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Nuclear Threats in the Vicinity of the Nordic Countries

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Norwegian Radiation Protection Authority

November 2002

Nordic Nuclear Safety Research (NKS)

organizes joint four-year research programs involving some 300 Nordic scientists and dozens of central authorities, nuclear facilities and other concerned organizations in five countries. The aim is to produce practical, easy-to-use reference material for decision makers and help achieve a better popular understanding of nuclear issues.

To that end the results of the sixth four-year NKS program (1998 - 2001) are herewith presented in a series of final reports comprising reactor safety, radioactive waste management, emergency preparedness, radioecology, and databases on nuclear threats in Nordic surroundings. Each report summarizes the main work, findings and conclusions of the six projects carried out during that period. The administrative support and coordination work is presented in a separate report. A special Summary Report, with a brief résumé of all projects, is also published. Additional copies of the reports on the individual projects as well as the administrative work and the Summary Report can be ordered free of charge from the NKS Secretariat.

The final reports - together with technical reports and other material from the 1998 - 2001 period - will be collected on a CD-ROM, also available free of charge from the NKS Secretariat.

During the last few years a growing interest has been noted among sister organizations in the three Baltic States, especially in the field of emergency preparedness, radiation protection and radioecology. This has widened the scope of our joint Nordic work and fed new influences and valuable competence into the NKS program. The Baltic participation is therefore gratefully acknowledged.

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Nuclear Threats in the Vicinity of the Nordic Countries

Final Report of the
Nordic Nuclear Safety Research
Project SBA-1

Inger Margrethe H. Eikermann
Norwegian Radiation Protection Authority

November 2002

This is NKS

NKS (Nordic Nuclear Safety Research) is a scientific cooperation program in nuclear safety, radiation protection and emergency preparedness. It is a virtual organization, serving as an umbrella for joint Nordic initiatives and interests. Its purpose is to carry out cost-effective Nordic projects producing seminars, exercises, reports, manuals, recommendations, and other types of reference material. This material, often in electronic form on the official homepage www.nks.org or CD-ROMs, is to serve decision-makers and other concerned staff members at authorities, research establishments and enterprises in the nuclear field.

A total of six projects were carried out during the sixth four-year NKS program 1998 - 2001, covering reactor safety, radioactive waste, emergency preparedness, and radioecology. This included an interdisciplinary study on nuclear threats in Nordic surroundings. Only projects of particular interest to end-users and financing organizations have been considered, and the results are intended to be practical, useful and directly applicable. The main financing organizations are:

- The Danish Emergency Management Agency
- The Finnish Ministry for Trade and Industry
- The Icelandic Radiation Protection Institute
- The Norwegian Radiation Protection Authority
- The Swedish Nuclear Power Inspectorate and the Swedish Radiation Protection Authority

Additional financial support has been received from the following organizations:

In Finland: Fortum (formerly Imatran Voima, IVO); Teollisuuden Voima Oy (TVO)

In Sweden: Sydkraft AB; Vattenfall AB; Swedish Nuclear Fuel and Waste Management Co. (SKB); Nuclear Training and Safety Center (KSU)

To this should be added contributions in kind by all the organizations listed above and a large number of other dedicated organizations.

NKS expresses its sincere thanks to all financing and participating organizations, the project leaders, and all participants, all in all some 300 persons in five Nordic countries and the Baltic States, without which the NKS program and this report would not have been possible.

Disclaimer

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In particular, neither NKS nor any other organization or body supporting NKS activities can be held responsible for the material presented in this report.

Abstract

The acute phase of a nuclear accident and the possibility of high exposure of the populations are always the most important threats in the emergency preparedness work. Radioactive contamination from an accident can however also cause long term effects for land use and enhanced doses to special population groups and economic problems for agriculture, reindeer industry, hunting, tourism and recreation. For planning purposes it is always valuable to be aware of surrounding radiation hazards and other potential threats. Thus, mapping such threats in a Nordic context is an important factor in emergency preparedness in the area.

This report presents a cross-disciplinary study from the NKS research program 1998-2001. The scope of the project was to prepare a “base of knowledge” regarding possible nuclear threats in the vicinity of the Nordic countries. This base of knowledge will, by modern information technology as different websites, be made available to authorities, media and the population. The users of the websites can easily get information on different types of nuclear installations and threats. The users can get an overview of the situation and, if they so wish, make their own judgements.

The project dealt with a geographical area including North-west Russia and the Baltic states.

The results from the different activities in the project were generated in a web based database called the “the base of knowledge”.

Key words

Nuclear threats, Nordic countries, nuclear power plants, nuclear ship, nuclear waste, literature database, base of knowledge, web-accessed information, atmospheric transport, decommissioning of submarines, nuclear installations, waste management, radioactive contamination in marine environment, radioactive sources, criticality analysis.

