerås, NO**

**NKS(02)16**

**The R&B program:**

- All future R&B contracts must specify a deadline for scientific work and final reporting.
- Activities approved at one Board meeting have to be contracted by the time of the following meeting in order not to risk cancellation.
- The Owners declared that measures should be taken to avoid an accumulation of unused funds.
- The Owners have decided to prolong the present program into 2004.
- The chairman is invited to participate in future Owners Group meetings. (The Nordic secretary acts as secretary at these meetings.)
- The Swedish owners agreed to produce a memo to be used in the continued strategy discussions.
- In their status reports to the Board, program managers shall include information on participants, end users and an estimate of the quality of the expected results.
- The chairman proposed and distributed a chart to be used by the program managers for presenting plans vs. results in their status reports. The chart was accepted by the Board.
- The Board approved seven new R activities and seven new B activities plus a small Baltic travel fund for the B program.
- The presented program handbook and administrative handbook need additional revision.

**The 1998 – 2001 program:**

- The Board expressed its satisfaction with the beta version of the CD-ROM containing the final reports, technical reports and other NKS material.
- The SBA-1 final report has not yet been finished.
- The scientific evaluation report is ready and will be discussed at the next Board meeting.

**May 6, 2003**

**KTM, Helsinki, FI**

**NKS(03)4**

**The R&B program:**

- The program manager of NKS-R, Timo Okkonen, was replaced by Petra Lundström, Fortum, since TimO had left his position with STUK.
- The strategy discussion continued – and will do so. The owners and members of the Board were urged to send their input to the Swedish owners who will produce a new memo.
- The NKS-B status report was well received. Additional funds were allocated for the NucVes (nuclear vessels) activity. After an intense debate on whether this actually is a B activity and not rather an R activity it was decided to keep it under the B umbrella.
- The Board was interested in the Nordic Nuclear Network suggested by the NKS-R program manager.
- Due to the present financial situation no new activities were added to the R or B programs. Work to find new co-financiers is in progress.
- The program handbook and administrative handbook were approved.
- It was decided that final reports shall still be printed but that the project managers can choose whether technical reports should be printed or published electronically.

**The 1998 – 2001 program:**

- The Secretariat demonstrated a master CD containing the final reports. Older reports and other relevant material will be added.
- The scientific evaluation was presented and discussed in depth. The mostly positive report concludes that the objectives were fulfilled and recommends that NKS work continues for a new period. The evaluators supported the new structure and administrative changes adopted by the Board. The chairman thanked the evaluators for their valuable contributions.

**The R&B program:**

- 10 new R activities and 11 new B activities were approved. Conditions for continued work / funding of some of the ongoing R&B activities were given.
- The Nordic secretary informed on the preparations for a joint NKS-BKAB seminar on Quality in Radiation Protection Work at Nuclear Installations.
- At its last meeting the Nordic Directors Group concluded that for the foreseeable future the Directors Meetings and NKS will continue to be two separate arenas with no formal links.

**Planning for the future:**

- The Swedish owners presented a memo on efficiency and organization in the next couple of years.
- The Board agreed on the goals but differed somewhat in ways to get there.
- It was decided to let the program managers report whether they are able to take on additional tasks under the present contracts with NKS.
- The Swedish owners and the Nordic secretary will discuss his function in order to optimize his efforts and use of resources.
- The Bureau was asked to send a questionnaire to the program managers and all of their activity leaders in order to poll the general opinion on the new program structure, organization and administrative support.

- The Board approved the additional work and funding of ongoing activities requested by the program managers, together with the suggested relocation of funds within the R&B programs.
- The Board wished to stress that if there is a request for relocating unused funds to another activity, this is to be considered as a new new application and will be treated as such.
- The Nordic secretary informed on the participants' very enthusiastic evaluation of the second joint NKS-BKAB seminar on Quality in Radiation Protection Work at Nuclear Installations. A third seminar of this kind, however, requires an external initiative by a co-sponsor and end user.
- The Bureau reported that the activity leaders were satisfied with the new R&B structure and the services offered by the Nordic secretary and the Secretariat, and that the program managers saw no possibility to take on more administrative duties under the present contract.
- The Secretariat was requested to draft a policy for dissemination of information.

- The proposed funding of 9 R activities was approved, together with a revised framework for the R program as a whole. The Board expressed some concern regarding the fact that there are activities with as little as one or two participating organizations. Measures should be taken to avoid this to the extent possible, in order not to lose the Nordic dimension.
- The proposed funding of 11 B activities was approved. The Board pointed out that the process of assessing new proposals should be made more transparent.
- Re the new program handbook: The Consortial partners should from now on be referred to as the Owners. The Owners are also the main financiers of NKS. It is the Board that decides in budgetary matters, after proposals from the Bureau. With this, the handbook was accepted.
- The Nordic secretary presented the new routines for dissemination of information. Changes have been made in the program and administrative handbooks. The NKS webpage is updated continuously, and electronic newsletters and newsflashes will be distributed as need be; at least twice a year.

- Report from the previous Owners Group meeting: The owners are very satisfied with the new structure. A replacement for the present program manager for NKS-R will have to be found

soon since Petra Lundström has been promoted to a top position within her present organization. The contract with the NKS-B manager will be prolonged. Although the owners are satisfied with the Bureau and its work, administrative routines and costs will continue to be scrutinized. Discussions and a new decision on the administrative way ahead can be expected at the November meeting.

- The presented R&B status reports and their respective applications for additional funding were approved. The Board expressed its satisfaction with the work.
- The need for an evaluation of NKS work since the start of the R&B programs will be discussed in November. The Bureau was asked to produce a memo until then.
- An NKS status seminar in Finland May 2006 was discussed and a work group (the Bureau and a Finnish Board member) was appointed.
- The improved NKS website and newsletters were discussed.

**Nov. 17, 2005**

**IRSA, Grand Hotel Reykjavík, IS**

**NKS(05)8**

News from the previous **Owners Group meeting**:

- Nici Bergroth fills in as program manager for the rest of the year. It was later decided that Jesper Kierkegaard will take over in 2006.
- Measures will be taken to save money and simplify the administration. Effective June 2006, the post of Nordic secretary will be replaced by a time-limited coordinating function. The Bureau will be dissolved and the post as secretary of the Board discontinued. NKS owners, board members, chairman, secretariat and program managers are expected to take over most of the work earlier done by the Nordic secretary, the secretary of the Board and the Bureau. The role of the coordinator will be defined over time and is expected to decrease.
- Finland and Sweden will check whether some large R activities could be carried out bilaterally, thus opening for NKS activities concerning decommissioning and waste, which could be of a more general Nordic interest. Also, a review of the R program should consider the interests of the co-financiers.
- Sigurður Magnússon takes over as chairman of NKS after the next Board meeting.

**The R&B program**:

- The proposed funding of 9 R and 10 B activities was approved. The Board declared its satisfaction with the progress of the R&B program.
- The Bureau presented its proposed directives for the evaluation of work and results in 2002 – 2005. It was accepted after some changes. SEK will not be evaluated this time since the owners had already done that since the May meeting. The R&B evaluators were appointed: Risto Sairanen and Per Persson (NKS-R); Per Hedemann Jensen and Tore Lindmo (NKS-B).
- The program and budget for the 2006 NKS status seminar presented by the Bureau was positively received by the Board. The work group will continue its preparations.
- The Board is satisfied with the NKS website and the number of hits registered.
- SEK will have to review the VAT routines, especially the favorable agreement with SKI which will be ended shortly due to new regulations.

**May 11, 2006**

**Dipoli, Otaniemi, FI**

**NKS(06)5**

News from the previous **Owners Group meeting**:

- A new program manager for NKS-B is expected to take over in 2008.
- The NKS framework program needs to be reviewed in the light of the past years' experience, conclusions of the evaluation (once it is finished) and the presentations and discussions at the status seminar.

**The R&B program**:

- The Board approved funding of one R and four B activities and expressed its satisfaction with the progress of work in relation to adopted work plans. It was stressed that the major portion of the funding of the NKS-B Young Scientists Seminar should be used for travel grants rather than for seminar preparations.

