Strål säkerhets myndigheten
Swedish Radiation Safety Authority

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

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SSM perspective

Background

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

Objective

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

Conclusions

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

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

Project information

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

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Content

Abbreviations

Abbreviations used in the report are listed below in alphabetical order

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

Executive Summary

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

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

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

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

1. Introduction

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

1.1. What is NKS?

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

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

1.2. About the assignment

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

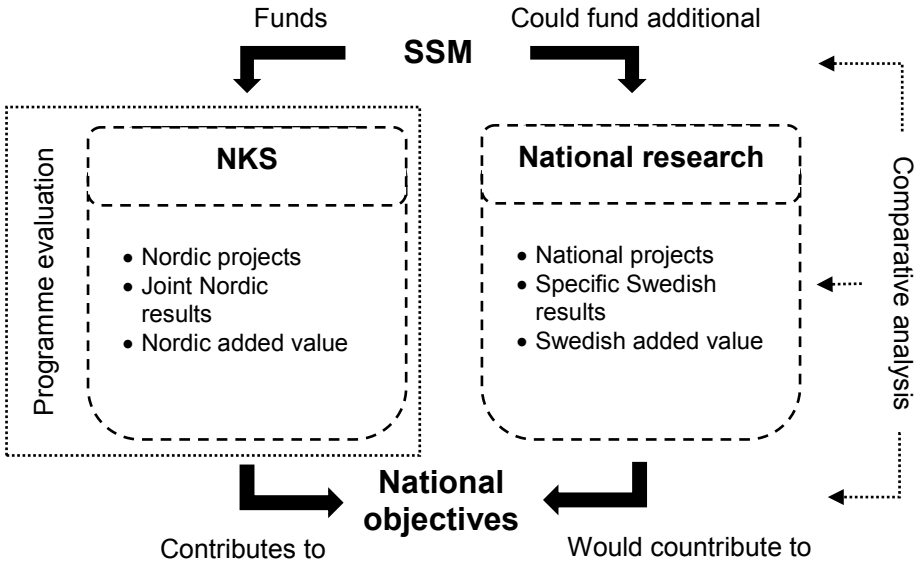
1.3. Framework and evaluation questions

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

1.3.1. Framework

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

Figure 1. Illustration of the framework for the evaluation



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

1.3.2. Evaluation questions

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

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

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

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

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

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

1.4. Methods and material

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

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

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

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

1.4.1. Exploratory interviews

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

1.4.2. Document studies

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

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

1.4.3. Project database

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

1.4.4. Survey

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

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

1.4.5. Interview study

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

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

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

1.4.6. Workshop for analysis and interpretation

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

1.5. Structure of the report

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

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

2. About NKS

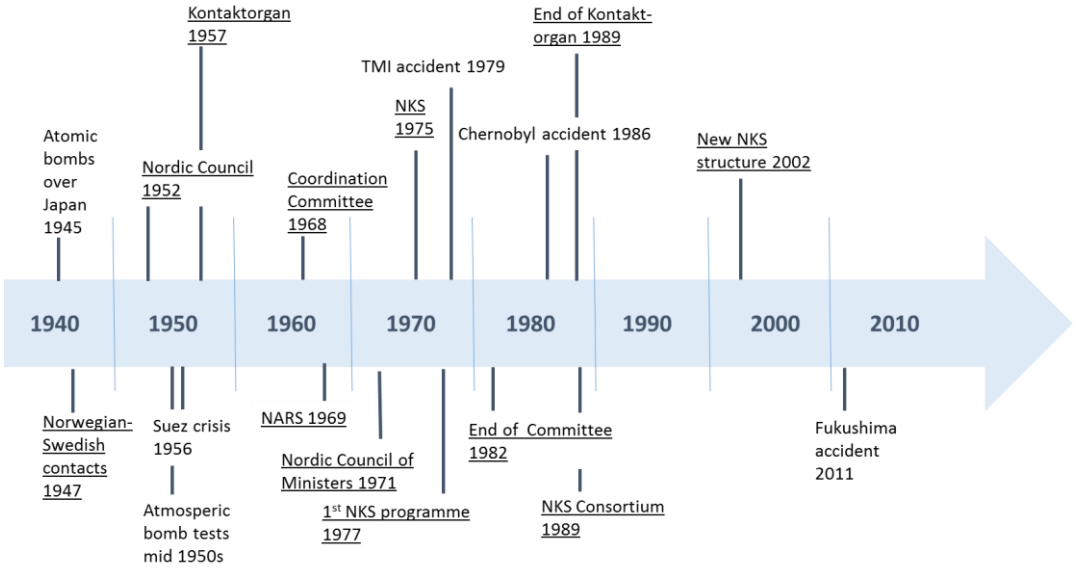
2.1. Background

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

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

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

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



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

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

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

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

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

2.1.2. The foundation of NKS[5]

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

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

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

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

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

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

2.1.3. NKS 1994-2008[6]

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

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

> "the Nordic countries have cooperated in the field of nuclear safety for well over half a century. Informal networks for exchange of information have developed over the years, strengthening the region's potential for fast, coordinated and adequate response to nuclear threats, incidents and accidents. NKS has served well as a platform for such activities."[7]

2.2. What is NKS expected to contribute?

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

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

2.2.1. Strategy and themes

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

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

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

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

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

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

2.2.2. Nordic added value

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

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

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

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

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

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

Direct impacts have been expected to consist in the following:

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

Indirect impacts have been expected to consist in the following:

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

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

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

2.3. Organisation

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

The owner and main financiers of NKS are the following:

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

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

Co-financiers of NKS are the following:

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

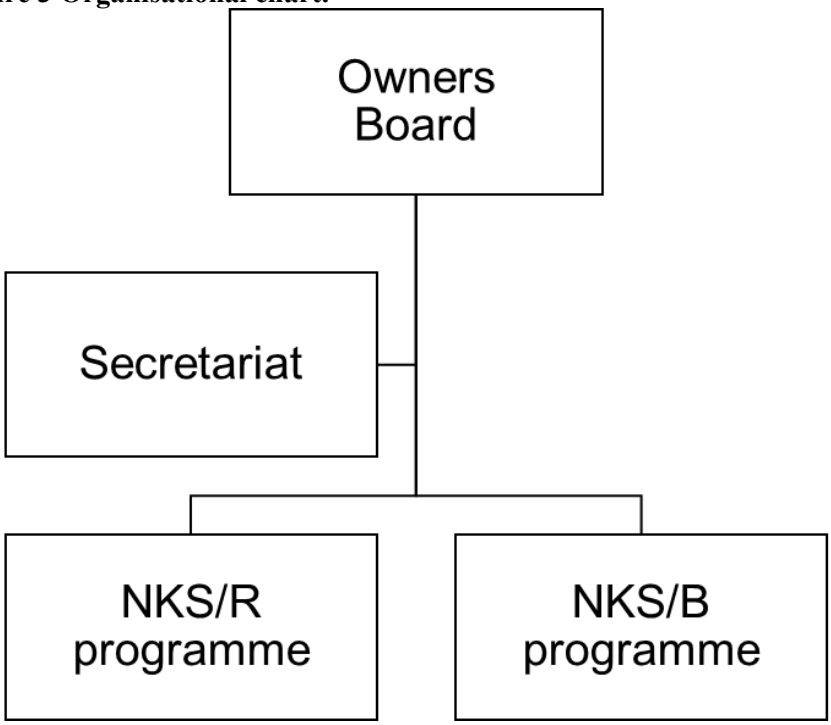
Previous co-financers during the relevant time frame are:

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

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

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

Figure 3 Organisational chart.



2.4. Project characteristics

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

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

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

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

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

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

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

3. Activities of NKS

3.1. System and routines of NKS

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

3.1.1. Quality assurance

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

- 'assessment of applications received during the Call for Proposals process
- participation of end users throughout the entire process: planning, execution, deliverables, implementation, and evaluation
- reporting and discussions at Board meetings
- publication of results in reports and refereed journals
- dissemination and discussions of NKS results in Nordic and international fora (conferences, seminars, topical meetings, workshops etc.)
- regular evaluations of the entire technical / scientific program and the administrative support structure'[13]

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

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

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

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

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

Awarding funding

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

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

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

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

Reporting

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

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

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

3.1.2. Cost efficiency

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

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

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

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

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

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

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

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

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

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

National distribution of NKS grants

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

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

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

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

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

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

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

3.2. Project portfolio

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

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

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

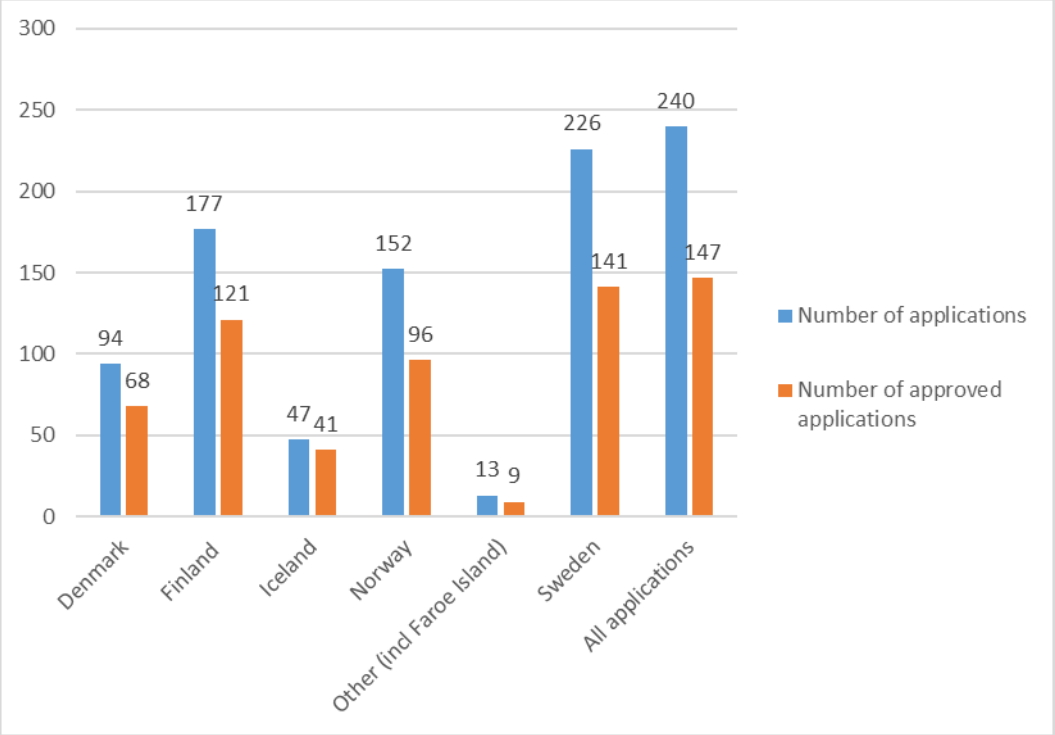
3.2.1. Participation by country

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

The average application success rate for each country is given by comparing the number of applications and the number of approved applications for each country as presented in Figure 4. The success rate ranges between 50-100% depending on year, country and program. On average the success rate for applications is around 60%. There are only small differences in success rates by program. However, countries participating in fewer applications (such as Denmark and Iceland) generally have a higher rate of success for applications they are a part of, compared to countries that are active in almost all applications, such as Sweden. Since Swedish actors have been participating in almost all applications, the success rate for applications with Swedish actors is 62.4%. This can be compared to applications with Danish partners, which have a success rate of 72.3%. It should be noted that actors from Denmark, Iceland and Finland have a higher success rate for applications where they are coordinating the activity, in comparison to when they are project members. For Norway, the success rate is close to equal. Swedish actors on the other hand have a success rate of 46.9% for applications where the Swedish actor is coordinating the activity, compared to 73,8% when the Swedish actor is a project member. One explanation for the low performance for applications with Swedish coordinators could be that each year Swedish actors submit at least one application with participation from only Swedish actors. Since the rules of NKS stipulate that at least three Nordic countries should be involved in a project, projects with participation form only one country are very seldom approved.[20]

[20] On occasion applications with only Swedish actors have been approved, such as the INCOSE-project 2009-2010.

Figure 4 Number of submitted and approved project proposals during 2008-2015 grouped by involvement of actors from the Nordic countries.



Many NKS projects have more than one participating actor from each country as shown by comparing the following three graphs (Figure 5 - Figure 7) with Figure 4 above. During the time period a total of 203 Swedish actors took part in 141 projects. Note that the graphs below describe the number of project participations from actors in each country. That is, if two Swedish organisations have both been active in two projects during the time period, a total of four participations have been noted.

Figure 5. Number of project participations by actors divided by country and program for 2008-2015.