Summary

The SBA-1 project was one of the new cross-disciplinary studies in the NKS research program 1998-2001. The main task for the project was to aggregate already compiled knowledge of nuclear threats in the vicinity of the Nordic countries, into a “base of knowledge”, presented by modern information technology. This web based “base of knowledge” will be available to Nordic authorities as a supplement to national emergency preparedness systems. The project focused on potential events in nuclear installations and the possible consequences for the Nordic countries and especially on vulnerable food chains, dose to man, environmental contamination and emergency preparedness. The main nuclear installations focused in the project were nuclear power plants, nuclear powered ships and nuclear fuel and waste storage facilities in the vicinity of the Nordic countries.

The objective of the project was to prepare a “base of knowledge” regarding possible nuclear threats in the vicinity of the Nordic countries. This base of knowledge can, by information technology, be made available to authorities, media and the population. The users of the websites can easily get information on different types of nuclear installations and threats.

Base of knowledge

The first stage of the project was to prepare a list of relevant papers and reports that have been previously produced concerning nuclear threats in the vicinity of the Nordic countries; a literature database. The literature database is presented on a website and as a report with 500 references.

The literature database was created as a part of the “base of knowledge” and is a database with the most relevant publications, papers and reports that have been produced regarding possible nuclear threats in the vicinity of the Nordic countries.

As a summary on the literature in the database there are made two status reports on the most important issues of the project, threats from the nuclear power plants and the nuclear vessels. The reports give an overview of the work done in this matter. The reports are published as NKS reports.

At the Workshop 2000 experts from the different Nordic countries presented each country’s evaluation of the threats against their country. There were presentations from the different Nordic countries concerning the threats from nuclear installations. There were discussions about source term, models and consequences of nuclear threats.

As a result of the discussions at the workshop and the presented literature there are made NKS reports on the threats from nuclear power plants and nuclear power ships.

During the work four supplementary studies have been added regarding:

The Base of Knowledge - an open database

The objective was to make a structure and guidelines for making the “Base of knowledge” a national open home page. The project was carried out in cooperation between the County governor of Finnmark and NRPA.

Gravitational settling of particles in dispersion model simulations using the Chernobyl Accident as a test case.

Atmospheric emission, transportation and deposition of radioactive particles of different size and density were the main topics of the project. A new source term description of the Chernobyl accident has been put in to the atmospheric dispersion model SNAP. The project was a cooperative effort between DNMI and NLH and the result is presented in the DNMI report No. 131: “Atmospheric Transport and Deposition of large particles released during the Chernobyl accident”.

Nuclear emergency preparedness in the Nordic and Baltic Sea Countries

The object was to update “Håndbok for atomberedskap i Norden”, the nuclear emergency preparedness handbook for the Nordic countries. The new version also includes contributions from Estonia, Latvia, Lithuania, and Poland. The previous issue of this handbook (1996) was only in Norwegian. The new handbook is in English and only in electronic form which facilitates future updates. The work was coordinated by NRPA in cooperation with the participating countries.

Information Preparedness in nuclear emergencies, NKS Workshop at the Barents Rescue Exercise 2001.

The fact that it always takes too long for the authorities to inform the public in emergencies was discussed at this workshop. Other issues were how the authorities can set up independent channels to the media, and information handling during a crisis. The authorities can prepare for this by creating contact networks and using IT.

Sammendrag

Dette prosjektet er en av de nye tverrfaglige prosjektene i NKS forskningsprogram 1998-2001. Hovedhensikten med prosjektet var å aggregere allerede foreliggende kunnskap om nukleære trusler i Nordens nærområder, og presentere kunnskapen i en "kunnskapsbase" presentert ved hjelp av moderne informasjonsteknologi. "Kunnskapsbasen" vil bli gjort tilgjengelig for de nordiske lands myndigheter og vil kunne fungere som et supplement for arbeidet som gjøres i forbindelse med beredskapsarbeidet i de respektive land.

Prosjektet har fokusert på å finne fram eksisterende beregninger på konsekvenser av hendelser ved nukleære installasjoner for de nordiske land og fokusere spesielt på sårbare næringskjeder, doser til menneske, miljøforurensing og beredskaps-systemer.

Prosjektet har konsentrert seg om nukleære installasjoner i et geografisk område som omfatter nordvest Russland og de Baltiske stater.

De nukleære installasjoner som er evaluert i prosjektet har vært kjernekraftverk, skipsreaktorer og lagring og håndtering av brukt brensel og radioaktivt avfall.

Kunnskapsbasen

Hensikten med prosjektet var å jobbe fram en "kunnskapsbase" som omhandler ulike nukleære trusler i Nordens nærområder. Denne "kunnskapsbasen" vil i form av moderne informasjonsteknologi som bruk av websider, kunne bli tilgjengelig for myndigheter, media og publikum. Prosjektets hovedmålgruppe var de nordiske lands myndigheter, men prosjektet inneholder også et forprosjekt der det vurderes om websidene kan utvikles til også å være åpne for andre brukergrupper.