- The Board was pleased with the status seminar in despite of the unexpectedly low attendance (some 60 participants).
- A new NKS pamphlet was distributed at the status seminar, and a beta version of a coming DVD containing all NKS reports and other material since the start was available for testing; it will be ready for distribution shortly.
- The evaluation report shall be finished no later than September 2006. The NKS coordinator arranges a meeting in the summer with the involved persons to speed up the process.
- The Call for Proposals procedure and the assessment of proposed activities will be reviewed by the program managers and the new chairman. Their work has to be completed before the next CfP.
- Two work groups were appointed to review the R&B frameworks. Their reports are to be presented at the November meeting and any changes adopted at that meeting should be implemented in May next year.
- New versions of the program and administrative handbooks were presented by the coordinator. The program handbook may be used tentatively until a revised version is to be discussed by the Board.
- Sigurður Magnússon now took over as chairman and thanked Helge Smidt Olsen for his many years of dedicated work for NKS.

**Nov. 10, 2006**

**SSI, Stockholm, SE**

**NKS(06)9**

- The new chairman, Sigurður Magnússon, noted that the structural and administrative changes seem to work well. But it is still too early to discuss and evaluate the new regime.
- The Board thanked the four evaluators for their fine work, both as regards the scientific results and the constructive conclusions and recommendations for future activities. The section on dividing NKS funds between R and B, the five countries and participating organizations was thought provoking. NKS results are of high standard, especially considering available resources. The evaluation will be published as NKS report No. NKS-145. The implementation of suggested changes will be discussed together with the review of the R&B frameworks.
- The coordinator presented the Secretariat's report on the status seminar in Otaniemi, Finland.
- The ongoing review of the R&B frameworks was reported and will continue at the next meeting. The revision of the Call for Proposals procedure was presented. End users shall be identified in all applications and given an opportunity to comment on the usefulness of the activity in question. In the case of NKS-B the Nordic NEP group will be considered as a potential end user.
- Since Jesper Kierkegaard moves on to a new job, Patrick Isaksson was appointed new NKS-R program manager.
- The Board approved funding of nine R and eight B activities.
- The chairman was given the mandate to use up to DKK100k between Board meetings for urgent matters.
- The program and administrative handbooks cannot be updated until the revision of the R&B frameworks is finished.
- The coordinator reported that a new folder is under production; electronic newsletters are sent out as scheduled; and the much delayed DVD will be distributed shortly. The website will undergo a complete overhaul.

**May 11, 2007**

**Risø, Roskilde, DK**

**NKS(07)6**

- The coordinator and the NKS-B program manager will be replaced during 2008.
- Work on the new R&B frameworks will continue in the summer. As a part of this work, prioritized areas for this year's Call for Proposals are to be identified.
- An information policy shall be outlined by the chairman, the coordinator and the Secretariat. It is to be integrated with the program handbook and the framework to form an NKS policy document and shall be presented at the next Board meeting. The administrative handbook will undergo a revision once the policy document has been approved.

- According to status reports given by the program managers R&B work is proceeding according to plans, apart from some minor delays.
- NKS-B: It is essential that REIN is concluded as soon as possible. A reservation for additional funding of one activity was made, pending a Board approval via email.
- NKS-R: The program manager had received an extraordinary proposal for a new activity. A reservation for funding of that activity was made, pending a Board approval via email.
- NSFS: The chairman had received an application from NSFS regarding financial support of the 2010 IRPA conference hosted by NSFS in Helsinki. Again, a reservation for funding of that activity was made, pending a Board approval via email. The cost, DKK200k, is to be shared equally by R and B.

**Nov. 16, 2007**

**NRPA, Esterase, NO**

**NKS(07)11**

News from the previous **Owners Group meeting**:

- Justin Gwynn will succeed Sigurður Emil Pálsson as program manager of NKS-B. The transition will be made smoothly over a period of six months starting in 2008.
- The two Swedish owners SKI and SSI will merge to form a new authority, SSM, from July 1, 2008. It is not known at this point exactly how this will affect NKS relations; most likely the changes will not be drastic.
- As the role of Nordic secretary / coordinator is gradually abolished the NKS chairman and – to a certain extent – the Secretariat and the program managers will take over his duties. The work to increase efficiency and cut costs will continue.

**The R&B program:**

- The program managers presented the R&B status reports and their proposals for funding.
- As the number of R proposals was much larger than usual and the quality of the applications high, it was decided to allocate extra funding. A total of 12 activities received financial support.
- Since the number of B applications did not reach the expected level, more than half of the available funding was withheld, pending a new CfP before the meeting in May 2008. A travel grant for young scientists was set up, replacing the YoungRad activity. A total of 5 activities received financial support.
- The policy document was discussed and changes made. E.g., it was decided to stress that non Nordic participants to NKS seminars have to be cleared with the program manager to avoid situations where non EU residents look for a loop hole to enter the Schengen zone legally. A corrected version of the policy document will be sent by email for further comments and final approval. The Swedish version reflects the official policy of NKS whereas the abridged English version serves as a guideline for an international audience.
- The chairman expressed his and the Board's gratitude to Sigurður Emil Pálsson for his excellent and ambitious work through many years as project leader and program manager.

**May 7, 2008**

**DEMA, Kastellet, Copenhagen, DK**

**NKS(08)5**

- No Owners Group meeting was held.
- The Board saw no reason to revise the R&B frameworks at this point.
- The new policy document was approved.
- The Board recommends that applications for NKS funding under the CfP procedure be written in English.
- The NKS-B program manager presented a status report and an assessment of the extra CfP. Five proposals met with the Board's approval. The program manager again suggested a young researchers' travel fund (*Author's comment*: This was already decided at the last meeting, budget and all), and the Board defined "young" in this context to be under 35 years of age.
- The NKS-R program manager noted that no formal applications for funds had been received but suggested additional funding of two activities, which was approved.
- The Board decided that NKS does not support seminars outside the Nordic countries, with rare exceptions for the Baltic states when motivated.



- This was the Nordic secretary's / coordinator's last appearance at an NKS Board meeting.

**Nov. 19, 2008**

**IRSA, The Culture House, Reykjavík, IS**

**NKS(08)8**

News from the previous **Owners Group meeting**:

- Two new members representing the Danish and Finnish owner, respectively, were welcomed: Michael Boesgaard Brøndel (DEMA) and Anne Väättäinen (KTM).
- A new Letter of Intent between the owners must be written since the formation of the new Swedish authority, SSM.
- The chairman will ask Torkel Bennerstedt to write the history of NKS for the years 1997 – 2004. (*Author's comment*: This was later corrected to 1994 – 2008.)

**The R&B program**:

- 9 of 18 NKS-R applications were honored; for NKS-B the figures were 7 out of 12. A new CfP for NKS-B activities will be announced during the spring since considerable funding is still available.
- A joint R&B seminar will be arranged in Stockholm March 2009.
- The assessment of applications from the CfP procedure were discussed at some length. The chairman suggested that Board members should do the assessments to ensure balanced priorities and secure national interests.
- The English version of the policy document was approved after a few changes. The administrative handbook was presented without any comments from the Board; the chairman was given the mandate to approve future versions.
- The Board was positive to publishing NKS accounting and audit reports on the website. From now on material to be discussed at Board meetings will be available for download on the website.
- Special thanks were directed to Torkel Bennerstedt who left his position as Nordic secretary / coordinator at the previous Board meeting after many years of dedicated work.

## Appendix 3: Overview of NKS Programs and Evaluations

### Program Overview 1977 - present

Number	Years	Main Programs
First	1977-1980	QA, AO, KRU, RA, MY
Second	1981-1985	SÄK, KVA, LIT, AVF, REK
Third	1985-1989	AKT, KAV, RAS, MAT, INF
Fourth	1990-1993	BER, KAN, RAD, SIK
Fifth	1994-1997	RAK, AFA, EKO, SAM
Sixth	1998-2001	SOS, BOK, SBA
R&B	2002 →	R (Reactor safety), B (Emergency preparedness)

See Appendix 11 for an explanation of the acronyms.