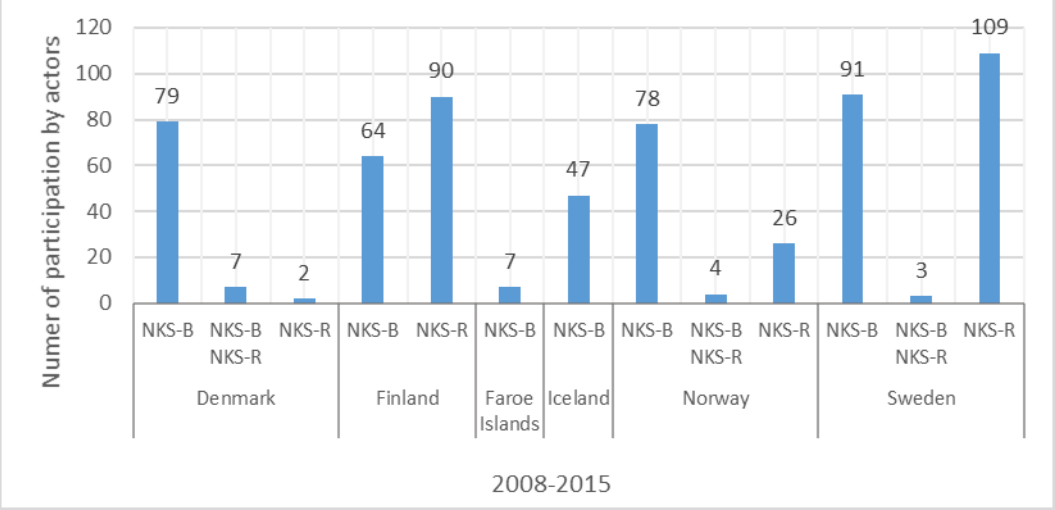
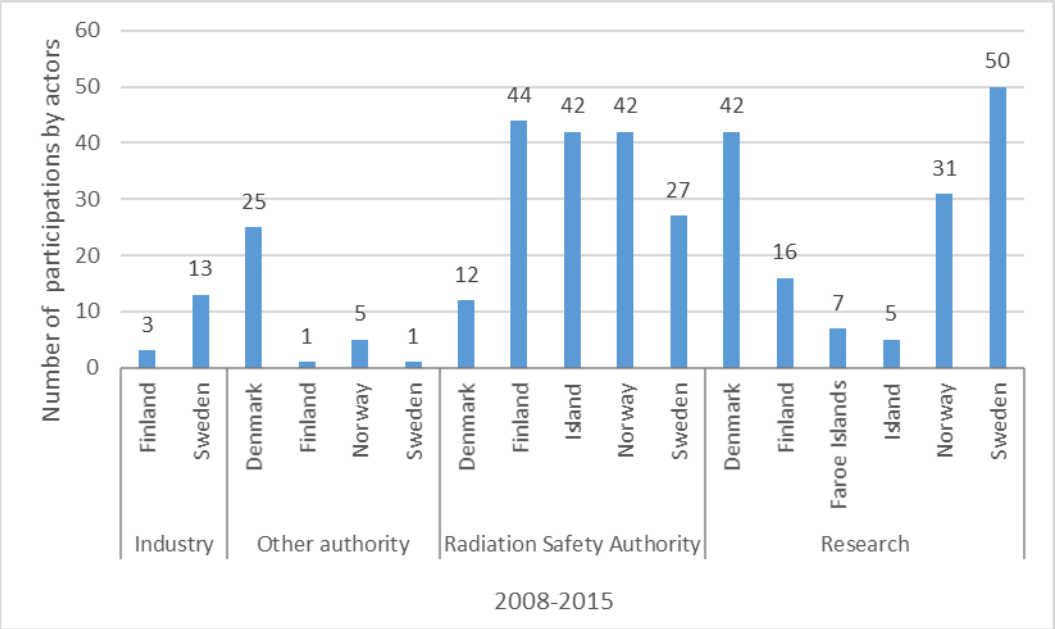


Figure 6 and Figure 7 describe the number of project participations from actors in each of the Nordic countries divided by type of actor for the NKS-B program and NKS-R program separately. It is important to note that the graphs do not provide information on the number of unique actors active within NKS, but the number of participations from actors in each country. For example, only two different research actors from Denmark were active within NKS-B during the time period. Participants from the Danish Technological University (DTU) stood for 40 of the 42 project participations by Danish research actors. To compare a total of eight research actors from Sweden were active within NKS-B during the time period with an average of 6.25 project participations per actor.[21]

Figure 6. Number of project participations by actors in NKS-B projects, divided by type of actor and country.

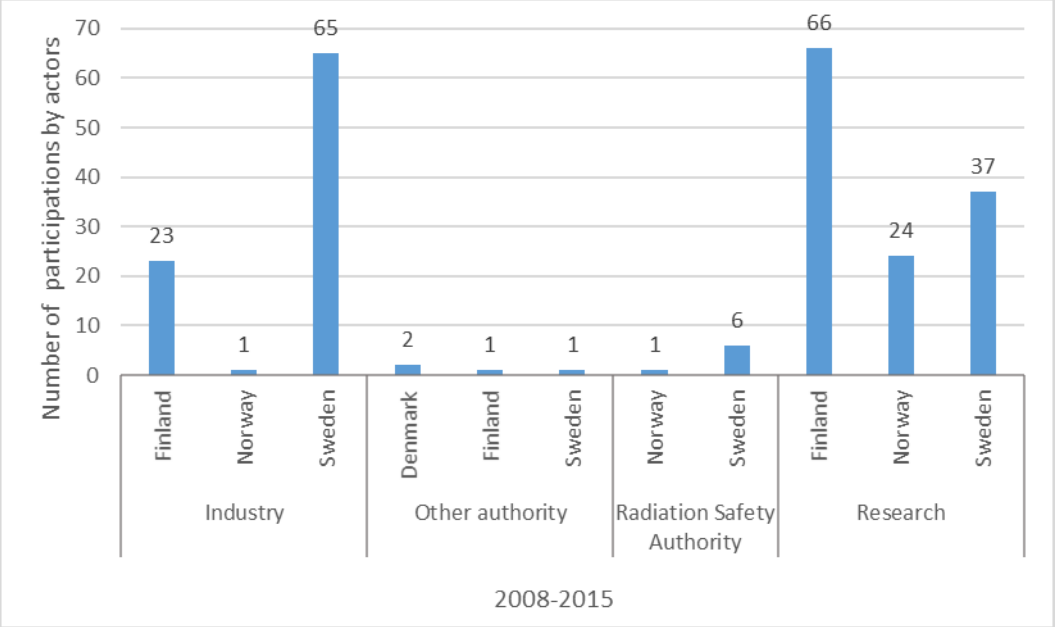


Note that the high number of participations from "Other authorities" in Denmark is due to the Danish Emergency Management Agency, DEMA (Beredskabsstyrelsen) being categorised as "Other authority".

Mainly actors from Finland and Sweden are active in the NKS-R program, as can been seen in Figure 7. Norwegian participation in NKS-R is almost exclusively made up of participations from IFE, either by individuals working with the Halden Reactor Project or at the Kjeller research reactor. Swedish industry, often in form of technical consultants, and Finnish research actors, predominantly VTT, are the main actors within the NKS-R program.

[21] For a full list of unique Swedish actors, see segment 3.3.

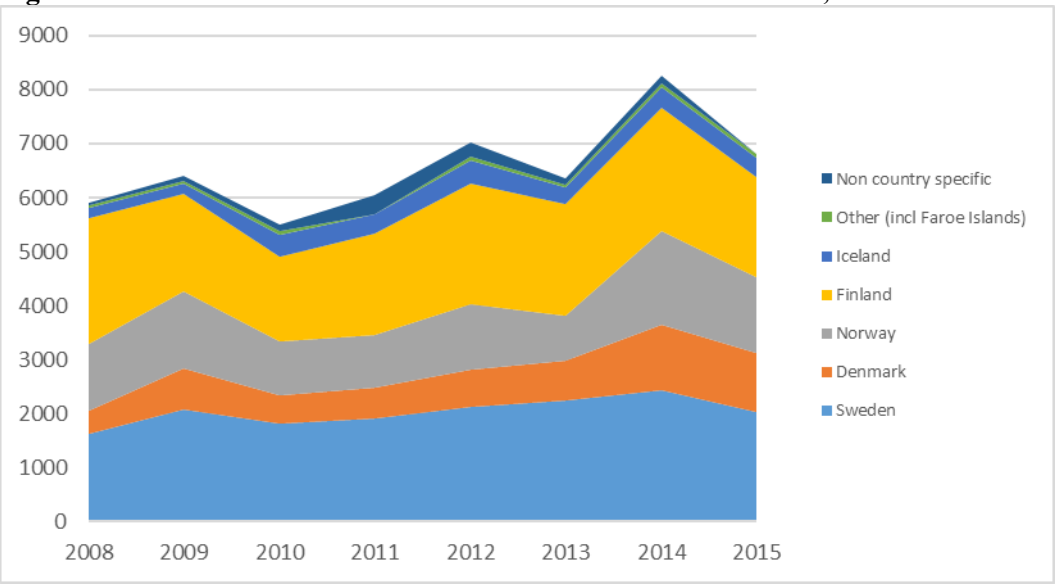
Figure 7. Number of project participations by actors in NKS-R projects, divided by type of actor and country.



3.2.2. Project funding and co-funding

Below the distribution of NKS project funding and the distribution of project co-funding is presented. The information is presented separately for NKS-B and NKS-R to highlight the differences regarding proportion of project co-funding and Nordic participation.

Figure 8. Distribution of NKS funds between the Nordic countries, 2008-2015



NKS R

As previously noted, actors from Sweden and Finland are the primary participants in NKS-R projects. This can be seen in the distribution of NKS funds presented in Figure 9. Finland and Sweden receive most of the funding within the program. NKS-R projects are

heavily co-funded which can be seen in Figure 10. NKS demands that project participants provide co-funding equal to the amount of funding from NKS. However, within the NKS-R program project co-funding equals to more than twice as much as the NKS funding as can be seen by comparing Figure 9 and Figure 10. The high amount of co-funding of NKS-R projects indicate lower additionality of the NKS-R program in relation to the NKS-B program. The project portfolio data indicates that NKS-R projects, to a higher degree than NKS-B projects, would have been realized if NKS funding had not been granted.

Figure 9. Distribution of NKS-R funds between the Nordic countries, 2008-2015. [22]

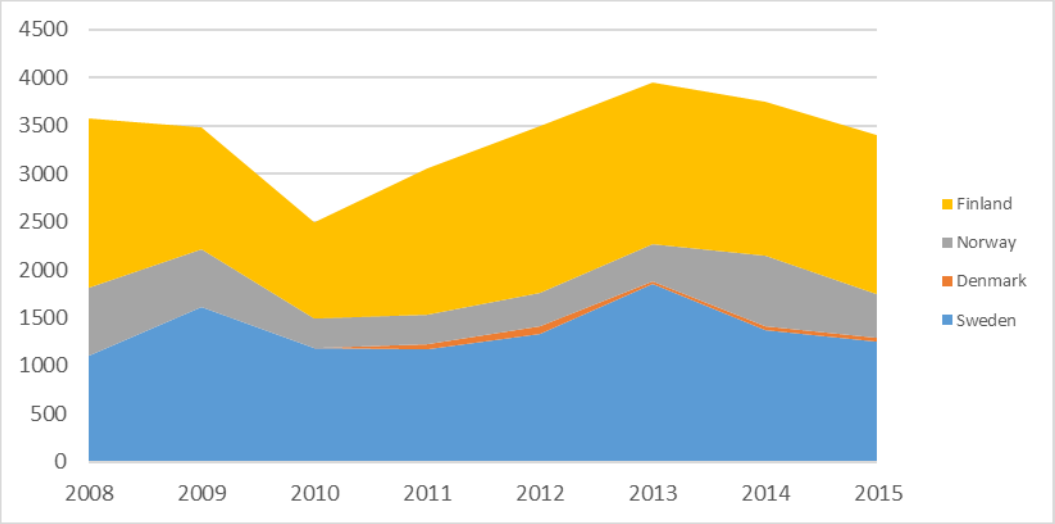
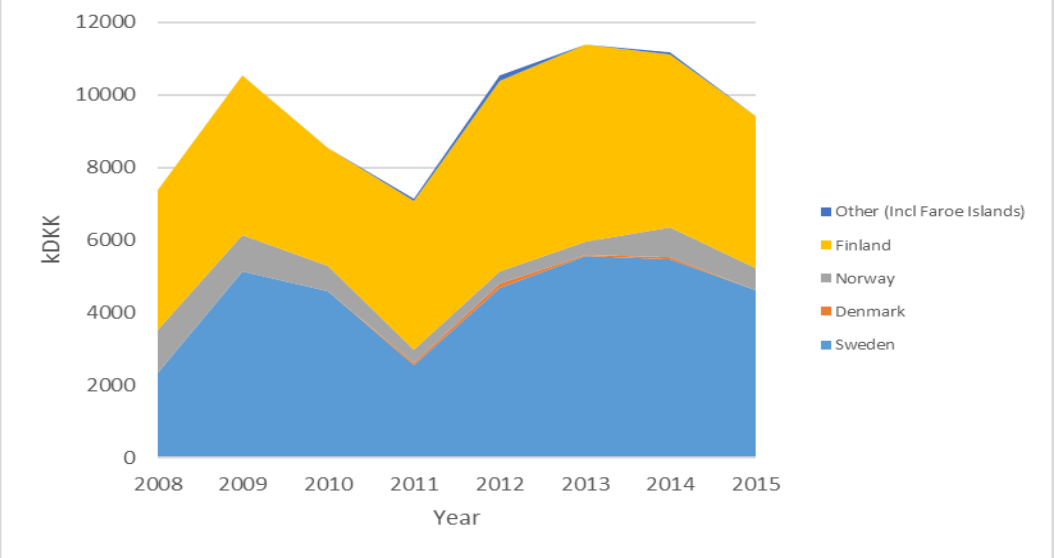


Figure 10. Distribution of expected co-funding of NKS-R projects between the Nordic countries, 2008-2015. [23]



[22] Note that records for 2008-2009 are not as specific as records for later years. For these years the distribution of project funds between project members are not avaliable. For 2009 the distribution presented in applications has been used to allocate funds to different country participants. For 2008 the distribution from subsequent projects has been used. In cases where no subsequent project exist all funding has been attributed to the coordinating organisation.

[23] Applications for the NKS-R program for 2008 are not available why information on co-funding is generally missing. For projects spanning several years the level of co-funding for later years has been assumed for 2008 as well. For remaining projects co-funding equal to the amount of NKS funding has been assumed (in accordance with NKS rules).

NKS B

The distribution of NKS funds and project co-funding for the NKS-B program, grouped by country, is presented below. All Nordic countries are active within the NKS-B program, and actors from Denmark, Norway and Sweden, have generally received the largest amount of funding. Project co-funding is generally in proportion to the NKS funding.

Figure 11. Distribution of NKS-B funds between the Nordic countries, 2008-2015.