Litteraturlatabasen er en del av "kunnskapsbasen" og gir en liste over de viktigste publikasjoner og prosjekter som er produsert i de nordiske land omkring problemområdet nukleære trusler i Nordens nærområde. Publikasjoner med nordiske deltagere står for majoriteten av det innlagte datamateriale, men også andre publikasjoner som er relevant innen problemområdet er inkludert.

Det er avholdt en workshop i løpet av prosjektperioden der eksperter innen de ulike fagområdene som blir omhandlet i "kunnskapsbasen" kom sammen i Oslo. Det var totalt 35 deltagere fra alle de nordiske land. Det ble presentert ulike undersøkelser innen fagområdet. I tillegg ble det diskutert hvilke kunnskapshull der finnes innen fagområdet og gitt signaler om innenfor hvilke områder de trengs videre studier og som bør utredes hos nasjonale myndigheter og institusjoner.

Supplerende prosjekter:

Kunnskapsbase - åpen nasjonal database

Hensikten med dette prosjektet var å lage en struktur og prinsipper for å gjøre "kunnskapsbasen" til en åpen nasjonal hjemmeside. Prosjektet ble utført i samarbeid med fylkesmannen i Finnmark og NRPA.

Atmospheric transport and deposition of large particles released during the Chernobyl accident

Atmosfæriske utslipp, transport og deposisjon av radioaktive partikler med ulik størrelse og tetthet har vært hovedtema for dette prosjektet. En ny kildeterm beskrivelse av Tsjernobyl ulykken er satt inn i spredningsmodellen SNAP. Prosjektet var et samarbeid mellom DNMI og NLH og resultatet er presentert i DNMI rapport No. 131: "Atmospheric Transport and Deposition of large particles released during the Chernobyl accident".

Nuclear emergency preparedness in the Nordic and Baltic Sea Countries

Hensikten med dette prosjektet var å oppdatere "Håndboken for atomberedskapen i Norden", som beskriver atomulykkeberedskapen i de nordiske landene. I den nye versjonen er bidrag fra Estland, Latvia, Litauen og Polen også inkludert. Den forrige utgaven var bare på norsk (1996). Den nye håndboken er på engelse og bare i en elektronisk form som vil lette framtidige oppdateringer. Arbeidet har blitt ledet fra NRPA i samarbeid med de deltagende landene.

Information Preparedness in nuclear emergencies, NKS Workshop at the Barents Rescue Exercise 2001.

Utgangspunktet for denne workshopen var at det tar for lang tid før myndighetene er i stand til å informere publikum i forbindelse med beredskap. Andre tema var hvordan myndighetene kan sette opp uavhengige kanaler utenom media for å håndtere informasjon i forbindelse med kriser. Myndighetene kan forberede seg ved å bruke nettverk og IT.

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1. Introduction

The scope of the project was to prepare a base of knowledge regarding possible nuclear threats in the vicinity of the Nordic countries. This base of knowledge is made available to authorities, media and the population so that the users can get an overview of the situation and, if they so wish, make their own judgements.

The first stage of the project was to prepare a list of projects and reports that have been previously produced and published.

Based on the literature, workshops and seminars the different findings were aggregated in a database.

The project dealt with the geographical area including North-west Russia and the Baltic states.

The project focused on potential events in nuclear installations and the consequences for the Nordic country especially as regards:

- vulnerable food chains
- doses to man
- environmental contamination
- emergency preparedness systems

The acute phase of an accident and the possibility of high exposure of the populations are some of the most important factors in emergency preparedness work. Radioactive contamination from an accident can however also cause long term effects for land use and enhanced doses to special population groups and economic problems for agriculture, reindeer industry, hunting, tourism and recreation.

The nuclear installations that were investigated in the project were:

- nuclear power plants (Kola NPP, Ignalina NPP, Leningrad NPP)
- ship reactors (icebreakers and submarines)
- storage and handling of used fuel and radioactive waste



Fig. 1: Potential threats in the vicinity of the Nordic countries

Project activities have been:

- Making a literature list
- Workshops and seminars on the different subjects
- Making websites
- Complementary studies

The project was organised with a project leader and a project group which co-ordinated the different tasks and was responsible for aggregating knowledge from the different Nordic countries. Working groups were established to focus on the different subprojects and perform different tasks such as organising workshops, making summary reports and identify knowledge gaps.

2. Base of knowledge

The scope of the project is to prepare a “base of knowledge” regarding possible nuclear threats in the vicinity of the Nordic countries. This base of knowledge will, by modern information technology as different websites, be made available to authorities, media and the population. The users of the websites can easily get information on different types of nuclear installations and threats. The users can get an overview of the situation and, if they so wish, make their own judgements.

Based on the evaluation of the literature, workshops were conducted to get specialists together to discuss the different findings and to aggregate new knowledge based on these investigations. Whenever gaps of knowledge were identified, the project group initiated further studies or identified the needs for the consideration of national organisations and authorities.