### List of all evaluations since the first 4-year program

Program	Report Id.	Author(s)	Comments
1977 – 1980	NORD	Erik Jansson Lars Högberg Jan Olof Snihs Curt Bergman Leif Moberg Veikko Palva Niels Busch Frits Heikel Vinther Jon Olav Berg	QA(Quality Assurance) QA AO (Waste Management) AO AO KRU (Control Room Design) RA (Radioecology) RA MY (Authority Related Projects)
1981 – 1985	NORD87:7	Ami Rastas Bjarne Regnell Mats Danielsson Kåre Netland Bengt Edwall Uffe Korsbech Lennart Hammar Pekka Silvennoinen	SÄK (Reactor Safety) SÄK KVA (Quality Assurance) LIT (Human Reliability) AVF (Radioactive Waste) REK (Radioecology) General overview General overview
1985 – 1989	NORD90	Heikki Kalli Heikki Raumolin Jørgen Firing Christer Jansson Arne Jensen	AKT (Releases, Dispersion, Impact) KAV (Nuclear Waste Management) RAS (Risk Analysis & Safety Philosophy) MAT (Materials Research) INF (Advanced Information Technology)
1990 – 1993	NKS(94)17	Göran Steen Leiv Berteig Olli Paakkola Povl L Ølgaard	BER (Emergency Preparedness) KAN (Waste Management) RAD (Radioecology) SIK (Reactor Safety)

1994 – 1997	NKS(98)2	Antti Vuorinen	Entire program (RAK, AFA, EKO, SAM)
1998 – 2001	NKS-66	Gustaf Löwenhielm	SOS (Safety and Radiation Protection) SBA (Safety Threats in Nordic Surroundings)
1998 – 2001	NKS-66	Raimo Mustonen	BOK (Emergency Preparedness and Consequences) SBA (Safety Threats in Nordic Surroundings)
1998 – 2001	NKS-67	Martin Høiby	SEK (Secretariat and NKS organization)
R&B 02-06	NKS-145	Risto Sairanen Per Persson Per Hedemann Jensen Tore Lindmo	NKS-R (Reactor Safety) NKS-R NKS-B (Emergency Preparedness) NKS-B

Summaries of the evaluations of the 1994-97 program and onward are given under the respective NKS program in the main text.

## Appendix 4: Economic Contributions to NKS in kDKK

<b>Year</b>	<b>TOTAL</b>	<b>DEMA</b>	<b>KTM</b>	<b>IRSA</b>	<b>NRPA</b>	<b>SKI&amp;SSI</b>	<b>Others</b>
1994	7420	860	2015	150	970	3425	0
1995	9875	970	2290	150	1348	3563	1554
1996	9515	970	2305	150	970	3425	1695
1997	9129	970	2302	150	970	3425	1312
1998	8512	970	2264	150	600	3425	1103
1999	8890	970	2255	150	970	3425	1120
2000	8347	900	2252	150	970	3425	650
2001	7727	900	1632	150	970	3425	650
2002	7551	484	2232	149	893	3273	520
2003	7391	260	2228	149	966	3268	520
2004	7466	261	2234	149	968	3276	578
2005	7458	260	2231	149	967	3272	579
2006	7817	336	2313	157	1007	3394	610
2007	7869	358	2312	161	1025	3393	620
2008	8598	773	2386	168	1059	3504	708

Total for the fifth 4-year program	1994 – 1997:	DKK 35,939k
Total for the sixth 4-year program	1998 – 2001:	DKK 33,476k
Total for the first 4 R&B years	2002 – 2005:	DKK 29,866k
Total for the next 3 R&B years	2006 – 2008:	DKK 24,284k
<b>GRAND TOTAL for the NKS program</b>	<b>1994 – 2008:</b>	<b>DKK 123,565k</b>

## Appendix 5: NKS Budgets in kDKK

N.B.: Budgets as decided by the Board – not actual spending

### Budgets for the fifth 4-year program 1994 – 1997 (kDKK)

Project	1994	1995	1996	1997	In all
RAK-1	700	1150	1250	1150	4250
RAK-2	800	1150	1150	1140	4240
AFA-1	500	1050	1060	1050	3660
EKO-1	1000	1200	1210	1110	4520
EKO-2	1000	1300	1530	1355	5185
EKO-3	500	1100	1040	1100	3740
EKO-4	500	1000	1135	830	3465
EKO-5 *	---	247	605	207	1059
SAM **	2450	2215	1860	3285 ***	9810
<b>TOTAL</b>	<b>7450</b>	<b>10412</b>	<b>10840</b>	<b>11227</b>	<b>39929</b>

\*) Proposed 1995 and financed by SRV; carried out by FOA for NKS

\*\*) Including the SAM-4 information project

\*\*\*) Raised costs in 1997 due to final reporting, evaluation and planning for the next 4-year program

### Budgets for the sixth 4-year program 1998 – 2001 (kDKK)

Project	1998	1999	2000	2001	In all	Notes
SOS-1	570	700	700	1487	3457	
SOS-2	1050	1400	1450	1462	5362	#1
SOS-3	570	700	700	650	2620	
BOK-1	1130	1100	2681	2755	7666	#2
BOK-2	1130	1850	2000	2094	7074	#3
SBA-1	400	150	590	830	1970	#4
SBA-2	120	120	245	0	485	#5
SEK	1700	1600	1800	2700	7800	#6
<b>TOTAL</b>	<b>6670</b>	<b>7620</b>	<b>10166</b>	<b>11978</b>	<b>36434</b>	

N.B.: Late start for the 4-year program due to a long pre-project period

Note #1: 2001: Including funds according to an earlier decision

Note #2: Additional funding for participation in the Barents Rescue international exercise and two more activities

Note #3: Additional funding of five separately approved activities

Note #4: Additional funding of three separately approved activities

Note #5: Projected cancelled

Note #6: Raised costs in 2001 compared to earlier years due to final reporting and evaluation of the present program and planning for the next program

### Budgets for the R&B program 2002 – 2005 (kDKK)

Project	2002	2003	2004	2005	In all
R Activities	2360	2250	2320	2400	9330
R Program manager	400	400	400	400	1600
R Expenses	75	175	100	100	450
B Activities	2590	1760	2200	2200	8750
B Program manager	400	400	400	400	1600
B Expenses	100	200	100	100	500
SEK: Coord., adm.	2005	1685	1505	1480	6675
TOTAL	7930	6870	7025	7080	28905

### Budgets for the R&B program 2006 – 2008 (kDKK)

Project	2006	2007	2008	In all
R Activities	2400	2500	3430	8330
R Program manager	400	400	400	1200
R Expenses	100	100	200	400
B Activities	2600	2500	2520	7620
B Program manager	400	400	400	1200
B Expenses	100	100	200	400
Special Support	715	270	200	1185
SEK: Coord., adm.	1115	975	1270	3360
TOTAL	7830	7245	8620	23695

Total for the fifth 4-year program	1994 – 1997:	DKK 39,929k
Total for the sixth 4-year program	1998 – 2001:	DKK 36,434k
Total for the first 4 R&B years	2002 – 2005:	DKK 28,905k
Total for the next 3 R&B years	2006 – 2008:	DKK 23,695k
GRAND TOTAL for the NKS programs	1994 – 2008:	DKK 128,963k

## Appendix 6: NKS Policy, Framework and Procedures

This document was adopted by the NKS Board at its meeting in Reykjavík, Iceland, on Nov. 19, 2008. (*Author's comment:* Maybe the time is ripe to give this document a good overhaul.)

### Introduction

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

In addition to this policy document, practical NKS work is governed by an administrative handbook in Danish, also available at [www.nks.org](http://www.nks.org). Reviews and updates of the policy document and the handbook will be brought to the Board for approval; smaller changes will be decided by the chairman.

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

This document sets out to answer questions like:

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

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

### This is NKS

#### Scope and Objectives

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

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

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



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

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

### The Nordic Perspective

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

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

### Major Nordic Nuclear Installations

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

### Financial Support

Normally, only activities of interest to financing organizations and other end users are carried out. The results should be practical and directly applicable. The owners and main financiers are:

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

Additional financial support is obtained from these organizations:

- Fennovoima Oy in Finland
- Fortum Power and Heat Oy in Finland
- TVO in Finland
- IFE in Norway

- Forsmarks Kraftgrupp AB in Sweden
- Nuclear Training and Safety Center AB (KSU) in Sweden
- OKG Aktiebolag in Sweden
- Ringhals AB in Sweden

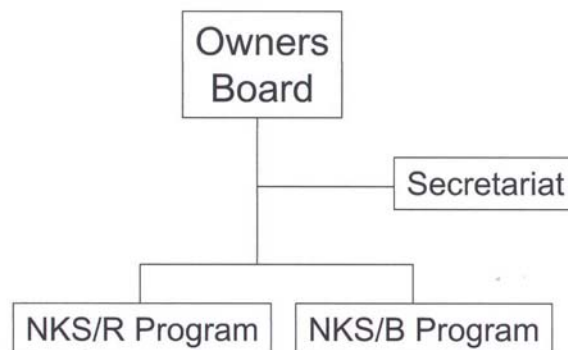
In 2007 the contributions of the owners together with support from the additional financiers above totalled some 7.9 million Danish crowns (1.1 million euros). To this should be added in-kind contributions by participating organizations, e.g., work hours, travel expenses and laboratory resources. These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

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

## Organization

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

Organization of NKS:



Presently, the following organizations form the NKS Board:

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

Fortum Nuclear Services LTD. and Vattenfall AB represent the nuclear industries in the countries.