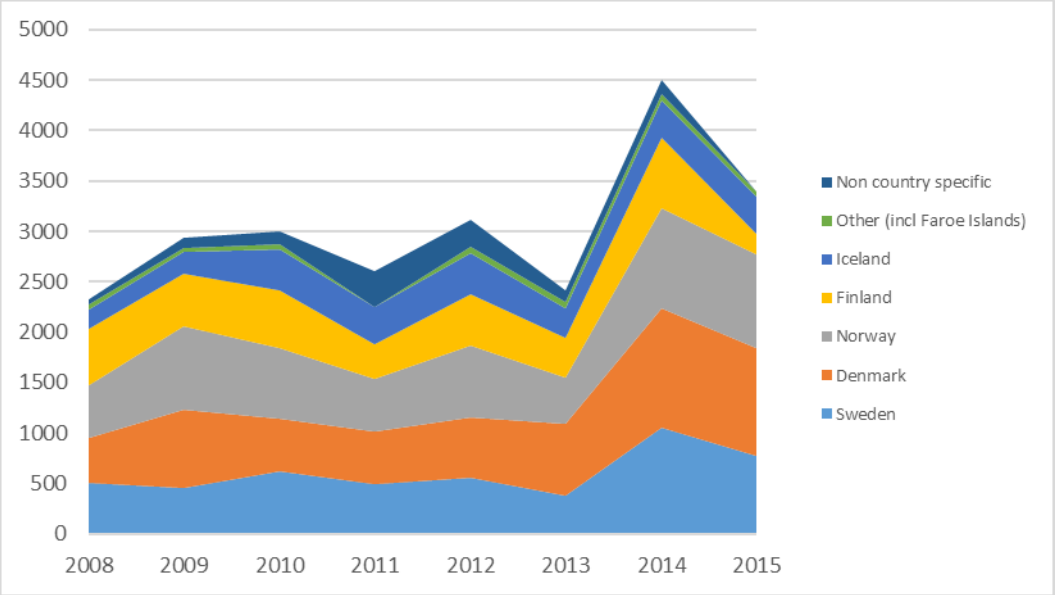
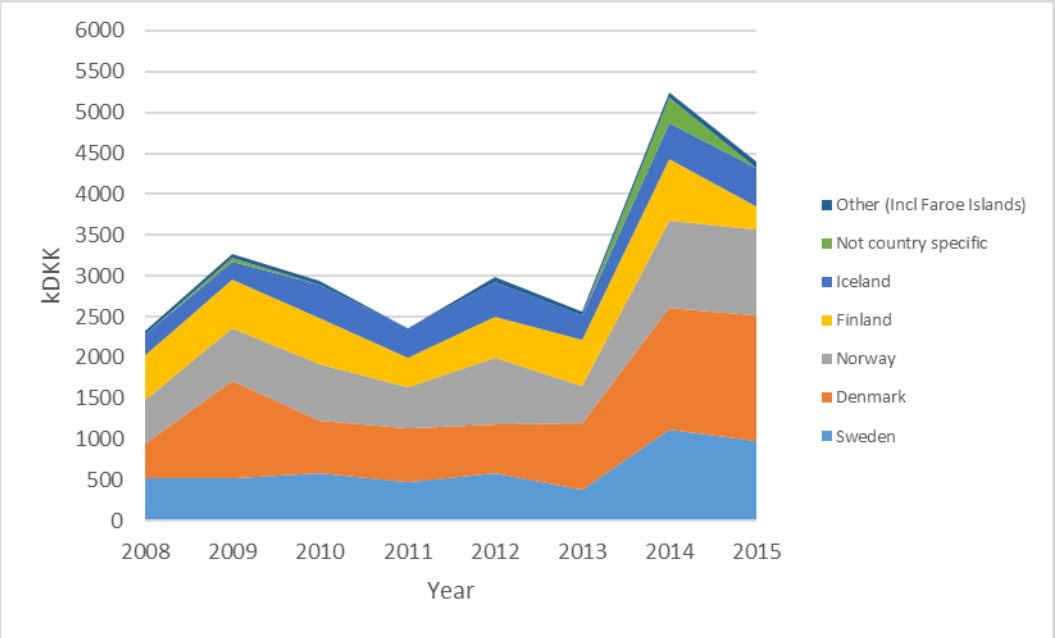


Figure 12. Distribution of expected co-funding of NKS-B projects between the Nordic countries, 2008-2015[24]



[24] Co-funding data is missing in some applications for 2008. In those cases, co-funding has been assumed to be equal to NKS-funding (in accordance with NKS rules).

3.3. Swedish participants in NKS

In this section, Swedish actors who have participated in either NKS-R or NKS-B projects are listed. An actor who has participated in both NKS-R and NKS-B projects is presented twice. The total number of participations by Swedish actors in NKS projects during the relevant time period is presented in Figure 13. Most of the relevant actors within the Swedish nuclear safety knowledge community have participated in NKS during the investigated time frame. This conclusion is based on SSM's and Oxford Research's experience of the Swedish nuclear safety knowledge system. Hence, reach of the target group appears to be satisfactory and accurate.

Table 3. Swedish actors who have participated in either NKS-B and/or NKS-R projects during 2008-2015.

Actor (NKS-B)	Type of Actor	Actor (NKS-R)	Type of Actor
Barsebäck kraft AB	Industry	Chalmers University of Technology	Research
Swedish Defence Research Agency (FOI)	Research	ES konsult	Industry
Forsmark Kraftgrupp AB	Industry	Forsmark Kraftgrupp AB	Industry
The University of Gothenburg	Research	Inspecta Sweden	Industry
KTH Royal Institute of Technology	Research	KTH Royal Institute of Technology	Research
Linköping University	Research	Kärnkraftsäkerhet och Utbildning AB	Industry
Lund University	Research	Lloyds Register Consulting Energy AB	Industry
Oskarshamnsverkets Kraftgrupp OKG	Industry	Luleå University of Technology	Research
Ringhals AB	Industry	Lund University	Research
Geological survey of Sweden (SGU)	Other authority	Ndcon	Industry
Swedish University of Agricultural Sciences (SLU)	Research	Oskarshamnsverkets Kraftgrupp OKG	Industry
Swedish Radiation Safety Authority (SSM)	Radiation Safety Authority	Ringhals AB	Industry
Studsvik Nuclear Ab	Industry	Risk Pilot AB	Industry
Stockholm University	Research	Scandpower	Industry
Uppsala University	Research	Swedish Meteorological and Hydrological Institute (SMHI)	Other authority
Vattenfall	Industry	Solvina AB	Industry

		Swedish Radiation Safety Authority (SSM)	Radiation Safety Authority
		Studsvik Nuclear AB	Industry
		Swedish Nuclear Fuel and Waste Management Company (SKB)	Industry
		Uppsala University	Research
		Vattenfall	Industry
		ÅF Consult	Industry

Figure 13. Participations by Swedish actors in NKS during 2008-2015 divided by type of actor.

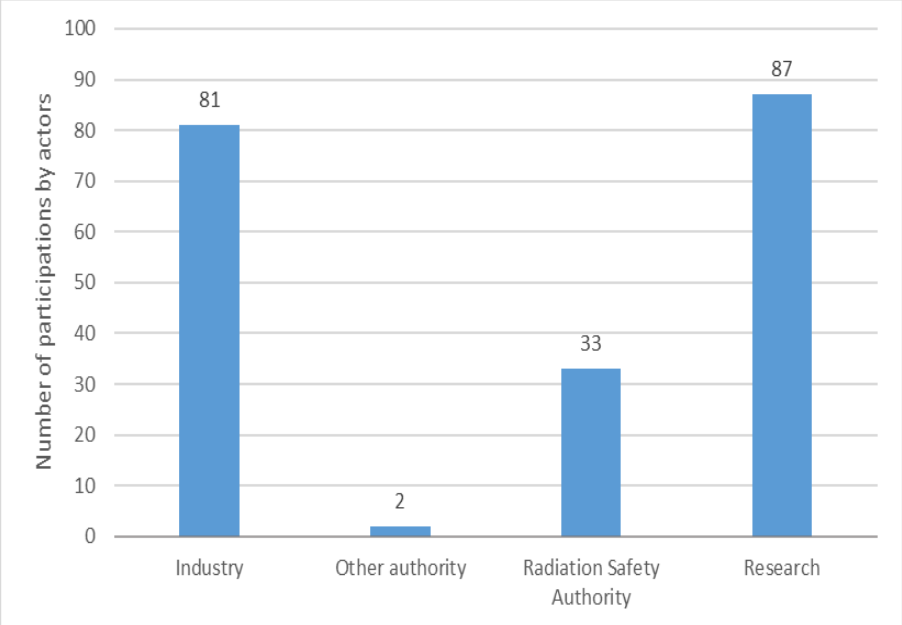
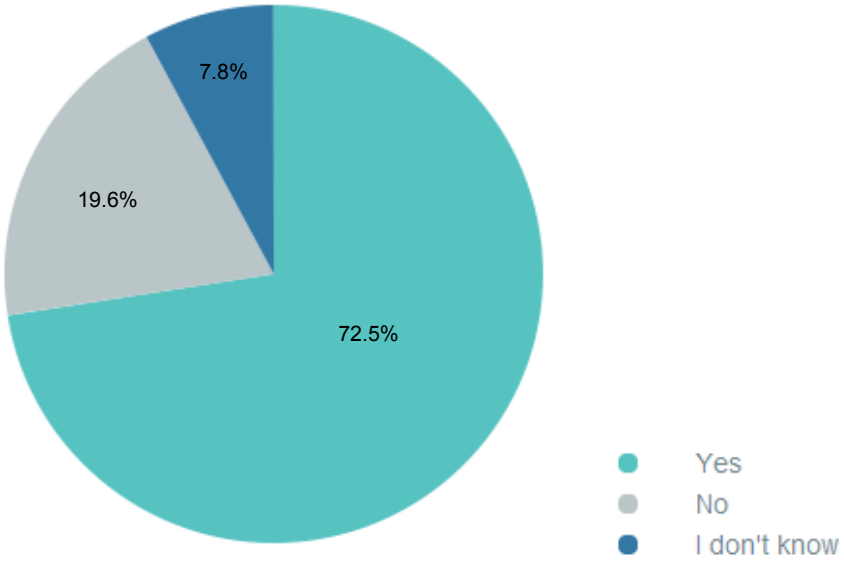


Figure 14. Answers from Swedish survey respondents to the question: 'Did you, at the time when you were active in NKS, consider yourself to belong to the main target group for participating in NKS?'



4. The impacts of Swedish participation in NKS

4.1. The relevance and standing of NKS

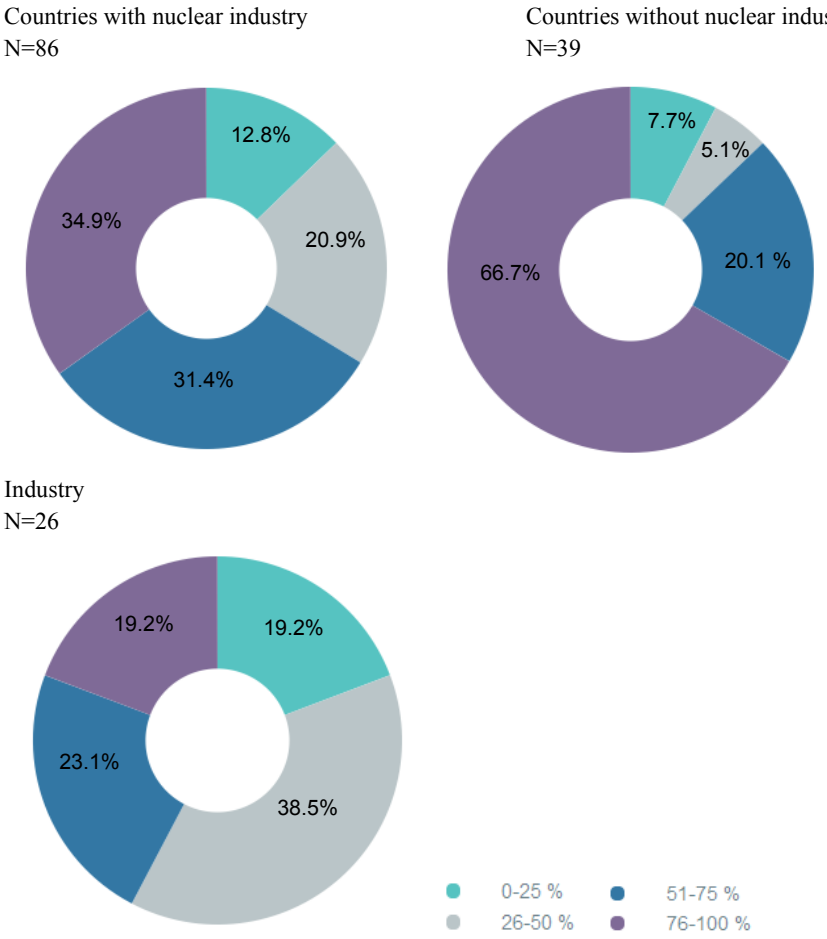
Below we address the standing of NKS through presenting results on how well known NKS is and on the function of NKS as compared to other funding opportunities. NKS is generally well known and funding is considered relatively easy to receive. The granted amounts are considered to be low or negligible by around 40%, of the respondents which partially explains the relatively low competition for funds.

4.1.1. Who knows of NKS?

NKS is considered well known among survey respondents and interview subjects. It should be noted that the selection of interview subjects and survey respondents has been based on individuals who have been active in NKS why a certain amount of selection bias can be expected. However, overall the institutions and organisations which could be anticipated to be engaged in NKS have been part of the interview and survey population sample. Knowledge of NKS within relevant populations is estimated to be higher in the countries without a nuclear industry than in countries with nuclear industry as can be seen in Figure 13. Note that 12 out of 13 Danish respondents have estimated that 76-100% of colleagues within Nuclear Safety are aware that NKS exists.

Between-country effects as presented in Figure 15 are mainly driven by low estimations by actors within industry. All but one industry actor come from Sweden and Finland, as can be seen in Figure 6 and Figure 7, why the lower estimations on knowledge of NKS from countries with nuclear industry can be expected to be driven by industry actors. Significant differences based on NKS program exist as well, with higher knowledge of NKS among NKS-B participants in comparison to NKS-R participants. Due to the skewed participation of industry actors, with more prevalent participation in NKS-R projects compared to NKS-B projects, this difference can be expected to be an effect of the views of industry actors as well.

Figure 15. Survey respondents' estimations of the percentage of colleagues within Nuclear Safety that are aware that NKS exists



Some interview respondents note that fewer young researchers have knowledge of NKS compared to older researchers. The reason is that young researchers are often introduced to NKS by older peers. Overall 35% of survey respondents got information on NKS from a radiation safety authority (either through official of private information) which indicates an important role of the radiation safety authorities as well, since only 23% of the respondents were associated with a radiation safety authority. 13% of respondents got information on NKS directly from NKS.

4.1.2. NKS as a funding opportunity

The NKS application procedure is generally considered appropriate. Figure 16 shows that respondents consider it to be easier to receive funding from NKS compared to national or international funding opportunities within nuclear safety research. Figure 18 shows that project participants in general consider project administration to be less taxing in NKS projects in relation to national and international ones. The results in both Figure 16 and Figure 18 are mainly driven by research actors. They have responded in higher frequencies, which is explained by the fact that they have more experience of applying for funding.

A comparison between respondents from countries with nuclear industry (Sweden and Finland) and countries without nuclear industry (Denmark, Norway, Iceland and Faroe Islands) show statistically significant differences regarding the difficulties in receiving funds compared to national and international options. Actors from countries with nuclear industry are more inclined to agree that it is more difficult to receive funds from NKS, although differences are small and a majority of respondents disagree with the statement as can be seen in Figure 16.

NKS-R participants and industry actors to a significantly higher degree than NKS-B participants and non-industry actors agree with the statement that it is more difficult to receive funding from NKS in comparison to national funding as can be seen in Figure 17**.** A majority still find NKS funding easier to receive than national or international funding though. Because most NKS-R participants and industry actors are from Sweden or Finland this difference based on program participation and type of actor affects differences based on country.