Fig.2: Base of Knowledge

2.1. Literature database

The literature database will be part of the “base of knowledge”. It is a database with the most relevant publications, papers and reports that have been produced regarding possible nuclear threats in the vicinity of the Nordic countries. Publications by Nordic authors were most highly prioritised, but other relevant publications were also included.

The literature database is presented on a website and as a report with approximately 500 references. The website can be seen below:

The screenshot shows a Netscape browser window displaying the NKS SBA-1 literature database website. The browser's address bar shows the URL: <http://www.svanhovd.no/rpa/nks/sok.htm>. The website has a yellow background and a search form with the following fields:

- Original title:** A dropdown menu set to "Begins with" and a text input field.
- Author:** A dropdown menu set to "All the words" (max 3 words) and a text input field.
- Year of publish:** A dropdown menu set to "=" and a text input field.
- Keyword:** A dropdown menu set to "All the words" (max 3 words) and a text input field.

Below the search form are two buttons: "Submit query" and "Reset". To the right of the search form is a large vertical search bar with the text "NKS SBA-1" repeated twice. Below the search form, the text reads: "This database contains 29 publications. Last publication was added August 1, 1999." There is a link to "[NKS SBA-1 intrapage]" and a small illustration of an open book. The footer of the page mentions "Statens strålevern Beredskapsenheden Svanhøvd Svanvik, Norway" with a small logo.

Fig. 3: Literature database

The registration of publications and projects available for this database started in the spring of 1999. The list has been updated regularly. Anyone was welcome to suggest additional information and expansion of the database by filling out a registration form (a Word document). See below. The registration form was sent to the project leader and the paper or report was included in the literature database.

Example of a correctly filled form (publication):

Original title:	Probabilistic trajectory and dose analysis for Finland due to hypothetical radioactive releases at Sosnovyy Bor
English title:	As above
Author(s):	Nordlund, Göran. Rossi, Jukka. Valkama, Ilkka. Vuori, Seppo.
Published by / in:	Technical Research Centre of Finland
Year of publish:	1988
Country:	Finland
Language:	English
Printed at (printing office):	Technical Research Centre of Finland
Number of pages:	46
Report code / number:	Research Notes 847
ISBN:	951-38-3106-X
ISSN:	0358-5085
Keywords*:	Radioactive contaminants, air pollution, nuclear reactor accidents
Summary:	The Chernobyl accident initiated a wide international interest in developing long range transport models for assessment of radiological consequences due to airborne releases. The Finnish TRADOS computer model had been developed to calculate long range atmospheric dispersion and resulting doses via several exposure pathways. During and after the Chernobyl release the code was utilized to make an initial estimate of the release magnitude and to predict both individual and collective doses in Finland. These calculations proved that the TRADOS system is also well applicable in the acute phase of an accident. In the present study the analysis of atmospheric dispersion to Finland from Sosnovyy Bor near Leningrad and the pertinent dose predictions due to a reactor accident in this area have been made. Both the Chernobyl type release and a smaller release typical of a modern light water reactor at the RBMK-1000 power plant site are considered. The results are compared with the previous studies, in which a smaller release from a light water reactor accident had been assumed to take place in northern Germany and in eastern Sweden (Forsmark). According to the analysis of the number of annual trajectories arriving to Finland from Leningrad this number is with a factor of two less than that for a site in eastern Sweden. Taking this fact into account the radiological risks to Finland seem to be approximately equal when the same release is assumed to have occurred either in Leningrad or in eastern Sweden. Acute health effects in Finland are not caused in either case.
Order from / available at:	VTT Energy, P.O. Box 1604, FIN-02044 VTT, Finland or http://otatrip.hut.fi/vtt/jure/search.html
Remarks:	Summary also available in Swedish and Finnish
Form filled by:	Bredo Möller, Statens strålevern. E-mail: bredo.moller@nrpa.no Tel: +47 78 97 36 09 Fax: +47 78 99 51 80

* select the appropriate keywords from the list in the appendix (last page)

Fig. 4: Registration form

The purpose of the form is to prepare a list of *publications* that has been produced regarding possible nuclear threats in the vicinity of the Nordic countries (north-west Russia and the Baltic states). Thus, a base of knowledge will be prepared and made accessible to the Nordic (preparedness) authorities through a web-based database.

2.2. Status reports

As a summary on the literature in the database there are made two status reports on the most important issues in the project, threats from the nuclear power plants and

the nuclear vessels. The reports give an overview of available knowledge in this matter. The reports are published as NKS reports.

NKS-SBA-1 Status Reports: The Potential Risks from Russian Nuclear Ships.

Povl L. Ølgaard, Risø National Laboratory Roskilde, Denmark.

Main Features of Kola, Leningrad and Ignalina NPPs for Emergency Preparedness Purposes. Heikki Holmström, VTT, Finland.

2.3. Workshop 2000

In October 2000 the project arranged a workshop in Oslo called Workshop 2000. At the workshop experts from the Nordic countries presented papers concerning the threats from nuclear installations.