# Overall Framework Program

## Program Areas

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

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

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

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

## Activities

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

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

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

## Young Scientists

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

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

## NKS-R Framework: Reactor Safety

### **R1                    Priorities and Challenges**

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

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

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

### **R2                    Main Research Areas and Program Contents**

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

Abbreviations used:

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

#### **Reactor Physics and Thermo-Hydraulics**

*Examples:*

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

#### **Modernization, Introduction of New Techniques and New Demands**

*Examples:*

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

#### **Aging of Nuclear Facilities**

*Examples:*

- Thermal and mechanical fatigue
- Radiation induced defects on reactor vessels

- Aging of concrete containments
- NDT technology and validation of methods
- RI-ISI, strategies and application of methods
- Aging managing program and aging mechanisms
- Aging properties of new materials

### **Severe Accidents**

#### *Examples:*

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

### **Probabilistic Methods**

#### *Examples:*

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

### **Organization, Man and Safety Culture**

#### *Examples:*

- Models and methods for safety review
- Safety culture significance in occurred events
- Actions taken as a result of event analyses
- Benchmarking between nuclear industry and other industries with high potential risks
- Safety assessment of organizational changes
- Safety culture and assessment of organizations
- Safety aspects on using subcontractors in nuclear power plants
- Introduction of new techniques and new working procedures
- Application of HR methods in nuclear power plants

### **Phase-Out and Decommissioning of Nuclear Facilities**

#### *Examples:*

- Phase-out and decommissioning of research reactors
- Stakeholder involvement in the Nordic countries
- Regulatory demands by Nordic authorities on decommissioning projects
- Experience from decommissioning projects

### **Common Seminars for Reactor Safety and Emergency Preparedness**

#### *Examples:*

- PSA, severe accidents and emergency preparedness
- Phase-out and demolition of nuclear facilities including release of protection of area
- Environmental Impact Assessments

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

### **NKS-B Framework: Emergency Preparedness**

#### **B1 Aim and Challenges**

The aim of the NKS-B program is to strengthen Nordic work concerning

- radiological emergency preparedness
- management of radioactive waste and discharges

- radioecology and environmental assessments

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

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

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

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

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

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

## **B2 Main Research Areas and Program Contents**

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

*Examples of activities:*

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

### **W Waste and Discharges**

*Examples of activities:*

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

## **R Radioecological Assessments**

*Examples of activities:*

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

## **M Measurement Strategy, Technology and Quality Assurance**

*Examples of activities:*

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

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

## **Cross-Disciplinary Activities**

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

Some examples of possible areas for cross-disciplinary activities:

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

## **Guidelines**

### **From Proposal to Final Report**

#### **Call for Proposals**

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

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

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

### **Silent Procedure**

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

### **Criteria for NKS Activities**

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

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

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

NKS aims at an approximately even overall distribution of funding between the R and B programs as well as between participating Nordic countries and organizations within the various activities. Gender neutrality and participation of young scientists shall be encouraged. When possible and relevant, M.Sc.



and Ph.D. support should be included in ongoing or proposed activities and NKS activities coordinated with international projects. Measures should be taken to ensure cost-efficiency, save resources and protect the environment, e.g., by substituting travels and business meetings with electronic contacts and virtual meetings.

## Quality Assurance

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

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

## International Cooperation

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

## Communication and Dissemination of Information

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

The major channels for distributing NKS information are:

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

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

## Appendix 7: NKS-R Activities and Funding

N.B.: (CONDITIONAL) in the table below indicates that some condition has to be met before the funding is made available; e.g., additional information on the scope, objective or work plan of the activity; or as regards the total financial situation of NKS. (The corresponding amount is noted in parenthesis.)

When approved	Code / Name	Description / Full title	Amount (kDKK)
<b>March '02</b>	<b>NKS-R</b>	<b>Initial activities as specified below</b>	<b>2000</b>
	R01	PREPOOL	
	R02	Contextual assessment of maintenance culture safety and efficiency in Finland and Sweden	
	R04	Safety management: Existing case studies from a non-nuclear context as references for an investigation of assessments of nuclear safety management	
	R05	3D transient methodology for the safety analysis of BWRs	
	R07	Barriers, Control and Management – An analysis of concepts with applications in nuclear plant safety	
	R14	PREMELT	
	R15	Independent review of CCF models used in calculations for high-redundant systems in NPPs of the Nordic countries	
	R16	Traceability and communication of requirements in digital I&C systems development	
	R17	Framework for a systematic approach and documentation for risk-informed decision making; pre-project	
<b>May '02</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>260 + 100</b>
	R12	Ruthenium behavior in severe accident condition	160
	R22	VALDOR 2003: The third symposium addressing transparency in risk assessment and decision-making	100
	---	Planning for an automation seminar	100
<b>Nov '02</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>2250</b>
	R01	DeliPool (PrePool)	400
	R02	Maintenance Culture	560
	R04	Safety Management	320
	R05	3D Transient Methodology	100
	R07	Barriers, Control and Management	300
	R12	Ruthenium Releases	270
	R16	Digital Requirements	300
<b>May '03</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>0</b>
		The financial situation did not allow further expenditures	
<b>Nov '03</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>2320</b>
	R_2002_01	DeliPool	400
	R_2002_02	MainCuluture	350
	R_2002_04	SafetyManagement	200
	R_2002_07	BarriersControlManagement	200
	R_2002_12	RutheniumReleases	120
	R_2002_16	DigitalRequirements	300
	R_2002_27	DecommSeminar	100
	R_2002_32	ShutDownSequences	250

	R_2002_35	NOTNet	300
	R_2002_38	ImprovementPrgSeminar	100
<b>May '04</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>490</b>
		Modified CoolSE / KTH	400
		Modified Knowledge Management Seminar / IFE	90
<b>Nov '04</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>2400</b>
		DeliPool	400
		MainCulture	350
		RutheniumReleases	350
		TACO	150
		ExCoolSE	400
		CorrosionFatigue	200
		CableAging	200
		MORE	150
		CostCalculation	200
<b>May '05</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>400</b>
		Safety Management	100
		The Validity of Safety Goals	300
<b>Nov '05</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>2200</b>
		DeliPool	400
		RutheniumReleases	300
		ExcoolSE	100
		CorrosionFatigue	200
		CableAging	200
		MORE	200
		CostCalculation	250
		AutoNewTech	350
		OrRe	200
<b>May '06</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>200</b>
		ExCoolSE part 2	200
<b>Nov '06</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>2500</b>
		LingAn	250
		Ruthenium behavior	450
		AutoNewTech	300
		SafetyGoals	200
		OrRe	350
		MORE	300
		POOL	300
		RiskEval	150
		CostCalc	200
<b>May '07</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>(145)</b>
		(CONDITIONAL)	
		Development of education in nuclear power technology for the NKS countries	(45)
		NSFS: Third All European IRPA Congress on Radiation Protection	(100)
<b>Nov '07</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>3255</b>
		WASCO	280
		PODRIS	250
		POOL	450

		MOSACA	300
		SafetyGoal	300
		RiskEval	200
		NROI	400
		MORE	175
		IACIP	250
		AutoStrat	200
		Werisk	300
		StratRev	150
<b>May '08</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>175</b>
		POOL	100
		PODRIS	75
<b>Nov '08</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>3520</b>
		WASCO	300
		INCOSE	300
		POOL	600
		MOSACA	500
		Safety Goal	375
		NOMAGE4	375
		NROI	500
		HRA-Guide	270
		IACIP	300

## Appendix 8: NKS-B Activities and Funding

N.B.: (CONDITIONAL) in the table below indicates that some condition has to be met before the funding is made available; e.g., additional information on the scope, objective or work plan of the activity; or as regards the total financial situation of NKS. (The corresponding amount is noted in parenthesis.)