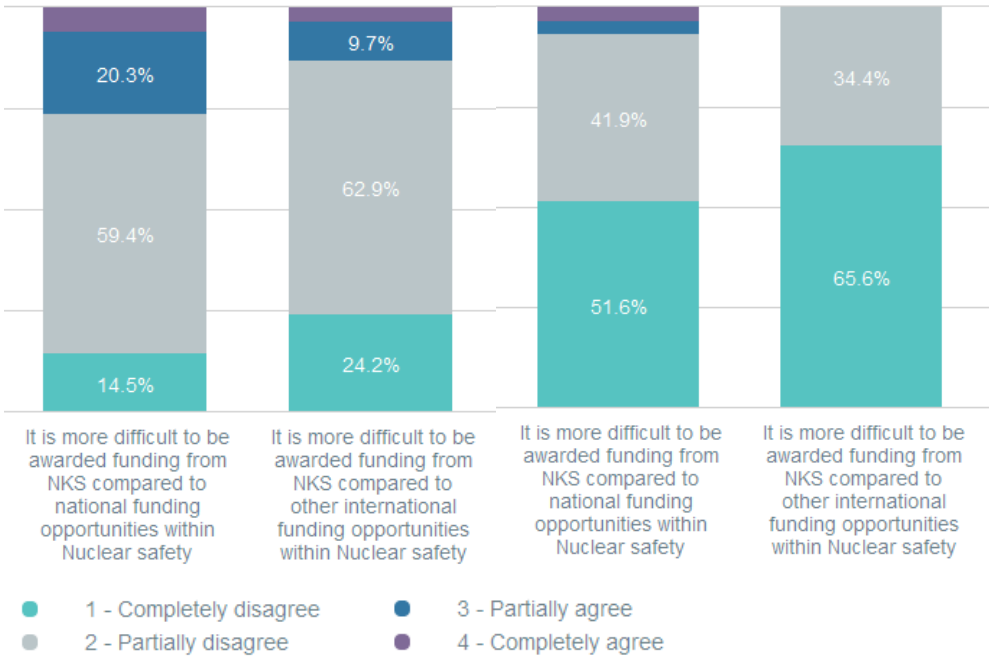
Interview results show that Swedish and Finnish participants in NKS-R projects, of whom many are industry actors, find the NKS rule on including a minimum of 3 Nordic countries difficult to live up to[25]. The reason is that many NKS-R projects are more relevant for countries with a nuclear industry. This fact partly explains perceived differences regarding the difficulties in receiving NKS funding compared to national funding based on country and program. The rate of success for NKS-B and R programs is equal though, why one could suspect that there is more national funding easily available for NKS-R than NKS-B projects. Another explanation for the perceived differences between countries is the availability of funding from SSM and SAFIR in Sweden and Finland. Additionally, interviews indicate that specific funding for some of the areas covered by NKS-R are available to a higher degree than funding for research within the thematic areas covered by NKS-B. An example on alternative national and/or Nordic funding for NKS-R projects is funding from the Nordic PSA group which consists of utilities, radiation safety authorities and research actors from Finland and Sweden. The group finance research on probabilistic safety assessments (PSA). Regarding difficulties in receiving NKS funding it should be noted that Swedish applications have a lower success rate than other countries, as shown in Figure 4. This difference in the actual success rate of applications also explains difference in perceived difficulty of receiving funding based on the country of origin of respondents.

[25] As previously noted many NKS-R projects contain only participation from Swedish and Finnish actors as evident from Figure 7 and Figure 9

Figure 16. Percentage of respondents from countries with and without nuclear industry agreeing or disagreeing with statements on the difficulties to receive NKS funding.

Countries with nuclear industry
N= 62-69

Countries without nuclear industry
N= 31-32

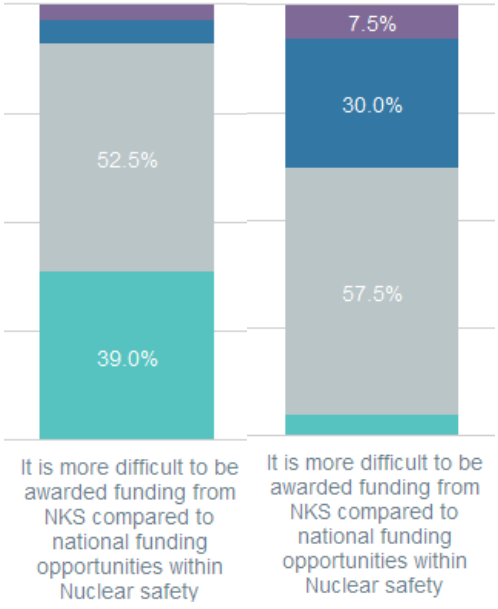


Note: "I don't know"-answers have been removed.

Figure 17. Participants in NKS-B and NKS-R agreeing or disagreeing with the statement below on the difficulties in receiving NKS funding as compared to national funding.

NKS-B
N=59

NKS-R
N=40

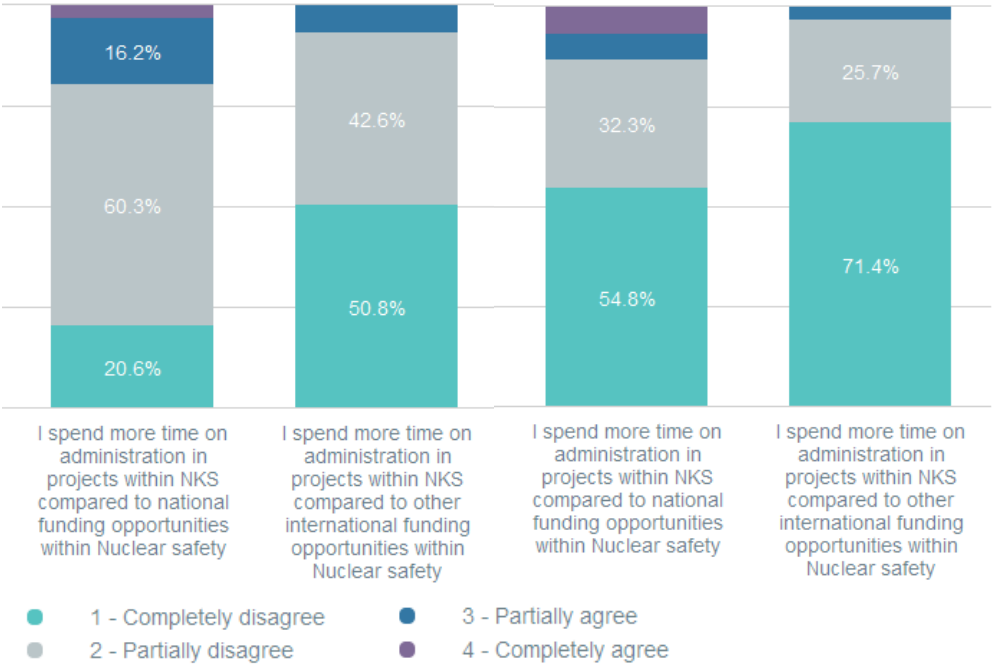


There are significant differences based on the survey respondent's country of origin regarding time spent on administration of NKS projects in relation to other national or international projects as can be seen in Figure 18 below. These differences based on country are partly driven by industry actors in Sweden and Finland who find the administration more time consuming than other actors. A majority of industry actors find the administrative burden of NKS less taxing than the administrative burden in other national and international projects though.

Figure 18. Percentage of respondents from countries with and without nuclear industry agreeing or disagreeing with statements on the administrative burden of NKS.

Countries with nuclear industry
N= 61-68

Countries without nuclear industry
N= 31-35

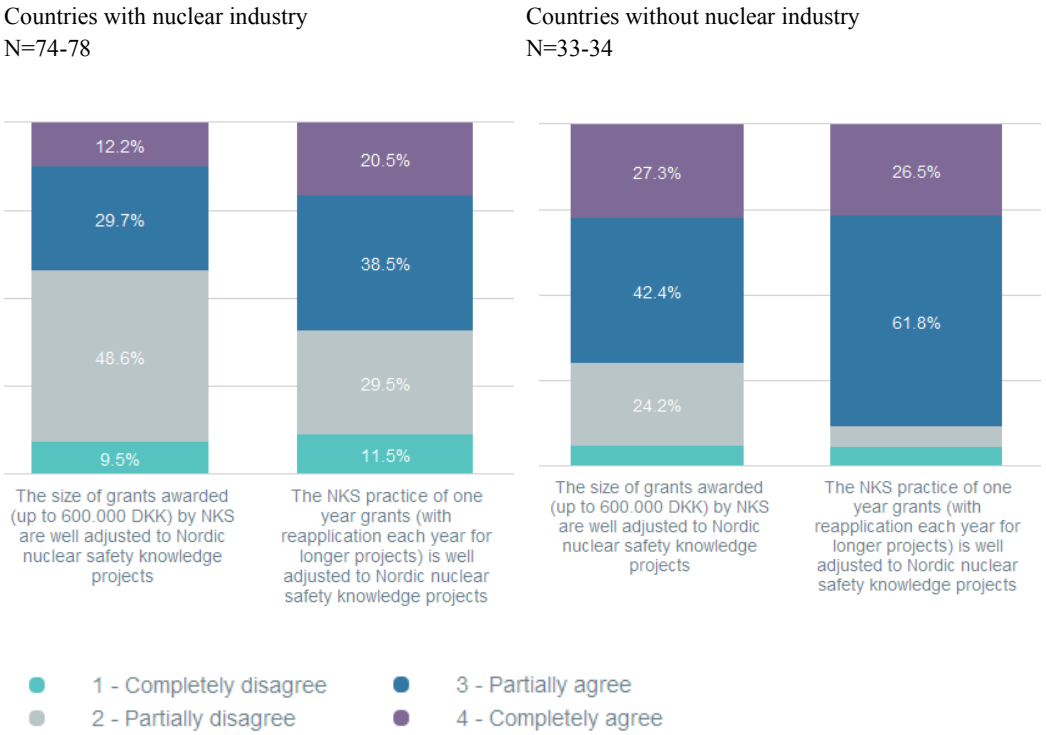


Note: "I don't know"-answers have been removed.

4.1.3. The relevance of NKS funding

Survey results show significant differences between countries with and without nuclear industry regarding the appropriateness of the amount of project funding provided by NKS (maximum 600k DKK) and the length of the project grants (1 year). These differences are presented in Figure 19 below. No significant differences based on type of actor or program have been identified. Overall there is no consensus in the survey data on the appropriateness of the size of grants.

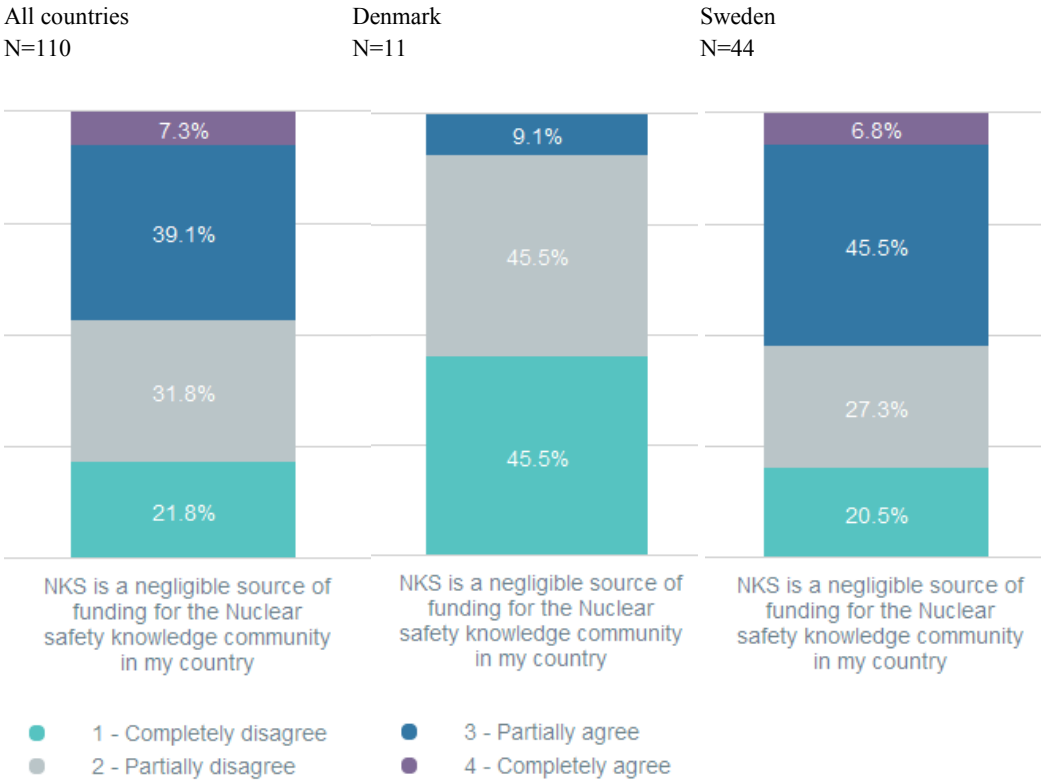
Figure 19. Percentage of respondents from countries with and without nuclear industry agreeing or disagreeing with the two statements presented below.



Note that "I don't know" answers have been removed

The view on the importance of NKS-funding, if it's a negligible source or not, is split evenly between survey respondents. However, no significant differences based on if respondents are from a country with or without nuclear industry, based on type of actor or based on which program the respondent has participated in have been identified. Danish respondents view the funding as more important than both Swedish respondents and the general survey population though, as can be seen in Figure 20. Overall, survey respondents express that NKS functions as a way of distributing knowledge, building competences and financing small projects which would otherwise be difficult to finance.

Figure 20. Percentage of respondents from all countries and from Denmark and Sweden agreeing or disagreeing with the statement below.



Note that the difference between Denmark, Sweden and the other countries has not been statistically tested due to the low number of Danish respondents. "I don't know" answers have been removed

In general, there are few alternatives to NKS funding. Specifically, few options exist aimed at Nordic cooperation and small projects including funding for knowledge dissemination activities. Alternative funding for Nuclear safety research overall is primarily funding from EU (Euratom/H2020), national research councils, radiation safety authorities or other authorities (such as Tekes in Finland and MSB in Sweden), and in some cases industry actors. Barely half of the Danish survey respondents see no alternative to NKS funding at all, which explains why almost all Danish respondents disagree with the statement that NKS is a negligible source of funding.