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

Several project meetings have generated discussions on how to focus on the different nuclear threats and the presentation of the results.

3. Supplementary studies

3.1. Base of knowledge – open webpage

The objective was to make a structure and create guidelines for making the “Base of knowledge” into a national open home page. The project was carried out in co-operation between the County governor of Finnmark and NRPA.

3.2. Atmospheric transport and deposition of large particles released during the Chernobyl accident

Atmospheric emission, transport and deposition of radioactive particles of different size and density are the main topics of the report. An important and innovative part of the report is a detailed description of the source term for particles released from the Chernobyl reactor, which is not typical for other studies dealing with simulation of atmospheric transport and deposition.

To assess the environmental impact of radionuclides released to the atmosphere from a known source, information on the source terms, the dispersion pattern and associated deposition pattern are needed. To improve predictions related to areas affected, the source term as input to the atmospheric dispersion model should be relevant. Furthermore, processes influencing radionuclides defined as the source term should be adequately treated in the models. The source term includes information on the activity concentration of released radionuclides, activity or isotopic ratios and the physico-chemical form (speciation). Radionuclides released from

different nuclear sources can be present in different physico-chemical forms, ranging from simple ions or molecules to colloids, particles and fuel fragments (Salbu, 2000).

The source term description led to 12 scenarios for the SNAP model runs, which included four different classes of particle size and three different classes of particle density. The SNAP model, developed originally at DNMI for operational applications, was modified mainly by implementing parameterisation of gravitational settling velocity, the main process leading to dry deposition of larger particles.

The result of the modified model simulations showed that the deposition of radionuclides was dependent mainly on particle size and that particles with a diameter of 10 μm were transported to Norway during the Chernobyl accident. This finding is in agreement with the measurements performed at NLH. Particles with sizes larger than 50 μm are deposited relatively close (less than 100 km) to the source, contributing more to local than regional problems.

This joint DNMI and NLH project produced several interesting results, probably more than expected. On one hand, meteorologist from DNMI modelling atmospheric transport have received an innovative and unique description of the source term for the Chernobyl accident based on detailed observations, which is quite different from the typical data used by most other modellers. On the other hand, chemists from NLH who can see the real particles through their microscopes, need information on transport and deposition pattern of particles to assess the environmental impact. The joint experiments and analysis of the results led to several interesting conclusions and recommendations for future research, which are presented in the project report.

3.3. Nuclear emergency preparedness in the Nordic and Baltic Sea Countries

The aim of the project was to update “Beredskapshåndboken”, a handbook on nuclear emergency preparedness in the Nordic countries, and to include Estonia, Latvia, Lithuania, and Poland in this issue. The previous issue of this handbook (1996) was published only in Norwegian. The new handbook is written in English and will be available only in electronic form, thus allowing easy updates.

The contents of the handbook are measuring resources; the organisation of the nuclear emergency preparedness in each country (including medical emergency); levels of preparedness; early notification; protective measures in case of an accident; dissemination of information; international and national exercises; bilateral agreements; and information on national nuclear installations.

This document is the third of its kind, but the first extended version in English. The first issue was prepared by the former Head of the department at the Norwegian Statens institutt for strålehygiene, Leiv Berteig. The second one was compiled by Morten Bremer Mærli of the Norwegian Radiation Protection Authority in February 1996. Both issues were financed by NKS. The present update is also financed by NKS through the SBA-1 project.

The handbook contains an overview of the emergency preparedness organisation in each country, and how the most important channels for the early notification and information systems function. There are included lists of addresses. They are however by no means complete. Such information gets obsolete very quickly. Different users can also have different needs. As the document is prepared in the electronic version, it will be easy to update it in the future and adjust to best suit the individual user.

3.4. Information preparedness in nuclear emergencies - NKS workshop at the Exercise Barents Rescue 2001

Anders Jörle, head of the information department at SKI, gave a presentation on “Always too late – authorities and information management at the operational level”. The following presentation was “We need information channels independent of mass media” where the information adviser Kirsti Aareth from the County Governor of Finnmark, Norway, gave a talk on regional needs of information.

“Information preparedness at the authorities and the possibility to build an information network between the authorities” was the title of a presentation by the Communication Director, Norwegian Directorate for Nature Management Siv Ødegård. She discussed how authorities can do a better job in the future in information preparedness. Anne Weltner, Senior inspector, Radiation and Nuclear Safety Authority in Finland (STUK), presented “Communication between authorities in Finland in a nuclear accident”.

4. Conclusions and Recommendations

The main task of the project was to aggregate already compiled knowledge of nuclear threats in the vicinity of the Nordic countries, into a “base of knowledge”, presented by modern information technology. This web based “base of knowledge” is today available to Nordic authorities as a supplement to national emergency preparedness systems. The users of the websites can easily get information on different types of nuclear installations and threats.

NRPA and STUK have included the home page in their emergency system and are using the information.