When approved	Code / Name	Description / Full title	Amount (kDKK)
<b>March '02</b>	<b>NKS-B</b>	<b>Initial activities as specified below</b>	<b>2000</b>
	B02	Urban contamination seminar	
	B04	Additional funding of a PhD course in radioecology	
	B11	Emergency management & radiation monitoring in nuclear and radiological accidents	
	B12	New indicator organisms for environmental radioactivity	
	B22	Improving regional impact assessments	
	B23	Communication technology and emergency preparedness	
	B24	Nordic-EU collaboration on design and evaluation of the RESUME 2002 exercise	
	B25	Nuclear threats in the vicinity of the Nordic countries: A base of knowledge	
<b>May '02</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>500 (+530)</b>
	B12	New indicator organisms for environmental radioactivity	150
	B26	Impact assessment of accidents with nuclear powered vessels – Analysis of release mechanisms and source term composition (CONDITIONAL)	(340)
	B27	Improving radiological assessments of doses to man from terrestrial ecosystems; pre-project	200
	B28	Coordination and modernization of methods for AGS and CGS measurements of multi-nuclide contamination	85
	B29	Course in advanced methods for processing AGS and CGS data and similar sets of spectral data	65
	B30	Nordic network of meteorological services engaged in nuclear emergency preparedness (CONDITIONAL)	(190)
<b>Nov '02</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>1760 + 50</b>
	B11	EMARAD	360
	B12	INDOFERN	800
	B26	Impact assessment of accidents with nuclear powered vessels (This is 100 of the 340 mentioned under May '02)	100
	B30	Nordic network of meteorological services (CONDITIONS from May '02 met)	190
	B32	Nordic cooperation on the use of MS	150
	B33	Area specific stripping for CGS and AGS	60
	B34	Seminar: Radioecology and measurement techniques	100
	---	Baltic travel fund	50
<b>May '03</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>240</b>
	B26	Impact assessment of accidents with nuclear powered vessels (This is 240 of the 340 mentioned under May '02) The financial situation did not allow further expenditures	240

<b>Nov '03</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>2200</b>
		Cskinetik	130
		EMARAD	280
		IRADES	50
		MetNet	200
		UrbHand	205
		LABINCO	100
		NorCMass	260
		RadChem	200
		EcoDoses	310
		INDOFERN	380
		REIN	85
<b>May '04</b>	<b>NKS-R</b>	<b>Additional activities or funding as specified below</b>	<b>480</b>
		INDOFERN / STUK	300
		Modified ASSb / DTU	180
<b>Nov '04</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>2200</b>
		EMARAD	100
		IRADES	50
		NordRisk	160
		UrbHand	205
		LABINCO	250
		NorCMASS	200
		RADCHEM	215
		SAMPSTRAT	95
		EcoDoses	350
		FOREST	225
		INDOFERN	350
<b>May '05</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>550 +50</b>
		INDOFERN	350
		MetNet	200
		Seminars	50
<b>Nov '05</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>2200</b>
		MetNet	200
		NordRisk	180
		UrbHand	205
		Lucia	400
		BioDos	300
		UGS	225
		HOT	180
		EcoDose	280
		FOREST	200
		YoungRad	30
<b>May '06</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>409</b>
		Urban Gamma Spectrometry Processing	49
		Nuclear risks from atmospheric dispersion in Northern Europe	80
		Assessing the impact of releases of radionuclides into the sewage systems in urban environment – simulation, modeling and experimental studies	80
		Seminar for young scientists in the fields of radio-chemistry, radioecology and radiation protection	200
<b>Nov '06</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>2500</b>

		PardNor	520
		BioDos	350
		NordThreat	200
		NordRisk	230
		Speciation	320
		Hot	230
		Lucia	500
		GAPRAD	150
<b>May '07</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>(200)</b>
		(CONDITIONAL)	
		UrbHand	(100)
		NSFS: Third All European IRPA Congress on Radiation Protection	(100)
<b>Nov '07</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>1200 (+1300)</b>
		BioPEX	300
		ParDNor	340
		GammaRate	100
		GapRad	260
		Young researchers' travel fund; replaces YoungRad	200
		(Reservations for a spring Call for Proposals)	(1300)
<b>May '08</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>1320</b>
		REMSPEC	300
		DepEstimate	250
		FOREST-2	130
		SPECIATION	320
		Hairpol	320
<b>Nov '08</b>	<b>NKS-B</b>	<b>Additional activities or funding as specified below</b>	<b>1800</b>
		PARDNOR	370
		GammaSem	260
		NORDSS	100
		GammaRate	100
		BIONCA	280
		HOTRATE	230
		Method MS	460

## Appendix 9: Author's Remarks

### About the Author

Professional record:

- 1970            Graduated as MSEE (Master of Science / Electrical Engineering) after 3.5 years of studies at KTH (Royal Institute of Technology), Stockholm, Sweden.
- 1970 – 1972   Research engineer at the Microwave Institute at KTH.
- 1973 – 1975   Full time studies in radiation physics and social anthropology at Stockholm University.
- 1973 – 1975   Part time positions at Karolinska Hospital, Stockholm and the Radiophysics Department at Stockholm University as assisting hospital physicist.
- 1976 – 1989   SSI employee (Swedish Radiation Protection Institute, Stockholm, Sweden).  
Some highlights:
- Employed as Senior Radiation Protection Officer and head of the Industrial Uses Section.
  - The position involved engagement in NKA work on transport of radioactive material, sub-group on radioactive consignments by mail, together with Nordic colleagues under the leadership of Franz Marcus. This was my first contact with him.
  - Became director of SweRad, SSI's division for marketing services world-wide. Arranged, among other things, two international courses on practical radiation protection in nuclear power production.
- 1989           Started the consultancy firm TeknoTelje HB. My major clients have been NKS, SKI, SIP, SSI, SIUS and Vattenfall. As a consultant to NKS I engaged in a number of projects prior to the work as Nordic secretary. Most relevant reports:
- T Bennerstedt: Radioaktivt sjukhusavfall. Regler, praxis och spårbarhet (SSI Report 91-09 in Swedish on national handling procedures concerning radioactive waste from hospitals, research institutions and industries). This was done as a part of the KAN-1.3 project.
  - T Bennerstedt et al: Monitoring Artificial Radioactivity in the Nordic Countries, TemaNord 1995:559. This was done as a part of the BER-2 project.
  - Nordic exercises NORA in Jan. 1993 and ODIN in Nov. 1993: coordination, planning, execution and follow-up (official evaluator: Anneli Salo). Final report: T Bennerstedt et al: Nordic Nuclear Emergency Exercises, TemaNord 1995:606. This was done as a part of the BER-5 project.
- 1994 – 2008   Hired (through TeknoTelje HB) as the Nordic secretary (later to become coordinator) of NKS.

And the rest, as they say, is history. Enjoy!

### The Post Marcus Era

When Franz Marcus decided to step down as Nordic secretary the search for his successor started. At a dinner following an Owners Group meeting in early 1993 many questions were raised. What direction was NKS to take? What did the owners look for in the next Nordic secretary? Were there any obvious candidates? The owners began sketching the profile of the person they wanted and discussed what criteria to use.

After the dinner Sigurður M Magnússon called me. He told me about the search for a new Nordic secretary and that in his view I had the profile that was of interest for the post. He went on to ask whether I was interested in the post. I gasped and was totally stunned at first. Then I exclaimed, Yes!

One thing led to the other, and before long I and another candidate were invited to the Arlanda Owners' meeting on Nov. 16, 1993 for an interview. I came well prepared with a stack of viewgraphs



and a bunch of ideas. I presented my visions and tentative plans for the job. The atmosphere was relaxed and friendly, and this was of great help to a nervous guy facing his greatest challenge in life so far.

Shortly after the interview Sigurður M Magnússon gave me another unofficial call to tell me “the results of the Arlanda jury”: a unanimous vote to offer me the job. I later received an official confirmation of this. The formal negotiations and setting up of a contract were handled by SKI and my firm, TeknoTelje HB, as decided by the Owners Group. It was not too hard to reach an agreement, so I soon found myself hired for 75% of a full time. This percentage was adjusted after a few years, to suit the needs of NKS..