As can be seen in Figure 20 a bit less than half of the survey respondents view NKS' funding as negligible. Interview results make clear that the main justification for participating in NKS is the opportunity to build Nordic networks and work with experts from other Nordic countries, something that is true for both NKS-B and NKS-R projects. The funding from NKS primarily funds pilot projects or provides an extra source of funding for a project. For example, for Swedish actors within radioecology, NKS-B projects facilitate Nordic professional networks and help maintain the competence needed to uphold development capacity within the field. The function of NKS as a base for building professional relationships is especially apparent for radiation safety authority actors, although a consensus exists among all types of actors as expressed through interviews and open survey answers. The funding is important as funding of the Nordic coordination of research activities rather than as funding for the basic research activities themselves. This discrepancy partly explains survey results presented in Figure 19 and Figure 20.

The additionality of NKS funding is lower for NKS-R projects as compared to NKS-B projects. Interview results show that especially NKS-R participants often view NKS as a source of extra funding rather than as the primary funding of a project. NKS-R projects are usually not dependent on the funding from NKS and would be executed with or without the NKS funding. The additionality of NKS funding is greater in NKS-B as shown in Chapter 3, and interview results reveal that participants within NKS-B depend on NKS to execute collaborative projects on a Nordic level to a higher degree than participants in NKS-R. However, the funding itself does not justify participation in the program, and if there was more competition and lower success rates, some actors would lose interest in the program. Several actors, both active in NKS-B and NKS-R, state that funding up to 600k DKK is in itself not a negligible amount for nuclear safety research, however when funds need to be split between three or more actors, the funding for each actor usually only covers a minor part of the funding needed for a research or development project. The additionality of the funding as pure research funding could therefore be suspected to be fairly low, however the funding is important when regarded as research coordination funding, especially for NKS-B projects.

4.2. Utilization of results from NKS

Below, we describe the utilization of NKS by Swedish and Nordic actors. Results are presented based on country, type of actor and based on which NKS program the respondent has been active in.

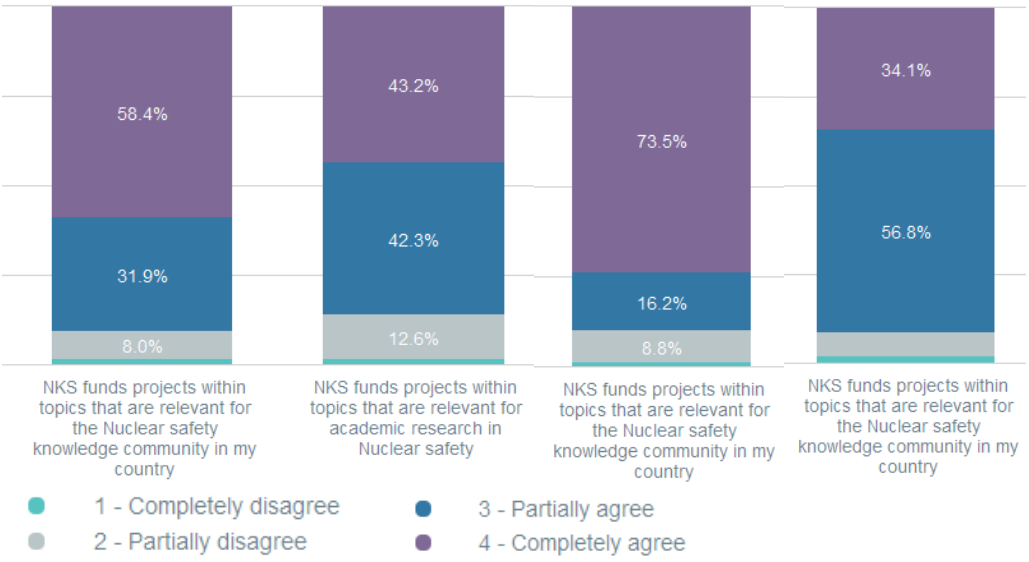
4.2.1. Relevance of NKS' themes

NKS generally funds projects relevant for respondents in all countries. Participants in NKS-B to a statistically higher degree than participants in NKS-R agree that NKS funds projects which are relevant for the national nuclear safety knowledge community.

Below, the general view on the relevance of the projects NKS funds, along with the difference based on program, is presented. Note that all participants agree that NKS funds relevant projects, the difference between NKS-R and NKS-B participants regard whether participants agree *completely* or *partially* with the statement. Interview results validate the survey data. Researchers applying for funding from NKS-B find that the program contains all relevant thematic areas for their research since their research is focused on nuclear safety and emergency preparedness. Researchers who apply for NKS-R funds on the other hand are also active within fields that are not encompassed by the NKS-R program. For example, research on the development of new nuclear fuels or other types of research and development which is not primarily focused on nuclear safety.

Figure 21 Percentage of participants agreeing or disagreeing with each of the two statements below.

All participants N=111-113 | NKS-B N=68 | NKS-R N=44

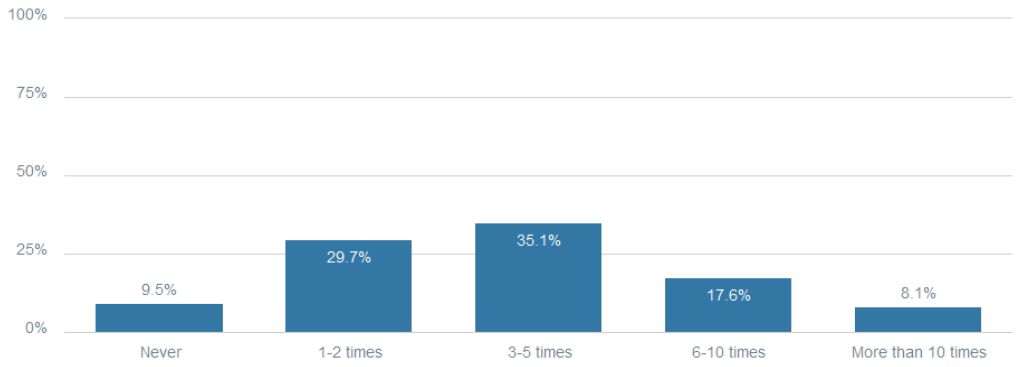


4.2.2. Use of NKS results and reports

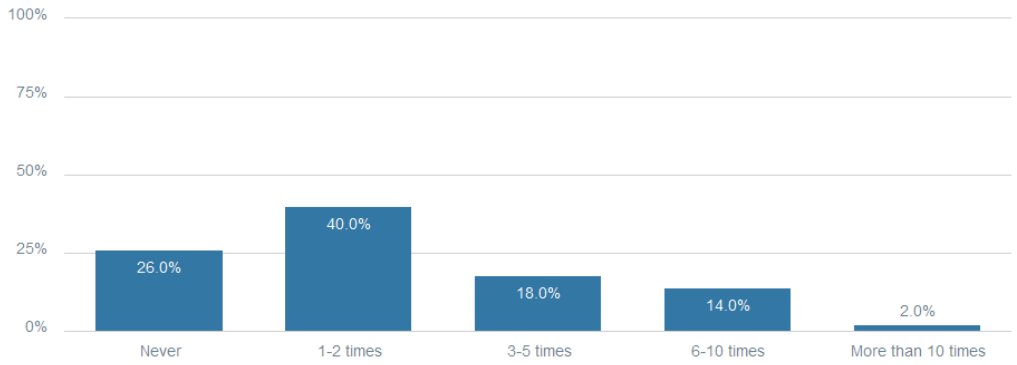
Non-parametric statistical testing shows no significant difference between countries with or without a nuclear industry regarding taking interest in results from NKS projects the respondent has not participated in. Danish respondents stand out though, taking interest in results to a higher degree than participants from the other Nordic countries. There are significant differences based on program, where participants in the NKS-B program to a higher degree than participants in the NKS-R program take interest in general NKS results as can be seen in Figure 22. Significant differences are also prevalent based on type of actor where research actors most commonly take interest in NKS results and industry actors take interest in results more seldom. An interaction exists between program and actor where research actors and respondents from other authorities active in NKS-B programs take interest in results to a higher degree than research actors and respondents from other authorities active in NKS-R projects.

Figure 22. Respondents' answers to the question 'How many times during the past three years have you taken interest in results from NKS projects, excluding projects which you yourself participated in?' grouped by which program respondents have participated in.

NKS-B, N=74



NKS-R, N=50



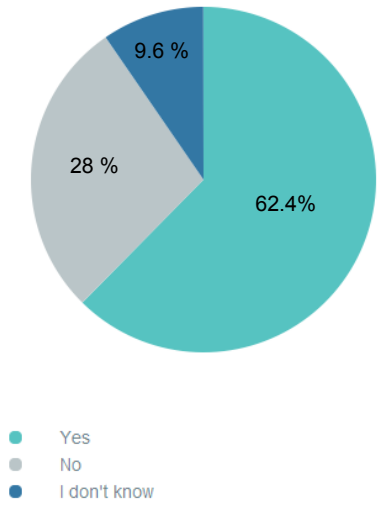
Overall interview results indicate that 'generalists' and NKS-B project participants are interested in NKS results in general, to a higher degree than 'specialists' and NKS-R participants, who are often themselves participants in all relevant projects.[26] NKS material is used in a number of ways, such as background for future research, competence-building and general orientation, validation of methods, development of regulation, for education/teaching purposes to name few.

Generally, the interview respondents are positive to NKS' free structure of reporting in comparison to the strict structure of peer-reviewed journals. The quality of NKS reports (and projects) is overall high, however a handful of interview respondents note that there is no obvious system that upholds a high minimum quality standard of projects, and note that at times there have been cases of reports with low or varying quality. These cases may partially be explained by the character of quality assurance procedures, and challenges for generalists to evaluate specific project proposals in fields not within the evaluator's area of competence.

[26] 'Generalists' and 'specialists' are not objectively defined terms, rather the view of respondents as 'generalists' or 'specialists' has been established through the interviews.

NKS project participants and end-users of NKS project results overlap to a high degree, as can be seen in Figure 23. In addition, most projects include end-users in some way and NKS projects generally focus on applied research and development, why results in most situations are directly applicable. End users are primarily industry actors and radiation safety authorities, why the percentage of respondents who consider themselves end-users is higher among participants of NKS-R projects than NKS-B projects, due to the skewed participation of industry actors.

Figure 23. Percentage of survey respondents who consider themselves end users of NKS results
All respondents, n=125



An example of the applied nature of NKS research and how results can be used is illustrated in the quote below

"[…] I was working with the regulatory framework connected to emissions from laboratories and hospitals. In connection to the regulatory work I had to conduct measurements on the level of radioactive exposure for the individuals working with the sewage. I found out that there was not much data available on the exposure of radiation for the individuals working with the sewage waste. We therefore had to conduct measurements and applied for a quite large NKS project in which all Nordic countries were involved. The results were very important for the regulatory framework regarding emissions from hospitals and laboratories. The results were for example relevant for making recommendations to use or not to use septic tanks for sewage from hospitals." - Radiation safety authority

4.2.3. Nordic dimensions of Nuclear safety issues

Common Nordic issues exist in a broad range of nuclear safety areas, such as within emergency preparedness, methods for training control room operators, environmental effects of radiological waste, methods for radiochemical analysis, methodology for atmospheric dispersion of radionuclides, and more. Common Nordic issues can to a higher degree be found within the NKS-B program than the NKS-R program due to the focus on reactor safety in NKS-R. Specific Nordic dimensions of radioecology, emergency pre-

paredness and waste management are connected to a shared climate and similar regulatory culture and policies in all Nordic countries. To give an example: radioecology at higher latitudes (above 55 degrees) is different from radioecology at lower latitudes, and possible issues are therefore specific for the Nordics. Common issues within NKS-R relate to the use of BWR (Boiling water reactors) and the regulatory culture and structure of radiation safety authorities in the Nordics. Those common issues are though mainly common for Sweden and Finland. In addition, research questions within NKS-R are often general and not unique for the Nordic context. Interview results show that common Nordic issues generally justify specific projects, but the general Nordic cooperation within nuclear safety research and NKS is based on common networks and common history, as well as similar regulatory cultures and views on nuclear safety research. There seems however to be little support for the sentiment that there are discernible similarities in safety culture on an operative level.

Nordic collaboration within nuclear safety research is important within small specialised areas where specific national knowledge based on different national conditions can be pooled together on a Nordic level. One such area is emergency preparedness within meteorology. Through Nordic collaboration the Nordic radiation safety and meteorological institutions have shared data and information and developed models for calculation atmospheric dispersion of radionuclides. Both increasing the quality of the models as well as establishing a collaboration for sharing of data which increases resilience in cases of atmospheric dispersion of radionuclides.

4.3. Added value of NKS

This section describes the specific Nordic added value of NKS relevant for Sweden and Swedish actors. Results are divided based on country, the type of actor and which NKS program the respondents have been active in. Results are grouped in accordance to the hypotheses on direct and indirect added values from participation in NKS as presented under 2.2.2. The most prominent added values as identified through the survey and interview studies are the opportunities for Nordic cooperation through NKS and the programme's function, especially for NKS-B participants, as an interface for building professional relations. Relations are important for receiving second opinions on professional issues and building collaborations for international projects.

The role of Nordic nuclear safety research and its added value is different for actors in different countries and sectors. Scientists and researchers, especially within the areas covered by NKS-B, use Nordic networks for development of measurement strategies and of modelling, and to discuss detailed questions regarding nuclear safety research and development. Nordic networks are useful for all types of actors due to the familiarity and informality of the Nordic context. Within the Nordic context there is a common view of the preconditions for nuclear safety and nuclear industry, and actors share a common regulatory and scientific context. Expertise in other Nordic countries is easily identified through common networks and specific issues and applied research problems are easily solved due to the common context and the informality of networks.

Norwegian and Danish respondents to a great degree interact directly on the Nordic level while Swedish actors and experts, especially within NKS-R areas, such as reactor safety, have the possibility to interact with peers within Sweden before turning to experts on the Nordic level. The presence of a nuclear industry has resulted in a larger research community in Sweden compared to the Nordic countries without a nuclear industry. Howev-

er, within NKS-B areas such as radioecology and emergency preparedness, the greater Nordic networks are important for Swedish research activities as well.

4.3.1. National knowledge systems

The main experts within NKS-R and NKS-B are spread out through the Nordic countries. A few key actors have been identified through interviews with stakeholders in Sweden, Denmark and Norway.

In general, main actors within the NKS-B area are the Nordic radiation safety authorities including the Danish emergency management agency (DEMA), the Centre for Environmental radioactivity (Cerad) at the Norwegian university of life sciences (NMBU) and Institute for Energy Technology (IFE) in Norway, DTU-Nutech in Denmark, Swedish universities in Gothenburg, Lund, Umeå and Linköping, the Swedish Defence Research Agency (FOI), the Swedish university of agricultural studies (SLU) and for matters concerning atmospheric modelling the Nordic meteorological institutes.