Today, NRPA is responsible for the website, which is located at a web server at the Svanhovd environmental centre. The web address is www.svanhovd.no/nrpa/nks

with the passwords svanhovd and nks. The base of knowledge will be updated by the NRPA.

Nationally this base of knowledge can easily be made available to other authorities, media and the population.

5. Acknowledgments

The author wishes to thank all the participants of the SBA-1 project, subproject leaders, researchers, and representatives of the nuclear safety authorities and utilities. I am grateful to NKS and the NRPA who have supported me as project leader. The NKS Board, the NKS Secretariat in Risø and Torkel Bennerstedt supported us all the time with good advice. I want to thank all financing organisations, the other project leaders in the NKS program and it has been a pleasure to be part of the Nordic network. I would like to thank very much all authors and other contributors for providing material and documents, which have made this compilation possible, yielding a description of the emergency preparedness organization in nine Nordic and Baltic Sea countries. Special thanks are due to the following persons for their contribution of the reports from the project: Alicia Jaworska, NRPA, Bredo Møller, NRPA, Povl Ølgaard, Risø National Laboratory, Jerzy Bartinicki, Jørgen Saltbones DNMI, Britt Salbu, NLH, Kirsti Aarseth, County governor of Finnmark.

6. Acronyms

DNMI – Norwegian Meteorological Institute

FOI – The Swedish Defence Research Agency

GR – Icelandic Radiation Protection Institute

IFE – Institute for Energy Technology, Norway

INPP – Ignalina Nuclear Power Plant

KNPP – Kola Nuclear Power Plant

LNPP – Leningrad Nuclear Power Plant

NKS – Nordic Nuclear Safety Research

NLH – Agricultural University of Norway

NRPA – Norwegian Radiation Protection Authority

SBA – NKS Cross Disciplinary Studies

SKI – Swedish Nuclear Power Inspectorate

SNAP – Severe Nuclear Accident Program

SSI – Swedish Radiation Protection Authority

STUK – Radiation and Nuclear Safety Authority, Finland

VTT – Technical Research Centre of Finland

7. References

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Jaworska, A. 2001.

Eikermann, I.M.H., Møller, B. 2001. Nuclear threats in the Vicinity of the Nordic Countries - a bibliography.

Appendix 1: Participants in the SBA-1 project

The following persons participated in SBA-1 either by contributing actively to the studies summarized in this report, taking part in the sub-project group meetings, or participating in seminars as invited speakers.

Norway:

Anne-Marit Østreng, NRPA
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Appendix 2: Financing

Table 1: SBA-1 economy. All amounts in DKK

	1998	1999	2000	2001	Sum
NKS budget					
Base of knowledge	150,000	400,000	350,000	450,000	1,350,000
Base of knowledge - open				130,000	130,000
Workshop: Information preparedness (BR 2001)				100,000	100,000
Atmospheric transport and deposition of large particles released during the Chernobyl accident				150,000	150,000
Emergency Preparedness handbook				140,000	140,000
Total budget	150,000	400,000	350,000	970,000	1,870,000

In addition to the NKS budget presented above, the SBA-1 project has received additional in-kind contributions from participating countries and organizations worth at least another DKK 800,000. These contributions, without which the project would not have been possible, are gratefully acknowledged.

Appendix 3: Base of knowledge – some examples

Kola Nuclear Power Plant - Microsoft Internet Explorer fra MySport

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NUCLEAR POWER PLANTS

Kola Nuclear Power Plant

Technical information

Below is a summary of the main design data which is valid both for all four units (if not stated otherwise).

Figures:

1. Kola VVER-400 Reactor, Units 1 and 2

Power	
Thermal	1375 MW
Electrical	440 MW
Efficiency	30.6 %
Reactor plant	
Coolant and moderator	H ₂ O
Fuel	UO ₂
Cladding material	Zr 1% Nb
Number of fuel assemblies	349
Fuel configuration	Triangle
Number of fuel rods in a bundle	126
Fuel assembly active length	2420 mm
Average specific power	33 kW/kgU
Total fuel weight	41 t
Number of control assemblies	37
Number of core screen assemblies	36
Number of reactor coolant loops	6
Operating pressure	125 bar
Reactor coolant flow rate	10.8 m ³ /s
Reactor pressure vessel	
Inside diameter	3560 mm
Maximum overall height	11800 mm
Wall thickness	-
Material	-
Design pressure	125 bar
Total weight	200 t
Steam generators	
Numbers	6
Steam output per unit	125 kg/s
Steam temperature	255 °C
Steam pressure	44 bar
Overall length	12000 mm

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Icebreaker Fleet - Microsoft Internet Explorer fra MySport

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Nordic Nuclear Safety Research

NUCLEAR SHIP REACTORS












Icebreaker Fleet

Technical information



[Russian Icebreaking Ships](#)