My actual work began in 1994. The Owners had planned for a smooth transition from Franz Marcus to me during a generous period of one year. Franz was the acting Nordic secretary for the first six months, with me as a happy and eager apprentice at his side. One of my first decisions was to interview him on as much as possible of his many tasks. To that order I prepared a long list of questions, and we sat down to work our way through the document. It took quite some time; in fact, we did not quite make it the first time, so we continued next time, and next, and... The work was far more demanding than I had ever imagined.

I soon found out that there were very few written job instructions, recommendations or advice that were detailed enough to be of practical help. It was all in his head; probably for a reason. As I got deeper and deeper involved and the day approached when I was to officially take the reins as Nordic secretary on July 1, 1994 I decided to formalize the work as much as reasonably warranted, given my experience as a serious but forgetful bureaucrat. When asked about any contracts and agreements NKS had reached with organizations and persons, I got a fairly good oral overview. At least that was what I thought. From time to time there popped up new agreements, never in writing, just closed by a confirming handshake. So I decided to note all agreements and anything similar to an NKS policy, first for my personal use but later for discussions with the Board.

After half a year of on-the-job training followed the fantastic feeling of being in charge. Wisely enough the Owners had decided to let Franz act as my mentor for another six months. He also remained active in areas related to his earlier position. Franz wrote his Recollections (see the reference list) and updated a document on EU/Euratom related organizations he had prepared for SKI a few years earlier. Franz, with his vast network, also assisted in setting up and carrying out NKS meetings with EU and the Nordic Council of Ministers. Through a clever arrangement between BRS, Risø and NKS he was hired to evaluate the Danish assistance programs for emergency planning and preparedness in some former USSR states.

My first major appearance as Nordic secretary was together with Franz at a reactor safety conference in Saltsjöbaden, Sweden 1994. This was noted by ENS in an article in their official publication, written by me, presenting NKS to a new audience.

### **Tasks and Responsibilities of the Nordic Secretary**

The Nordic secretary (also referred to as executive secretary) was appointed by the owners. The post as Nordic secretary was discontinued in 2008. Below follows a list of the most important tasks of the Nordic secretary. The tasks varied somewhat over the years as the programs and support structure of NKS changed.

- Participated on a regular basis in the most important NKS meetings: the owners group; Board; reference groups; Bureau; coordination group; Secretariat.
- Reported to the owners and the Board.
- Served as the official head of the Secretariat.
- For a number of years: prepared Owners Group meeting (agendas, invitations, minutes etc.).

- Prepared Board meetings (agendas, invitations, practical arrangements in cooperation with the host organization, follow-up); served as secretary of these meetings once the post as secretary of the Board was abolished.
- Made budget proposals to be discussed by the Bureau and the Board.
- Compiled directives for pre-project work and evaluators.
- Proposed contracts with project leaders / program managers and evaluators.
- Outlined and compiled other official NKS documents to be presented to the Board, including the program handbook / policy document.
- Planned, prepared and supervised larger (mostly joint NKS) seminars, conferences etc., usually together with the Secretariat and/or responsible project leaders.
- Edited semi-annual and annual reports, plans for next year, final report of SAM/SEK at the end of the 4-year period, summary final reports for the whole program.
- Helped develop the administrative handbook in close cooperation with the secretariat.
- Was responsible for overall coordination of the NKS program and held individual meetings with project leaders.
- Participated in a number of larger activities (workshops, exercises etc.) within projects.
- Handled formal contacts and cooperation with EU and NSFS. (Project leaders / program managers were responsible for any practical work in this connection.)
- Did follow-up of project work, economy etc.
- Assisted in structuring and writing of some final reports and checked the final reports of the projects.
- Led and assisted in website development in close cooperation with the Secretariat.
- Helped compile a template for final reports / NKS technical reports.
- Was at the disposal of the owners, the Board and to a certain extent the project leaders for *ad hoc* tasks.

### **Additional Info on This Report**

I was contracted to perform a pilot study on a possible historic review and delivered a report on the subject, NKS(09)3, entitled “Förprojekt om en eventuell NKS-historik 1994 – 2008” (in Swedish). It specified scope and objectives, timeframe, costs, administrative aspects etc., and a general outline of the historic review was suggested. Based on the pilot study and a Board decision in May 2009, a contract was signed by NKS / Sigurður M Magnússon and TeknoTelje HB / Torkel Bennerstedt (contract no. NKS/AFT(10)3) concerning such a review.

It was agreed that the objective of my report was to give a personal impression of NKS, its work, results and development during my 15 years as Nordic secretary and coordinator. Thus, the scope was quite wide.

It might strike the reader odd that the author’s wife Lena Bennerstedt has contributed a number of photographs to this report, and thus obviously participated in some of the travels. She always did this at her own expense, at no extra cost to NKS. There were times when she volunteered as an assistant to the NKS Secretariat, without pay. Occasionally she was hired to perform a special task (mostly in her capacity of consultant in information matters); this was then cleared in advance through the proper NKS channels, following the appropriate routines.

### **Two Nordic Profiles**

When writing the history of Nordic cooperation in nuclear safety research in the years 1994 – 2008 it is impossible not to mention two outstanding Nordic profiles. It so happens that they both are from Iceland.

The first person that comes to my mind is Sigurður M Magnússon, director of IRSA (the Icelandic Radiation Safety Authority). He has represented Iceland in the Owners Group since the formation of NKS, and served as secretary of the NKS Board and member of the Bureau for six years. He took over

as NKS chairman in 2006, a position that he still holds at the time of writing this in the spring of 2011. He has formed an international network, the like of which I have never heard. Sigurður has been the mastermind behind just about every major change in NKS format and procedure throughout the years. With great enthusiasm and diplomatic skill he has inspired the development of a slimmer, smarter, more efficient and end user oriented NKS. One of his many contributions is his constant readiness to let his staff participate in NKS activities.

In my view, the person who has contributed the most to the scientific work of NKS is the other Nordic profile, Sigurður Emil Pálsson of IRSA. With never-ending enthusiasm and ever-growing expertise and experience he was instrumental in shaping and developing NKS work in radioecology and emergency preparedness. He started as project leader of EKO-1 in 1994 – 1997, continued as project leader of BOK-2 in 1998 – 2001, and became the first program manager of NKS-B in 2002, where he served until 2008. His foresight and skills have helped NKS sharpen its tools in modern communication and use of information technology. One of his many ambitions has been to encourage and support young scientists in all Nordic countries and – when appropriate – the Baltic region. This has broadened the perspective of NKS and participants alike, and valuable international networks have been formed.

Both Sigurður and Sigurður Emil have helped create an added Nordic value that will last for years.

## Appendix 10: List of Some Important NKS Documents

Only NKS numbered documents are included. The original documents are, for the most part, in a Scandinavian language. These documents are no longer available at the website, just as a print-out at the Secretariat.

Budgets, agendas and minutes of Owners Group and Board meetings are excluded from the list below. The budgets are presented elsewhere in these Appendices. The minutes are listed in the report and summarized in the Appendices. The full documents are available (in Scandinavian languages) on the NKS website.

### Abbreviations (in alphabetical order) used in this Appendix:

Auditor	Ernst & Young
Bureau	Chairman + secretary of the Board + Nordic secretary
NS	Nordic secretary
Prg.	Program
Prg. Man.	Program Manager(s)
Proj. leader	Project leader(s)
Ref. group	Reference group(s)
SEK	The NKS Secretariat

Year	NKS No.	Title of Document	Author(s)
1993	NKS(93)8 Rev.	Plan for NKS 1994 – 1997	Prg. group
	NKS(93)11	Igangsætning af forprojektarbejde (Start-up of the pre-project work)	NS
1994	NKS(94)3	Financial statements and audit report for 1993	SEK, Auditor
	NKS(94)5	Fase 1 af igangsætningen af programmet 1994 – 1997 (Start-up phase of the 1994 – 1997 program)	NS
	NKS(94)7 Rev.	Pre-project reports: plans for 1994 – 1997	Prg. group
	NKS(94)8	Pre-projects and continued work	NS/Bureau
	NKS(94)9 Rev.	Plan for SAM, the coordination function of NKS	NS/Bureau
	NKS(94)10 Rev.23	Status for the 1990 – 1993 final reports	NS/Bureau
	NKS(94)11	Tasks, mandate and organization of NKS	NS/Bureau
	NKS(94)13	Draft contract for project leaders	NS
	NKS(94)16	Administrative handbook (update)	SEK
	NKS(94)17	Evaluation of the 1990 – 1993 program	NS (ed.)
1995	NKS(95)1	Annual report for 1994	Ref. groups
	NKS(95)2	Time schedule and budget for 1995	NS/Bureau