Within NKS-R, main actors are the Swedish radiation safety authority (SSM), The Finish radiation safety authority (STUK), VTT, Helsinki University, the Swedish universities in Uppsala and Lund, Chalmers technical university, KTH, consultancies such as Riskpilot, Lloyds register and ÅF, and the Nuclear power plants of Sweden and Finland along with Vattenfall and Fortum.

Somewhat surprisingly the consultancy Studsvik, the fuel vendor Westinghouse and SKB (Swedish nuclear fuel and waste management) have not been mentioned as key actors within the national knowledge systems. Studsvik and SKB have each participated in one or a few NKS projects but neither actor is prevalent in NKS projects. An individual at SKB explains that the company recently submitted an application to NKS, which was not approved.[27]

These major actors in the national knowledge systems mainly consist of small research environments focused on specific research questions. Some environments are therefore dependent on networks to reach critical mass. The importance of NKS in creating such networks is described in the 4.3.2 segment below and the value of collaboration between these Nordic actors and NKS' role in facilitating professional relations is describe in the 4.3.3 segment.

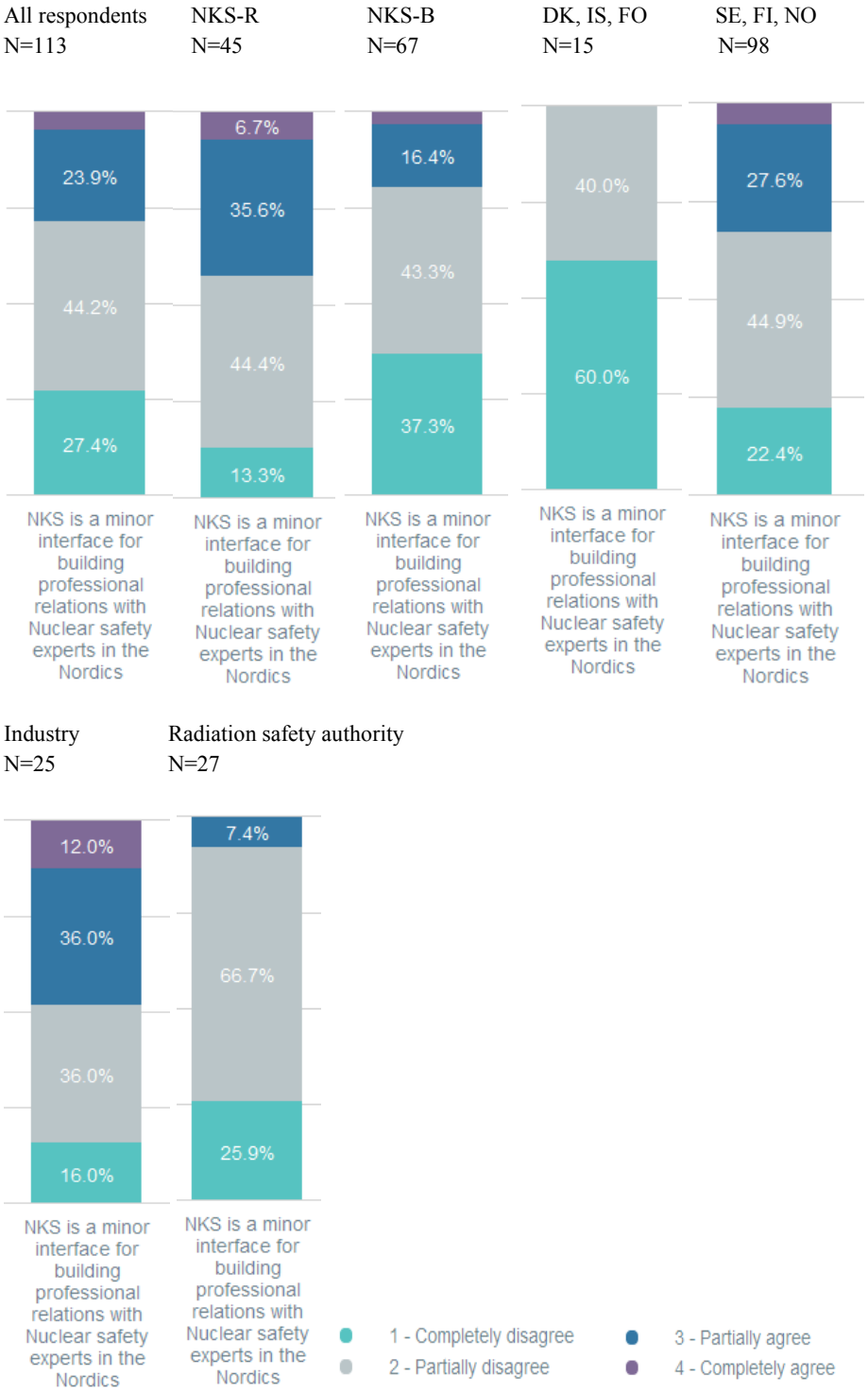
4.3.2. The importance of NKS for Nordic networks

Results from interviews show that NKS has an important and significant role in supporting professional relations and networks among Nordic experts within nuclear safety research. There is a clear consensus that: *'the fact that NKS offers opportunities for Nordic cooperation is an advantage compared to other funding opportunities'*, with 92.5% of the survey respondents either partly or completely agreeing with the statement. The opportunity for Nordic cooperation is the most prominent added value regarding NKS importance for Nordic networks. The direct connection between more specific Nordic nuclear safety networks and NKS are more apparent within the areas covered by NKS-B than the areas covered by NKS-R.

[27] Private communication.

The respondents' views on the importance of NKS to build professional relations within the Nordics differs depending on country of origin, NKS-program and type of actor. These three dimensions interact with each other and actors within NKS-R, where Swedish and Finish as well as industry actors are prevalent, to a higher degree see NKS as a minor interface compared with respondents from Denmark, respondents who are associated with radiation safety authorities and respondents who have been active within NKS-B. Norwegian respondents have similar views as Swedish and Finnish respondents rather than, as in most other cases, as Danish and Icelandic respondents. Statistically significant differences have been detected based on country, program and actor as illustrated in Figure 24.

Figure 24 Percentage of respondents agreeing or disagreeing with the below statement on the importance of NKS for building professional relations.



Note that differences were tested on group level and the specific actor or country causing the significant differences has been determined on a qualitative basis rather than through ad-hoc testing.

On a national level one general program usually funds either the areas covered by NKS-R or NKS-B, why the interaction between the areas covered by the program is generally low. The fact that NKS funds research activities within both the areas covered by NKS-B and NKS-R have therefore at times contributed to interactions between national actors who would not have worked together if not for NKS. For example, research conducted within PSA level three[28] has a close relationship to research within radio ecology. Within a national context PSA research and research on radioecology is seldom combined, although, through NKS, participants in PSA projects have cooperated with radioecologist usually active in NKS-B projects.

Most respondents are in contact with peers they built relationships with through NKS on a monthly or yearly basis. Non-parametric statistical testing shows no significant difference based on country, program or actor. However, interview results indicate that NKS has a more significant role in establishing professional relationships on a Nordic level within NKS-B than in NKS-R. Within the thematic areas covered by the NKS-R program, other networks such as the HAMBO-group connected to the Halden Reactor Project, the Nordic PSA group and connections between Finnish VTT and Swedish universities and utilities exist in parallel and independent of NKS. Within the thematic areas of NKS-B results indicate that NKS has a central and significant role in establishing Nordic networks. Many of the participants in NKS-B projects that have been interviewed view NKS as the main channel for establishing professional networks in the Nordics.

One example of NKS' role in creating and facilitating Nordic collaboration is the meteorological network MetNet. Within MetNet the Nordic meteorological agencies work with emergency preparedness connected to atmospheric dispersion of radionuclides and collaborate closely with national radiation safety authorities. The network was created as an NKS-project and has since then been institutionalized as described in the quote below.

"Later we had a three-year project called MetNet which involved all Nordic meteorological institutes. The idea was to create a network for dispersion modelling in case of a nuclear accident. MetNet had a two-fold objective: to create a Nordic forum, and to develop a back-up system enabling any Nordic country to look at the model results by all Nordic meteorological services. The project was successful since after completion, MetNet was institutionalised in an agreement between the Nordic meteorological services (Nordmet). The network is maintained; we collaborate closely with the national nuclear authorities, we share information, we have discussions which sometimes generate new ideas for projects and development, we maintain our backup systems, and we organise exercises." - Other authority

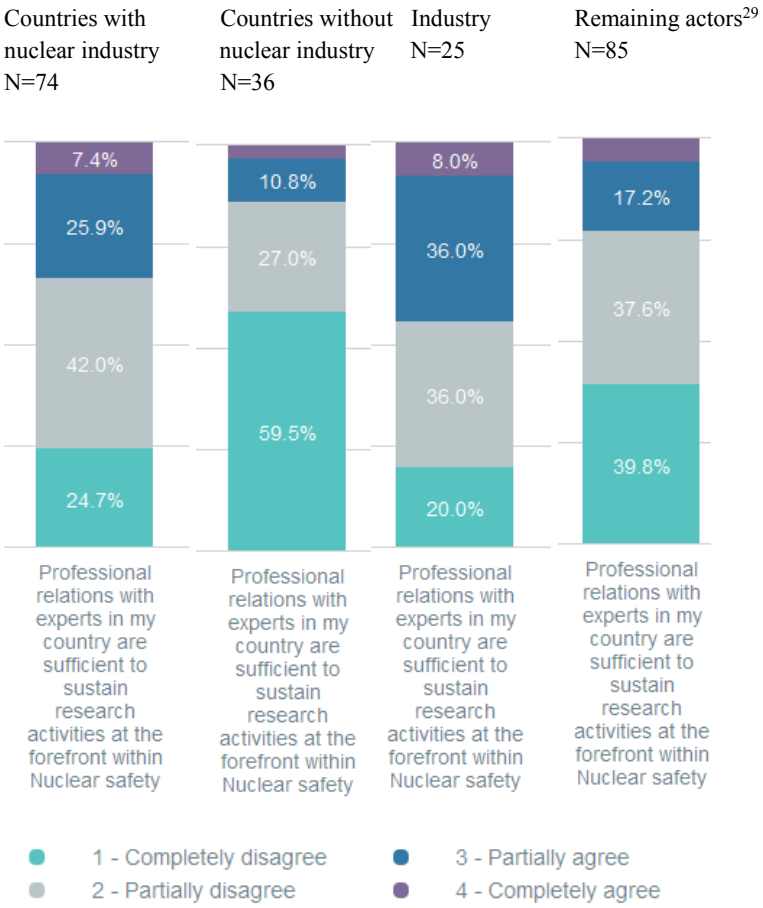
4.3.3. The importance of Nordic collaboration in Nuclear safety

There is a wide consensus that research in Nuclear safety is improved by combining perspectives from the Nordic countries, but the percentage of respondents completely agreeing, as compared to partially agreeing, with the statement is significantly higher within countries without a nuclear industry and among respondents who have been active in the NKS-B program as compared to respondents from countries with a nuclear industry or who have been active in the NKS-R program.

[28] probabilistic safety assessments regarding emergency planning and the environmental effects of nuclear accidents outside of the nuclear power plants

In general respondents do not agree with the statements that relations with professional experts within the country is enough to sustain research activities at the forefront within Nuclear safety. Significant differences have been detected based on type of actor and country as presented in Figure 25. Industry actors are generally Finnish or Swedish which highly affects results based on country.

Figure 25. Percentage of participants agreeing or disagreeing that relations with professional experts within the participant's country of residence is enough to sustain research activities at the forefront of Nuclear safety.



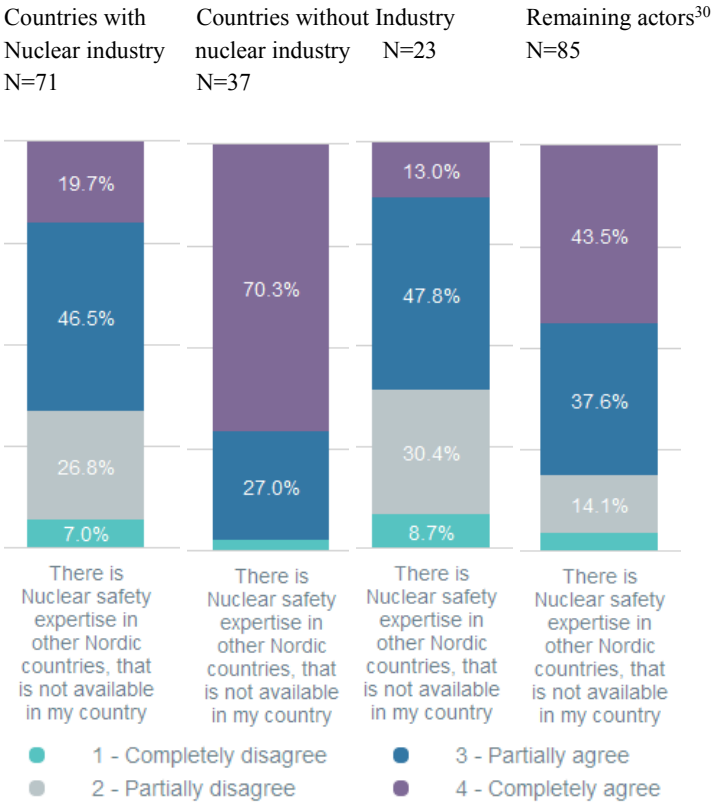
Interview results show that the opportunity to access expertise in other Nordic countries is a significant added value of participating in NKS. Expertise in other Nordic countries contribute with new perspectives and sometimes unique knowledge connected to specific national conditions. Survey results show general agreement with the statement that there is Nordic safety expertise available in other Nordic countries, not available in the respondents' own country. Each Nordic country has a national obligation concerning nuclear safety. For example, all Nordic countries and radiation safety authorities need to uphold national emergency preparedness and competence regarding modelling of the dispersion of radionuclides. Responsibility for competence within nuclear safety and operative emergency preparedness is generally centred on a few key actors and groups within and connected to the national radiation safety authorities. Nordic knowledge dissemination networks and common development capacity with the emergency readiness system is therefore important in order to uphold a high level of Nordic nuclear safety

[29] Research, Radiation safety authority and Other authorities.

emergency readiness. As is evident from survey and interview answers the Nordic countries have different specialities depending on the unique ecological conditions of each country, these unique national competencies are shared among the Nordic countries through a common knowledge system.

The percentage of respondents completely agreeing with the statement that there is expertise in other Nordic countries not available in the respondent's country of residence significantly differs based on country and type of actor. Furthermore, there is a tendency towards higher level of agreement from respondents active in NKS-B compared to NKS-R. Results are illustrated in Figure 26 below.