Name	Displacement (t)	Operational	Reactor power (MWt)	Horse Power (shp)
Lenin	17 810	1959-89	3x90 (2x135)	44 000
Arktika	20 905	1975-	2x171	75 000
Sibir	21 120	1977-?	2x171	75 000
Rossiia	22 920	1985-	2x171	75 000
Yamal	~22 000	1992-	2x171	75 000
Sovetskiy Soyuz	~22 000	1989-	2x171	75 000
50 let Pobyedy	~22 000	under constr.	2x171	75 000
Taimyr	20 000	1989-	171	50 000
Vaigatch	20 000	1988-	171	50 000
Sevmorput	61800	1988-	135	40 000

Home | Icebreaker Fleet | Technical information | Links

Internet

Radioactive Contamination - Microsoft Internet Explorer fra MySport

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Nordic Nuclear Safety Research

RADIOACTIVE CONTAMINATION











Radioactive Contamination

Spent Nuclear Fuel



A large amount of spent nuclear fuel has accumulated at the bases of the Russian Navy, including the Northern Fleet. In 1997 the total amount was about 300 reactor cores or 70,000 fuel assemblies. About half of these assemblies are still in the reactors of decommissioned submarines.

The rest are stored in various storage facilities at the naval bases. There are several reasons for this large amount of spent fuel at naval bases. The transport capacity for the shipment of spent fuel to the Production Association Mayak where the fuel is to be reprocessed is limited to 10-20 cores per year, and the transport costs have increased. Required lifting equipment and transport facilities are not adequate at the naval bases. This means that all storage facilities, whether on land or on ships are full and some of the facilities were not designed for long term storage.

In connection a NATO/NACC/CCMS Pilot Study meeting in February 1996 the Russians published information of the storage of spent fuel at the Northern Fleet. The documents are not dated, but the figures seem to relate to the situation at the end of 1994.

The spent fuel of the Northern Fleet is store at two shore bases, Andreyev Bay and Gremikha and at 6 support vessels.

At Andreyev Bay in Zapadnaya Litsa Bay spent fuel was initially stored in a in-door storage pool. However, the pool developed a leak and contaminated the surrounding area. Because of this three large liquid waste storage tanks were converted to dry storage facilities for spent fuel, and fuel was transferred from the pool to these facilities. The content of these three facilities was given to be as follows:



Storage facility # 1: 900 canisters or 6300 fuel assemblies

Storage facility # 2: 1021 canisters or 7147 fuel assemblies

Storage facility # 3: 993 canisters or 6951 fuel assemblies

The three facilities are fully loaded.

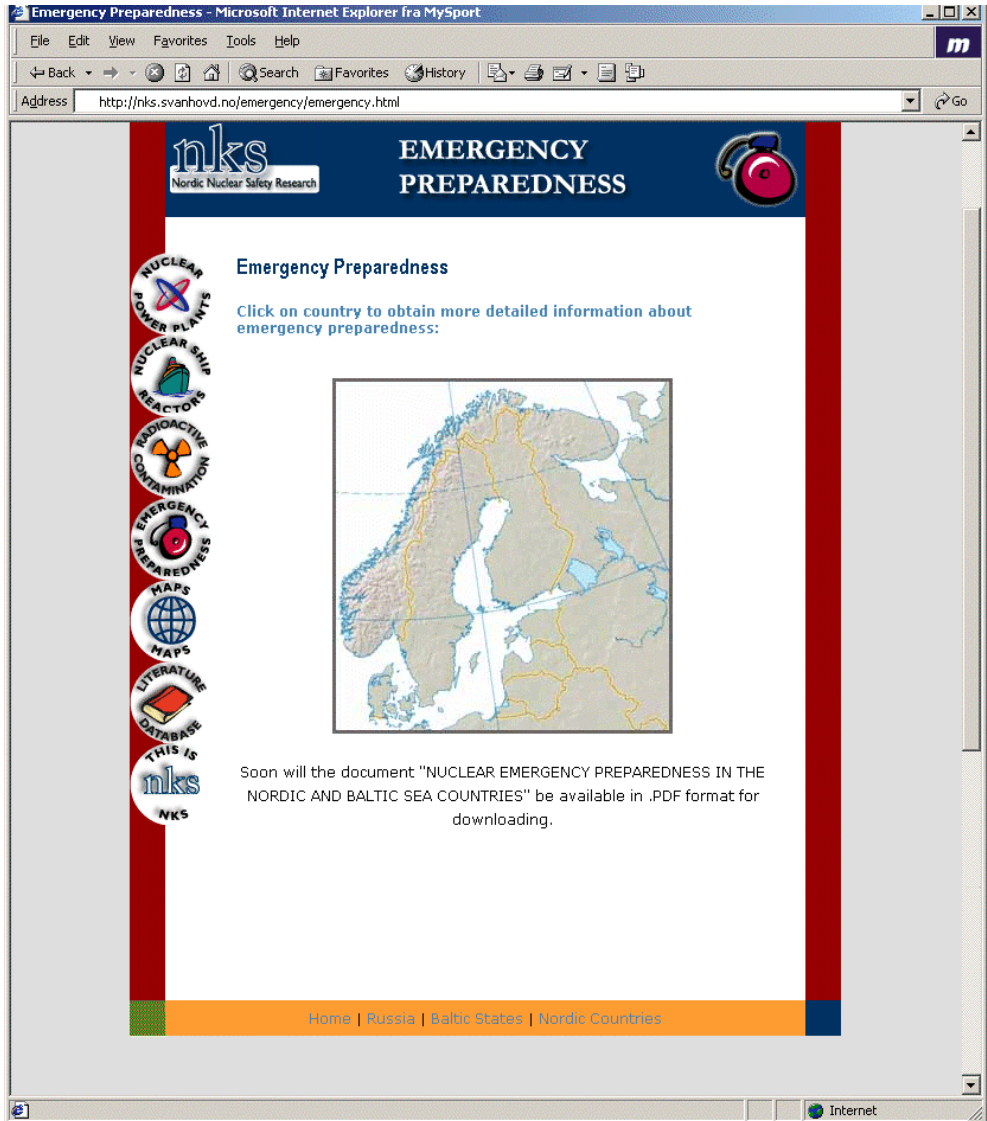
At the Gremikha base there are 4 spent fuel storage facilities.