	NKS(95)3	Financial statements and audit report for 1994	SEK, Auditor
	NKS(95)6 Rev.	Draft NKS policy	NS/Bureau
	NKS(95)8	Criteria for the half-time evaluation of the 1994 – 1997 program	NS/Bureau
1996	NKS(96)1	Annual report for 1995 and plans for 1996/97	Ref. groups
	NKS(96)2	Summary report for 1995	NS, SEK
	NKS(96)3	Administrative handbook (update)	SEK
	NKS(96)4	Participant list: names, addresses etc. (update)	SEK
	NKS(96)5	Financial statements and audit report for 1995	SEK, Auditor
	NKS(96)6	Semiannual reports	Proj. leaders
	NKS(96)7	Status for the final reports from the previous period	NS/Bureau
	NKS(96)8	Draft NKS policy (update)	NS/Bureau
	NKS(96)9	The next 4-year program, 1998 – 2001	NS/Bureau
	NKS(96)10 Rev.	This is NKS (update)	NS/Bureau
1997	NKS(97)1	Annual report for 1996 – Plans for 1997 (incl. the coordination function and the SAM-4 info project)	NS (ed.)
	NKS(97)1	Annual report for 1996 – Plans for 1997	Proj. leaders
	NKS(97)2	Summary report for 1996	NS, SEK
	NKS(97)3 Rev.	Proposed outline of final reports	NS/Bureau
	NKS(97)5 Rev.	Criteria for evaluating the 1994 – 1997 program	NS/Bureau
	NKS(97)6 Rev.	Some project ideas for the next 4-year program	NS/Bureau
	NKS(97)7	Directives for planning for the next 4-year program	NS/Bureau
	NKS(97)8	Project handbook	NS/Bureau
	NKS(97)9	Participant list: names, addresses etc. (update)	SEK
	NKS(97)10 Rev.	This is NKS (update)	NS/Bureau
	NKS(97)12	Project status for the 1994 – 1997 program	NS/Bureau
	NKS(97)13 Rev.	Recommendations and advice for authors of final reports	NS/Bureau
	NKS(97)14	Financial statements and audit report for 1996	SEK, Auditor

	NKS(97)15	Proposed project structure for 1998 – 2001	Bureau
	NKS(97)17	Directives for the program group	Bureau
	NKS(97)18	Final report of the BER-6 project	Proj. leader
	NKS(97)20	List of organizations to be consulted about next program	Owners
1998	NKS(98)1	Proposed new research program	Prg. group
	NKS(98)2	Evaluation of the 1994 – 1997 program	A. Vuorinen
	NKS(98)3 Rev. 2	Directives for the reference group for the 1994-97 prg.	NS/Bureau
	NKS(98)4 Rev. 2	Directives for the pre-projects 1998	NS/Bureau
	NKS(98)6 Rev. 3	Members of the pre-project working groups	NS/Bureau
	NKS(98)7	Financial statements and audit report for 1997	SEK, Auditor
	NKS(98)8	Minutes of a ref. group – pre-project leaders meeting	Ref.grp. chair
	NKS(98)9	Organization, program handbook etc.	SEK, Bureau
	NKS(98)10	Economic résumé of the 1994 – 1997 program	SEK
	NKS(98)11	NKS-5: Proposals for the 1998 – 2001 program	NS (ed.)
	NKS(98)12	Summary of prof. Vuorinen's evaluation of the 1994 – 1997 program	NS
1999	NKS(99)1	Seminar and status report	NS/Bureau
	NKS(99)6	This is NKS (update)	NS/Bureau
	NKS(99)7	Participant list: names, addresses etc. (update)	SEK
	NKS(99)8	Financial statements and audit report for 1998	SEK, Auditor
	NKS(99)11	Economic status report	SEK
	NKS(99)12	External funding in the last 3 years	SEK
	NKS(99)16	Status document Sept. 1999	NS, SEK
2000	NKS(00)1	Directives for the midway valuation of the 98-01 prg.	NS/Bureau
	NKS(00)2	Economic status report for 1999	SEK
	NKS(00)4	Program status report Feb. 2000	SEK (ed.)
	NKS(00)6	Agenda for status seminar with evaluation	NS/Bureau
	NKS(00)8	Financial statements and audit report for 1999	SEK, Auditor
	NKS(00)9	Directives for the final evaluation of the 1998 – 2001 program: organization, administration	NS/Bureau

	NKS(00)10	List of new project proposals for the 98-01 program	NS (ed.)
	NKS(00)11	Format and contents of final reports 1998 – 2001	NS/Bureau
	NKS(00)12	Additional directives for final reports 1998 – 2001	NS/Bureau
	NKS(00)13	Directives for the final evaluation of the 1998 – 2001 program: scientific contents and results	NS/Bureau
	NKS(00)15	Directives for midway evaluation reports	NS/Bureau
	NKS(00)16	Participant list: names, addresses etc. (update)	SEK
	NKS(00)17	Program handbook (update)	NS/Bureau
	NKS(00)20	Status report and midway evaluation Nov. 2000	NS (ed.)
2001	NKS(01)2 Rev. 3	Proposal for a new NKS organization and program structure: R&B	Bureau
	NKS(01)3	Economic status report	SEK
	NKS(01)4	Interviews with owners regarding the new program	Bureau
	NKS(01)5	Announcement: Preferred program manager profiles	NS
	NKS(01)7	Financial statements and audit report for 2000	SEK, Auditor
	NKS(01)9	Directives for the main research areas R&B	NS/Bureau
	NKS(01)10	Agenda for the Reykjavík status seminar	NS/Bureau
	NKS(01)13	Program status report May 2001	NS (ed.)
	NKS(01)14	Program status report in Roskilde	SEK (ed.)
	NKS(01)16	Economic status report	SEK
	NKS(01)18	Program status report November 2001	SEK (ed.)
2002	NKS(02)1	This is NKS (update; to be included in the program handbook henceforth)	NS/Bureau
	NKS(02)3	Economic status report	SEK
	NKS(02)6 Rev. 4	Program handbook (update; incl. This is NKS)	NS/Bureau
	NKS(02)7 Rev. 4	Administrative handbook (update)	SEK
	NKS(02)8	Financial statements and audit report for 2001	SEK, Auditor
2003	NKS(03)1	Financial statements and audit report for 2002	SEK, Auditor
2004	NKS(04)1	Financial statements and audit report for 2003	SEK, Auditor
	NKS(04)3	Evaluation of the second Nordic seminar in Malmö on Quality in Radiation Protection Work	NS

	NKS(04)4	Questionnaire: Activity leaders' opinions on the new NKS structure and organization (R&B)	NS/Bureau
	NKS(04)6	Program handbook (update)	NS/Bureau
	NKS(04)7	Administrative handbook (update)	SEK
	NKS(04)9	NKS-R framework program (update)	Prg. Man.
2005	NKS(05)1	Financial statements and audit report for 2004	SEK, Auditor
	NKS(05)4	NKS-R framework program (update)	Prg. Man.
	NKS(05)6 Rev.	Directives for evaluation of NKS work in 2002 – 2005	NS, Bureau
2006	NKS(06)1	Financial statements and audit report for 2005	SEK, Auditor
	NKS(06)3	Program handbook (update)	NS/Bureau
	NKS(06)4	Administrative handbook (update)	SEK
	NKS(06)8	Final report on the status seminar in Otaniemi May 2006	Ed.: NS
2007	NKS(07)1	Financial statements and audit report for 2006	SEK, Auditor
	NKS(07)3 Rev.	Program handbook (update; henceforth published as part of the policy document; see NKS(07)7 below)	NS/Bureau
	NKS(07)4 Rev.	Administrative handbook (update)	SEK
	NKS(07)5 Rev.	NKS-R and NKS-B frameworks (updates; henceforth published as a part of the policy document; see NKS(07)7 below)	Prg. Man.
	NKS(07)7	Policy document (in Swedish)	NS/Bureau
	NKS(07)10	Brief presentation / policy of the NKS program: framework, guidelines and procedures (English version of the policy document NKS(07)7)	NS
2008	NKS(08)1	Financial statements and audit report for 2007	SEK, Auditor
	NKS(08)2 Rev. 5	Policy document (update; in Swedish)	NS/Bureau
	NKS(08)3 Rev. 3	Policy Framework and Procedures (update of NKS(07)10)	NS
	NKS(08)6	Administrative handbook (update)	SEK
2009	NKS(09)1	Financial statements and audit report for 2008	SEK, Auditor
	NKS(09)3	Pre-project: Proposal of a history of NKS 1994 – 2008	NS