Figure 26. Percentage of individuals agreeing or disagreeing that there is Nuclear safety expertise in other Nordic countries not available in the respondent's country of residence.



NKS as a platform for reliable information and wider international collaboration.

In total, 53% of respondents agreed with the following statement '*I have used my professional relations from NKS in building collaborations for international projects beyond the Nordics'*. There is a tendency towards a significant difference between countries with and without nuclear industry driven by the Danish respondents, of which 77% indicate that they have used professional relations from NKS to build collaborations compared to 43% of Swedish respondents.

Relations established through NKS are also used to receive second opinions on professional issues. In total 55% of survey respondents agreed with the statement *'I have used*

[30] Research, Radiation safety authority and Other authorities.

my professional relations from NKS to receive a second opinion on a professional issue'
Interview results suggest that Nordic networks are often used due to the informality of the relations. Through Nordic networks individuals who can be trusted to supply correct and operatively useful information are easily found. Results from interviews indicate that Nordic networks are viewed as more important among actors active in NKS-B projects as compared to actors active in NKS-R projects. Within NKS-R national contacts and bi-lateral contacts are used to a higher degree than within NKS-B. For Swedish actors, relevant Nordic bi-lateral contacts are mainly VTT (Finland) and the Halden Reactor Project, HRP (Norway).

NKS as a platform for access to important infrastructure

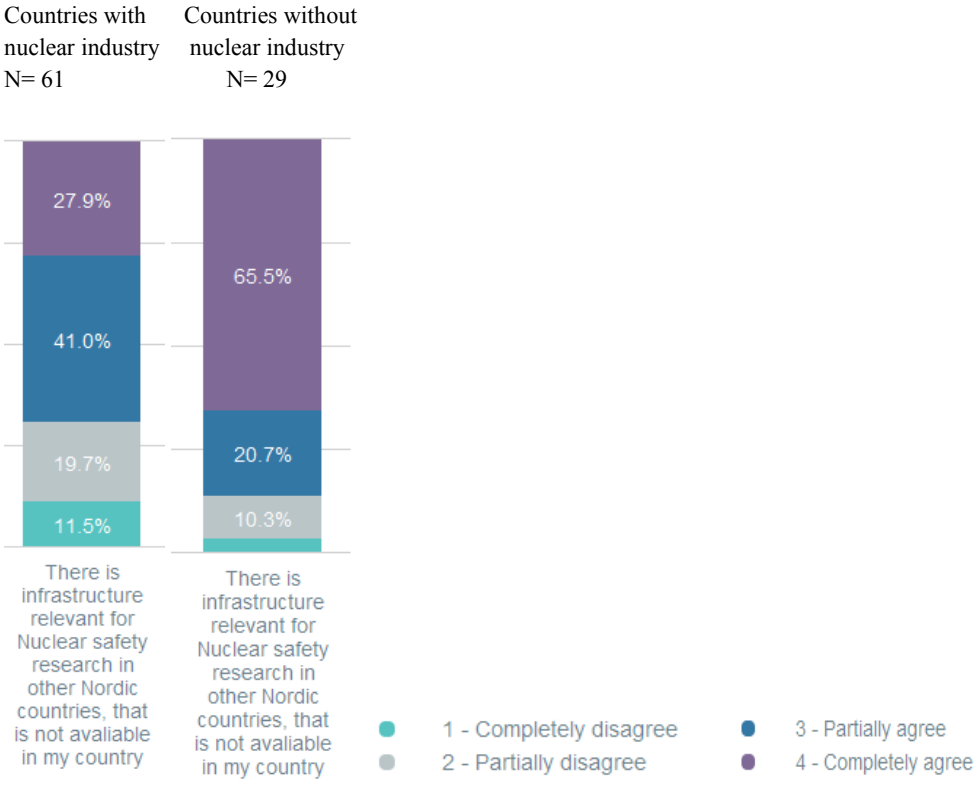
37% of respondents indicate that they through NKS have accessed infrastructure not available in their own country. Examples of relevant infrastructures made accessible through NKS are for example labs and neutron sources. The possibilities to use infrastructure in other Nordic countries and collaborate is used both for running tests and for education purposes. For example, Swedish radio-ecologists and radiation physicists have used lab infrastructure at DTU in Denmark through NKS networks. There are large differences based on country of origin regarding accessing infrastructure in other Nordic countries through as can be seen in Table 3 below.

Table 3. Percentage of respondents who through NKs have accessed infrastructure not available in their own country	
Denmark	62%
Sweden	41%
Finland	14%
Norway	36%
NKS-B	42%
NKS-R	28%

In general, NKS is more important for establishing professional relations, building collaborations for international projects and receiving advice on professional issues than for accessing infrastructure. Effects on the accessibility of infrastructure should be seen as a secondary added value of NKS.

The view on the availability of unique infrastructure relevant for Nuclear safety research differs between countries with or without a nuclear industry, which can be seen in Figure 27 below. In total 28% of respondents answered "I don't know" to the statement presented in Figure 27, why results should be conservatively interpreted.

Figure 27. Percentage of respondents agreeing and disagreeing with the statement below.



4.3.4. A Nordic labour market within nuclear safety

A common Nordic labour market within nuclear safety research is not a major added value from NKS. Most interview subjects, especially respondents active in NKS-R, would mainly look for a new job within their own country. Other Nordic countries would be relevant for a number of respondents if the respondents' current country of residence was not an option. In general, a majority of survey respondents state that they would use their professional relations from NKS for finding a new job, but most survey respondents would not use the network for recruitment of employees.

For young researchers[31] NKS can function as a first step towards building and taking part in international research networks. The extent to which young researchers are included and the level of strategy behind inviting young researchers to take part in projects differs from actor to actor and project to project. Some actors have a clear structure for including PhD-students and use NKS as a sort of training ground for working on an international arena while others might include a young researcher if one happens to turn up with the specific skill needed. Furthermore, through NKS young researchers and new staff can gain training and valuable knowledge on advanced infrastructure available through the Nordic network.

[31] In the NKS handbook "young researcher " is a broadly defined term, from master students to individuals who completed their Phd not longer than 5 years ago.

4.3.5. Summary

In summary, the Nordic added value of NKS primarily entails the creation of networks and professional relationships which contribute to a shared knowledge and emergency preparedness. Individuals in different Nordic countries gain knowledge on the specific situation in neighbouring countries through NKS, which increases their abilities to monitor risk and make correct statements on the nuclear safety and the potential risks of accidents, if they would occur. The harmonization of data between the Nordic countries is another relevant added value of NKS which contributes both to further possibilities for the Nordic countries to assist each other but also to increased competence and knowledge within Nuclear safety in the Nordics.

5. The value of Swedish participation in NKS

5.1. Summarised interpretation of results

Below is a condensed summary of the results from the project database analysis, the survey and the interview study. In Chapter 4 the results on the standing, utilization and added value of NKS was described based on the interview and survey study. In this chapter the relevance of the added value of NKS and the realisation of added values in Sweden will be discussed. The value of NKS for Sweden should be determined not only by analysing Swedish participation in NKS but also by accounting for the impacts of NKS in other Nordic countries as well.

5.1.1. NKS' function

The research activities funded by NKS has direct relevance for Swedish stakeholders. The applied nature of the activities make them relevant for regulation and licensing, and provides information both on the validity of methods and data, and on the availability of competence and data in neighbouring Nordic countries. The main value of NKS is the integration of Nordic knowledge systems and the establishment of professional relations within the Nordic nuclear safety research community. NKS funding may be likened to funding of coordination and support actions (CSA) within the EU framework program Horizon 2020. The CSA funding within Horizon 2020 is not as substantial as funding for research and/or innovation actions, and the aim of the funding is to promote cooperation between a number of European actors in pilot projects and other types of limited investigations, much in the same way as NKS. NKS' function as a program for coordination and a base for creating professional relations and networks is highly relevant for Swedish actors. Especially actors active in small specialised fields where important research environments exist in neighbouring Nordic countries have much to gain from participating in NKS.

NKS does not function as a significant financial contribution for research environments, and if evaluated only as a means to provide basic funding to national research communities within nuclear safety, the program would be assessed poorly. NKS is not the most effective way to finance major national research projects or researcher positions within nuclear safety, but as described above the program is highly relevant as an interface and facilitator for coordination of Nordic research activities. Small one-year grants, divided on a number of actors are not adjusted to sustain research environments and positions, but are relevant to enable Nordic cooperation within pilot projects or limited investigations. It should be noted that Swedish participants are estimated to have taken part in approximately one hundred peer-review publications based on NKS projects during the investigated time-period. Hence NKS projects do contribute to develop the research frontier in nuclear safety, even if the additionality of the funding in comparison to basic funding to national research communities is slightly negative, as regards direct impacts. The

programme's relative strength lies in its function as a means of establishing well-functioning and important networks.

5.1.1. Relevance of thematic areas

Both the project data base analysis and the interview and survey results point towards a higher relevance of NKS-B compared to NKS-R. NKS-B projects are to a higher degree dependent on NKS funding, indicating higher additionality in funding to NKS-B projects as compared to NKS-R projects, and NKS-B projects more often include actors from at least three Nordic countries. The NKS-B program is thereby more important for integrating the Nordic knowledge systems than NKS-R is. Although both programs hold merit, a wider range of actors and countries are active within NKS-B.

The thematic content in both NKS-B and NKS-R are highly relevant for Swedish actors, but a broader participation can be seen in NKS-B, where actors from industry, the research sector, and SSM are active, as compared to NKS-R, where Swedish participation is dominated by industry and some research actors.

5.1.2. Integration of knowledge systems

The main value of participation in NKS is integration of the Nordic knowledge communities within Nuclear safety, especially in the areas covered by NKS-B. Swedish actors are, relatively speaking, the least successful in attracting NKS funds. However, knowledge and capacity building activities in neighbouring Nordic countries are important both for Swedish emergency preparedness and for the Swedish knowledge communities. Swedish actors active in NKS-B are through NKS able to build professional relations with actors such as DTU-Nutech and together with other Nordic actors develop Nordic nuclear safety research. Swedish actors do to a higher degree than Danish and Norwegian actors contact colleagues within the national context when looking for advice on professional issues. Contact with Nordic actors is however still highly relevant for Swedish actors, in particular for actors active in the areas covered by NKS-B. There is an institutional value in the integration of Nordic knowledge systems within Nuclear safety as well. The cooperation as manifested in NKS contributes to predictability and continuity within the knowledge system and facilitates the knowledge activities of Nordic actors. Individual actors can predict that there will be possibilities for future knowledge activities within the Nordic intuitional framework, which reproduces continued activity and integration

5.2. Added values from NKS in Sweden

This evaluation stipulated a number of possible added values of NKS under the headline 2.2.2 Nordic added values. Here we will discussion and interpret the importance of the Nordic added values for Sweden. Before a discussion on the importance of the Nordic added values for Sweden can be conducted, a discussion on additional Nordic added values will be presented

5.2.1. Additional identified Nordic added values

Additional added values which were not anticipated have been identified throughout this study. The main unexpected added value is NKS' function in creating common Nordic development capacity within the emergency preparedness system. This shared emergency preparedness is established through professional relations and networks spanning authorities and/or universities. Shared data, information on models and methodology used, common networks for sharing information and common R&D activities are examples of shared development capacity in the emergency preparedness system.

The assumed direct effects on competence presented in the segment 2.2.2 do not constitute the primary added value of NKS. Instead effects on competence are indirect, through the established professional relations. The availability of information and data creates the possibility of enhanced operative knowledge and competence throughout the Nordics. Furthermore, through working on a Nordic level with colleagues in the Nordic countries competence in Sweden and the Nordics within Nuclear safety is improved. This effect should be seen as an indirect effect of NKS' direct effects on the formation of networks and professional relations.

5.2.2. Purpose of SSM' funding

The funding contributed to NKS by SSM is a part of SSM funding to support and uphold Swedish competence in nuclear safety research. SSM currently funds specific research positions, provides base funding to institutions at universities and funds projects through calls for proposals within nuclear safety research. These different types of funding maintain national competence, make sure that there is technical support capacity within the national context and ensures that Sweden lives up to the standards set forward by IAEA.

As this evaluation shows the main direct effects and added values of NKS are integration of knowledge systems through formation of networks and the establishment of professional relations. The relative direct effect on knowledge production and competence building is assessed as slightly negative when compared to SSM's other funding opportunities and the output of NKS therefore does not correspond directly to the primary goal of SSM's funding. However, as will be described in the next segment, the purposes of SSM's funding are met indirectly through the establishment of professional relations among Nordic nuclear safety experts and relevant high quality research is produced by NKS funded projects. Furthermore, NKS plays an important role in fulfilling more general goals on Nordic integration and cooperation, and has significant auxiliary effects on the integration of Nordic knowledge systems and emergency preparedness systems.

5.2.3. Impact of Nordic added values in Sweden

NKS plays a vital part in integrating the Nordic knowledge systems within nuclear safety, building Nordic professional networks and establishing contacts between industry, research and radiation safety authority actors in the Nordic countries, especially within areas covered by the NKS-B program. NKS' effects on competence and knowledge are mainly indirect where competence, and technical support capacity, is created and enhanced through Nordic professional relations and networks.

Furthermore, NKS contributes to dissemination of knowledge in the Nordic community. Research funded by SSM should be applied and have direct effects on the competence

within the nuclear safety community. Relatively speaking NKS is not the most efficient way to directly fund national competence building activities, although NKS has absolute effects on the Swedish competence in Nuclear safety. NKS supports common emergency preparedness and strengthened Nordic relations and networks within nuclear safety, which can be considered a general objective for SSM, if not an immediate objective of SSM's research funding. One example of how NKS promotes competence building through professional networks is the activity of research actors within the NKS-B program. In total eight different Swedish research actors have through NKS had the possibility to cooperated with DTU-Nutech in Denmark and form collaborations.

An additional added value of NKS for Sweden is improved knowledge of the nuclear industry in Sweden and Swedish nuclear safety in countries without nuclear industry such as Denmark and Norway. Through NKS the capacity of Danish and Norwegian actors to conduct analyses and make accurate judgements on the risks associated with an accident at a Swedish nuclear power plant is improved. The Swedish funding of NKS is based on taxation of the nuclear industry, where each nuclear power plant contributes to the research budget of SSM based on installed capacity at the power plant. It is relevant for the nuclear industry actors that there is competence in neighbouring countries to make accurate judgements on risks at Swedish nuclear power plants why the added value of increase knowledge in Denmark and Norway may also be considered relevant for Sweden.

5.2.4. NKS program logic

One could argue that there are a number of institutional objectives imbedded in NKS that are the actual objectives towards which NKS aims. Historically speaking, Nordic cooperation within nuclear safety, and previously nuclear development, has focused on creating a common Nordic base for actions on an international level. One example were the activities in NKA, for which one objective was to always have a Nordic participant in IAEA Board of Governors. In addition, cooperation has strived towards coordinating Nordic resources to increase the effectiveness in research and development. NKS is a program solely focused on nuclear safety research, but the institutional heritage of building common Nordic knowledge systems and harmonizing Nordic systems, in this case within emergency preparedness, can be seen in the output of today's NKS as well. If the program logic of NKS is judged according to the goal of integrating Nordic knowledge and improving the resilience of emergency preparedness systems, the focus on cooperation through coordination funding and the funding of activities aimed at areas such as harmonization of measurement strategies and modules is very reasonable. This evaluation has not focused on the program logic of NKS though and further analysis and discussions on the goals and purposes of NKS should be investigated on another occasion.

6. Conclusions and recommendations

This chapter contains conclusions and recommendations based on the presented data and the conducted analysis. Furthermore, Oxford Research has based recommendations on previous knowledge of research cooperation on a Nordic level, both in general and within nuclear safety.

6.1. Conclusions

6.1.1. Steering and justification of NKS

- NKS is motivated by a common Nordic context involving similar regulatory cultures, similar environmental conditions and a continuity of Nordic cooperation within nuclear safety. This justification of the NKS program is similar to the justification of other Nordic programs funded by the Nordic Council of Ministers.
- There is a weak connection between the contributions from the Nordic countries and the funding allocated by NKS to different projects. Nuclear safety is however not solely a national issue, and it is important for Sweden that there is an advanced and accurate understanding of nuclear safety in all Nordic countries, why the skewed allocation of funding is not necessarily problematic. With that said, there appears to be room for increase in the level of funding allocated to Swedish actors.

6.1.2. Operation of NKS

- The relative value of NKS as compared to funding of national research programs or activities lies in NKS' function as a coordination program which supports coordination of multiple Nordic actors in smaller R&D projects and pilot projects. NKS funds relevant research activities which contribute to the development of research within Nuclear safety, but the additionality of the funding, if viewed as basic funding for national research environments, is low. Instead NKS' grants of maximum 600kDKK spanning one year are suitable and have a high additionality as funding for Nordic coordination and collaboration within Nuclear safety research.
- NKS has a similar set up as other research institutions on the Nordic level.
- The quality of research and reports produced by projects funded by NKS are generally high, but NKS lacks routines for sufficient safeguarding against occasional deficiencies in the quality and/or scientific relevance of projects.
- NKS is a relevant program for both actors active within NKS-B and NKS-R, however NKS is more relevant for NKS-B participants as compared to NKS-R participants. Both the thematic areas and NKS' function as an interface for building professional relations are more relevant for participants active in NKS-B than

in NKS-R. Furthermore, NKS-B provides more added value than NKS-R primarily since there is a wider spread of both actors and countries among NKS-B project participants.

- NKS is more relevant and provides greater added value concerning the possibilities to build professional relations and networks for non-industry actors compared to industry actors. This is not surprising since nuclear industry actors in Finland and Sweden mainly interact with each other and at times with IFE. In addition, research actors are more interested in research activities than industry actors.

6.1.3. The impact of NKS' added values in Sweden.

- NKS integrates Nordic knowledge systems, especially within areas covered by NKS-B, and strengthens the capacity for research and development within the Nordic emergency preparedness system. This corresponds to overall goals for the activities of SSM, although not directly to the goals of the research department. The integration of Nordic knowledge systems includes access to information, shared data and shared knowledge on modules and models used in the Nordic countries within various fields of nuclear safety research.
- NKS promotes a Nordic knowledge base which strengthens the possibility of especially Danish and Norwegian actors to conduct valid judgements of risks associated with possible nuclear industry in Sweden. Danish and Norwegian information on Swedish nuclear industry and knowledge of Swedish emergency preparedness and the Swedish regulatory system is important to enable correct and valid interpretations and analysis among experts in neighbouring countries.
- NKS enables and realises continuity of Nordic cooperation within nuclear safety, which is important for gathering critical mass and continued development in small specialised research groups and environments in Sweden. Through NKS small research groups can coordinate common projects and build professional networks which can expand outside of NKS. NKS provides an area for networking and creating professional relations. Through NKS activities which ensure further integration of knowledge systems and possible future collaborations can be executed.

6.2. Recommendations

6.2.1. SSM's intentions with NKS

- SSM should initiate a discussion on the purpose and objectives of NKS within the NKS' owners group, considering the appropriateness of the size of grants and the length of project funding. The discussion should clarify the expectations on NKS as a funding programme for coordination and dissemination actions or for funding major new research projects and agendas.
- SSM should promote a thematic focus on topics which relate to common Nordic questions where a broad representation of Nordic actors is possible. One possible development is a shift towards only an NKS-B programme, which incorporates relevant Nordic topics within NKS-R.

6.2.2. Development of NKS' routines

- SSM should promote an effort to investigate synergies and lessons to be learned from other Nordic research programmes such as Nordforsk and Nordic Energy Research, in order to elaborate and increase the added value of NKS, and achieve synergies between the programmes.
- SSM should initiate a discussion on development of the quality assurance procedures of NKS, to be conducted in order to ensure consistent high quality and relevance of projects. A more detailed policy of, for example, the evaluation of project proposals, would also reduce sensitivity to staff turnover within NKS' board and ensure similar evaluation procedures in all Nordic countries.
- SSM should advocate that NKS establishes a structured database for recording project data, such as funding, co-funding, participation, dissemination etc., in order to facilitate monitoring and future evaluation.

6.2.3. Strengthening the impacts of NKS in Sweden

- SSM should promote increased inclusion of Swedish PhD students in NKS projects in order to capitalize on the networking aspects of the program.
- The value of the impacts from NKS' for SSM, and Sweden, should be assessed at management level in SSM, considering the auxiliary benefits to emergency preparedness on the Nordic level. Depending on which objectives are to be met by the collaboration, there may be different set ups for the allocation of funds to NKS within the authority's budget. This includes addressing expectations on the national distribution of NKS grants.

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7.2. Interviews

7.2.1. Explorative interviews

Name		Country	Actor	Role in NKS
Jourma	Aurela	Finland	Minstry of Enterprise	NKS board member and member of-NKS owners group.

Fredrik	Hassel	Sweden	SSM	-
Annelie	Bergman	Sweden	SSM	NKS board member.
Finn	Physant Christensen	Denmark	NKS Secretariat	NKS administrator
Olga	German	Sweden	Vattenfall	NKS board member
Sigurður	M. Magnússon	Iceland	Icelandic Radiation Safety Authority (IRSA)	Chairman of the board of NKS
Emma	Palm	Sweden	SSM	NKS-R Programme manager
Kasper	G Andersson	Denmark	DTU	NKS-B programme manager

7.2.2. Interview study

Name		Country	Actor	NKS-program	Type of actor
Charlotte	Nielsen	Denmark	Strålebeskyttelse (SIS)	NKS-B	Radiation Safety Authority
Xiaolin	Hou	Denmark	DTU-Nutech	NKS-B	Research
Jens	Havskov Sørensen	Denmark	Danish materological institute (DMI)	NKS-B	Other Authority
Bent	Lauritzen	Denmark	DTU-Nutech	NKS-B and NKS-R	Research
Peter H.	Voss	Denmark	Geological Survey of Denmark and Greenland	NKS-B	Other Authority
Lindis	Skipperud	Norway	Norwegian University of Life Science (NMBU)	NKS-B	Research
Mark	Dowdall	Norway	Norwegian radiation protection agency (NRPA)	NKS-B	Radiation Safety Authority
Arnfinn	Tveit	Norway	Wirescan	NKS-R	Industry
Naeem	Ul Syed	Norway	Norwegian radiation protection agency (NRPA)	NKS-R	Radiation Safety Authority
Heiko	Klein	Norway	Norwegian meterological institute (Met)	NKS-B	Other Authority
Lilián	del Risco	Sweden	Swedish radiation	NKS-B	Radiation Safety

	Norrlid		safety authority (SSM)		Authority
Mats	Isaksson	Sweden	Gothenburg University/Sahlgrenska university hospital	NKS-B	Research
Andrew	Wallin Caldwell	Sweden	Lloyd´s Register Consulting - Energy AB	NKS-R	Industry
Mathias	Franzon	Sweden	Swedish radiation safety authority (SSM)	NKS-R	Radiation Safety Authority
Synnöve	Sundell-Bergman	Sweden	Vattenfall	NKS-B	Industry
Stefan	Eriksson	Sweden	Ringhals AB	NKS-R	Industry
Jonas	Lindgren	Sweden	Swedish radiation safety authority (SSM)	NKS-B	Radiation Safety Authority
Maren H.	Rø Eitrheim	Norway	Institute for energy technology (IFE)	NKS-R	Research
Christian	Ekberg	Sweden	Chalmers university of technology	NKS-R	Research
Anders	Karlsson	Sweden	Forsmark Kraftgrupp AB	NKS-R	Industry

7.3. Workshop participants

Eva Simic, Swedish Radiation Safety Authority (SSM)
Kåre Axell, Swedish Radiation Safety Authority (SSM)
Andreas Kjellin, Swedish Radiation Safety Authority (SSM)
Anna Alvestav, Swedish Radiation Safety Authority (SSM)
Hjalmar Eriksson, Oxford Research
August Olsson, Oxford Research

Appendix A - Survey response analysis

A non-response analysis of the survey shows non-respondents are similar to respondents, Norwegian and Icelandic respondents are a few percentage points more common in the non-response group compared to the response group, and Swedish respondents are a couple of percentage point more uncommon in the non-response group compared to the response group.

A comparison based on the affiliation of respondents show that respondents affiliated with research actors are more common in the response group than in the non-response group, 48% of the respondents are affiliated with a research actor, compared with 37% of the non-respondents. On the other hand, respondents affiliated with a radiation safety authority are more common in the non-response group than in the response group, 23% of the respondents are affiliated with a radiation safety authority compared with 34% of the non-respondents. 74 (60%) respondents had been active in the NKS-B program, 49 (40%) with the NKS-R program and one respondent was active in both programs. This corresponds very well with the population of contact persons where 61% were active in NKS-B, 38% in NKS-R and three individuals (1%) in both programs). The survey response group is described in Figure 28 and Figure 29 below.

Figure 28. Number of survey respondents by type of actor

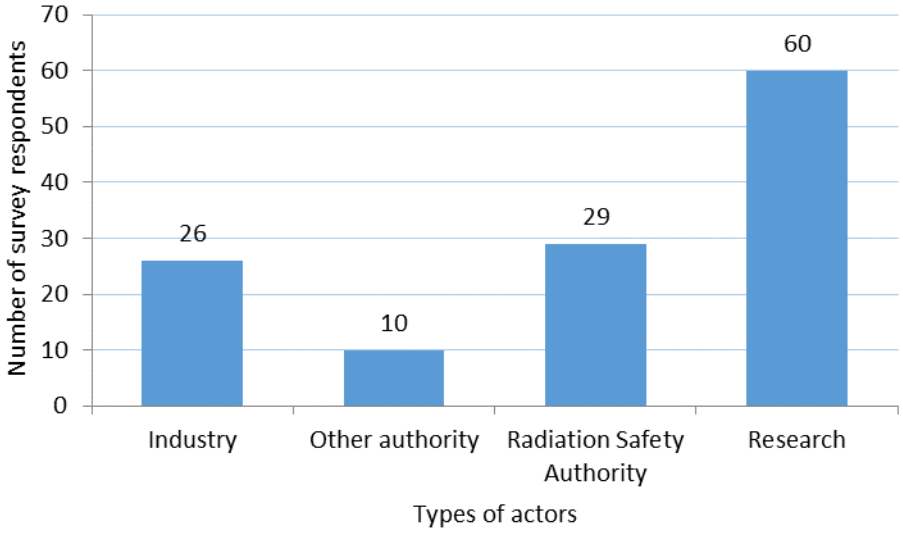
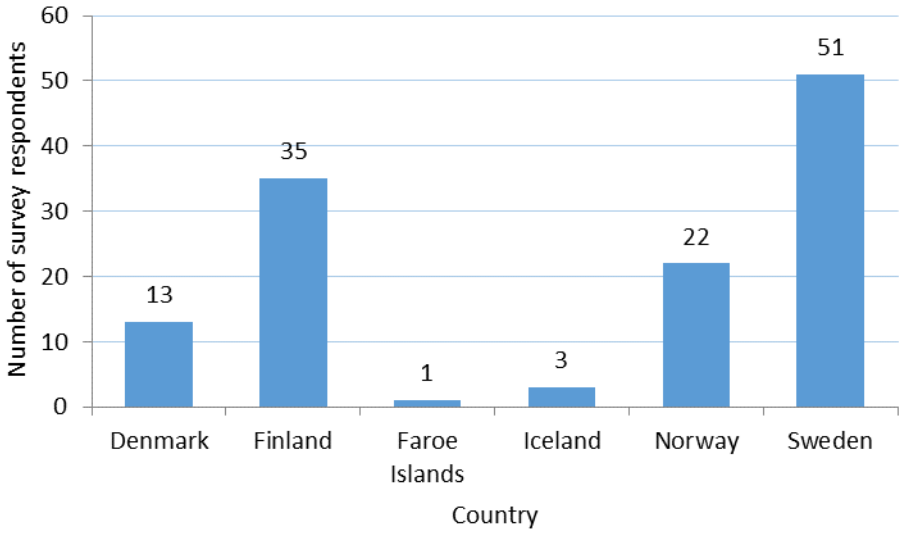


Figure 29. Number of survey respondents by country



2017:09

The Swedish Radiation Safety Authority has a comprehensive responsibility to ensure that society is safe from the effects of radiation. The Authority works to achieve radiation safety in a number of areas: nuclear power, medical care as well as commercial products and services. The Authority also works to achieve protection from natural radiation and to increase the level of radiation safety internationally.

The Swedish Radiation Safety Authority works proactively and preventively to protect people and the environment from the harmful effects of radiation, now and in the future. The Authority issues regulations and supervises compliance, while also supporting research, providing training and information, and issuing advice. Often, activities involving radiation require licences issued by the Authority. The Swedish Radiation Safety Authority maintains emergency preparedness around the clock with the aim of limiting the aftermath of radiation accidents and the unintentional spreading of radioactive substances. The Authority participates in international co-operation in order to promote radiation safety and finances projects aiming to raise the level of radiation safety in certain Eastern European countries.

The Authority reports to the Ministry of the Environment and has around 300 employees with competencies in the fields of engineering, natural and behavioural sciences, law, economics and communications. We have received quality, environmental and working environment certification.

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