## Appendix 11: Acronyms and Abbreviations Used in This Report

ABB	Asea Brown Boveri, Ltd.
AFA	NKS program on radioactive waste 1994 – 1997
AGS	Airborne Gamma Spectrometry
AKT	NKS program on radioactive releases, dispersion and environmental impact 1985 – 1989
ALARP	As Low As Reasonably Practicable
AO	NKS program on waste management 1977 – 1980
ARGOS	Accident Reporting and Guiding Operational System (Denmark)
AutoNewTech	NKS-R activity
AVF	NKS program on radioactive waste 1981 – 1985
BER	NKS program on emergency preparedness 1990 – 1993
BIODOS	NKS-B activity
BIOPEX	NKS-B activity
BKAB	Barsebäck Kraft AB (Swedish NPP; now under decommissioning)
BOK	NKS program on emergency preparedness and environmental consequences 1998-2001
BWR	Boiling Water Reactor
CAMS	Computerized Accident Management System
CAT	Center for Advanced Technology, Denmark
CEC	Commission of the European Communities
CCF	Common Cause Failure
CFD	Computational Fluid Dynamics
CfP	Call for Proposals (NKS procedure)
CGS	Carborne Gamma Spectrometry
DD	Danish Decommissioning, Risø
DELI	Development and Validation (one of two main NKS-R themes; the other being MANGAN)
DEMA	Danish Emergency Management Agency
DG XI	Directorate General #11 of EU/EC
DG XII	Directorate General #12 of EU/EC
DKK	Danish <i>kroner</i> (currency)
DTU	Danish Technical University
EC	European Commission
ECOSYS	German model for ingestion dose calculation, used in RODOS and ARGOS
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EKO	NKS program on emergency preparedness and radioecology 1994 – 1997
EMARAD	NKS-B activity
ENS	European Nuclear Society
ESREL	An annual European safety and reliability conference
ETEX	European Tracer Experiment
EU	European Union
ExCoolSE	NKS-R activity
EXSI	Experimental Study on Iodine Chemistry
FKAB	Forsmarks Kraftgrupp AB, Sweden
FRIT	Danish host organization for the NKS Secretariat, SEK
GAPRAD	NKS-B activity
GBP	British pound (currency)
HIM	Swedish acronym for KTM; now TEM
HOT II	NKS-B activity
HPGe	High Purity Germanium (Detector)
HPME	High Pressure Melt Ejection
I&C	Instrumentation and Control
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICRP	International Commission on Radiological Protection

IFE	Institute for Energy Technology, Norway
INF	NKS program on advanced information technology 1985 – 1989
IRPA	International Radiation Protection Association
IRSA	Icelandic Radiation Safety Authority
ISA	Integrated Sequence Analysis
IUR	International Union of Radioecologists
IVO	Imatran Voima Oy, Finland; now: Fortum
KAN	NKS program on nuclear waste management and decommissioning 1990 – 1993
KAV	NKS program on nuclear waste management 1985 – 1989
KRU	NKS program on control room design 1977 – 1980
KTH	Royal Institute of Technology, Stockholm, Sweden
KTM	Finnish Ministry of Trade and Industry; now TEM
KVA	NKS program on quality assurance 1981 – 1985
LIT	NKS program on human reliability 1981 – 1985
LOCA	Loss of Coolant Accident
LUCIA	NKS-B activity
LUT	Lappeenranta University of Technology, Finland
LWR	Light Water Reactor
MANGAN	Management and Organization (one of two main NKS-R themes; the other being DELI)
MAT	NKS program on materials research 1985 – 1989
MFM	Multilevel Flow Modeling
MGS	Mobile Gamma Spectrometry
MOI	Method of Images
MORE	NKS-R activity
MOSACA	NKS-R activity
MS	Mass Spectrometry
MSc	Master of Science
MSWI	Melt-Structure-Water Interaction
MY	NKS program of authority related projects 1977 – 1980
NEA	Nuclear Energy Agency (under OECD)
NEP	Nuclear Emergency Preparedness (a work group for relevant Nordic authorities)
NKA	Nordic Liaison Committee for Atomic Energy
NKS	Nordic Nuclear Safety Research
NLH	Agricultural University of Norway
NorCMass	NKS-B activity
NordRisk	NKS-B activity
NPP	Nuclear Power Plant
NPSAG	Nordic PSA Group
NRC	US Nuclear Regulatory Commission
NROI	NKS-R activity
NRPA	Norwegian Radiation Protection Authority
NRPB	National Radiological Protection Board (now under the Health Protection Agency)
NSFS	Nordic Society for Radiation Protection
NTNU	Norwegian University of Science and Technology
OECD	Organization for Economic Cooperation and Development
OIL	Operational Intervention Levels
OKG	Oskarshamn KraftGrupp AB, Sweden (Oskarshamn nuclear power plant)
PardNor	NKS-B activity
PCC	Premature Chromosome Condensation
PhD	Doctor of Philosophy
POD	Probability of Detection
PODRIS	NKS-R activity
POOL	NKS-R activity
PPOOLEX	Experimental facility at LUT, Finland
PSA	Probabilistic Safety Analysis
PWR	Pressurized Water Reactor
QA	Quality Assurance; also an NKS program on quality assurance 1977 – 1980

R&B	Rhythm & Blues; here: Reactor Safety and Emergency Preparedness
R&D	Research and Development
RA	NKS program on radioecology 1977 – 1980
RAD	NKS program on radioecology 1990 – 1993
RAK	NKS program on reactor safety 1994 – 1997
RAS	NKS program on risk analysis and safety philosophy 1985 – 1989
REIN	NKS-B activity
REK	NKS program on radioecology 1981 – 1985
REMSPEC	NKS-B activity
RESUME	Rapid Environmental Surveying Using Mobile Equipment (NKS exercises 1995, 2002)
RI-ISI	Risk Informed In-Service Inspection
RISCOM-II	EU project on Risk Communication
RiskEval	NKS-R activity
Risø	Risø DTU National Laboratory, Denmark
RODOS	Real-Time On-Line Decision Support System for Nuclear Emergencies (EU)
RPV	Reactor Pressure Vessel
Ruthenium-Releases	NKS-R activity
SafetyGoal	NKS-R activity
SÄK	NKS program on reactor safety 1981 – 1985
SAM	NKS program for administrative control and information 1994 – 1997
SARA	EU project 1997-98, involving, e.g., a continuation of RAK.2.1
SBA	NKS program for safety and emergency preparedness related activities 1998 – 2001
SEA	Strategic Environmental Assessment
SEK	The NKS Secretariat
SIK	NKS program on reactor safety 1990 – 1993
SIP	Swedish International Project (division of SKI)
SIS	Danish Radiation Protection Authority
SIUS	SSI's International Development Cooperation Program
SKI	Swedish Nuclear Power Inspectorate (now part of SSM)
SOS	NKS program for nuclear safety and radiation protection 1998 – 2001
SPECIATION	NKS-B activity
SRV	Swedish Rescue Services Agency
SSI	Swedish Radiation Protection Authority (now part of SSM)
SSM	Swedish Radiation Safety Authority (formerly SKI and SSI)
StratRev	NKS-R activity
STUK	Finnish Radiation and Nuclear Safety Authority
TACO	NKS-R activity
TEM	Finnish Ministry of Employment and the Economy (formerly KTM/HIM)
TRACE	Traceability of Requirements for Analyzable Computerized Environments (NKS-R/MORE tool)
TS	Technical Specifications
TVO	Teollisuuden Voima Oy (Industrial Power Ltd.), Finland
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UrbHand	NKS-B activity
VALDOR	VALues in Decisions On Risk (NKS supported international conference)
VAT	Value Added Tax (a European sales tax)
VTT	Technical Research Center of Finland
WASCO	NKS-R activity
WASH-1400	A reactor safety study produced in 1975 for NRC; “the Rasmussen Report”
WDSE	Workshop on Dependable Software Engineering
WERISK	NKS-R activity
WWW	World Wide Web