Pool # 2 (no longer in operation) contains 95 defect fuel assemblies, which can not be accepted by Mayak.

Facility 1V contains 5 cores from liquid metal cooled reactors, probably of the order of 1000 fuel assemblies. They can not be accepted by Mayak due to their design.

An open-air storage area contains 116 Type 6 containers with a total of 812 fuel elements. They can not be accepted by Mayak due to their

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nks

Nordic Nuclear Safety Research

Search the NKS SBA-1 literature database

The purpose with this database is to make a base of knowledge regarding possible nuclear threats in the vicinity of the Nordic countries. This base of knowledge will be made available to the authorities, media and the population so that the users can get an overview of the situation.

This database is a part of the NKS SBA-1 project, to get an overview of this project please visit its website: [NKS SBA-1 intro page](#) (only in Norwegian).

The registration of publications and projects available for this database started spring 1999 and are at regular intervals updated. Anyone are welcome to add information and to expand the database by filling out the [registration form](#) (a word-document). Read the form for more information.

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Author:	All the words	
	(max 3 words)	
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Original title	Author
Analysis of Atmospheric Transport and Deposition of Radioactive Material Released During a Potential Accident at Kola Nuclear Power Plant	J. Saltbones, J. Bartricki, (1997)
Atmosfærisk transport av radioaktivt materiale fra en potensiell ulykke ved kjernekraftverket på Kola	J. Saltbones, J. Bartricki, (1997)
Atmospheric Transport and Deposition from Potential Accidents at Kola Nuclear Power Plant. Part II: Worst Case Scenarios	J. Saltbones, J. Bartricki, A. Foss, (1997)
Consequence analyses as a basis for emergency planning	Naadland Holo E., Larsen E., Saltbones J., Stokke E., Ø
Kola konsekvensanalyse. Vurdering av dosemessige konsekvenser av en eventuell ulykke ved Kola kjernekraftverk	Larsen, E., Naadland Holo, E., Saltbones, J., (1999)
Spredning av radioaktive utslipp fra kjernekraftverket på Kola - episodestudier	J. Saltbones, J. Bartricki, A. Foss, (1998)

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 You selected the following publication:

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Original title:	Analysis of Atmospheric Transport and Deposition of Radioactive Material Released During a Potential Accident at Kola Nuclear Power Plant
English title:	As above
Author(s):	J. Saltbones, J. Bartnicki
Published by / in:	DNMI Research Report No. 43 (Norwegian Meteorological Institute)
Year of publish:	1997
Language:	English
Printing office:	Norway
Number of pages:	29
Report code / number:	-
ISBN	-
ISSN	0332-9879
Order from / available at:	Norwegian Meteorological Institute, Oslo, Norway
Summary:	Summary: As a result of "Stortingsmelding nr. 34 (1993 - 94)": "Atomvirksohmet og kjemiske vopen i vore nordlige nromrder", a plan for follow-up activities was worked out by the Ministry of Foreign Affairs (1995). A main activity under this programme, concerns - "the unsatisfactory safety of nuclear installations in the region", see section 3.1 in the "Action-plan" - from the Ministry of Foreign Affairs (1995). The nuclear power plant at Kola Peninsula: Polarny Zory (Kola NPP), is one of the installations of main concern. An assessment study of safety aspects for the Kola NPP had earlier been initiated by the Ministry of Environment in 1991, ending with a preliminary report. The present approach can be seen as a continuation and extension of that initiative. On this basis and as part of the Ministry of Foreign Affairs "Action-plan" (1995) for follow-up activities, NRPA initiated a project: "Consequence Analysis of Potential Accidents at the Kola Nuclear Power Plant" - with IFE and DNMI as partners. DNMI's part of the project consisted of analysing the atmospheric transport and deposition pattern of the radioactive emissions resulting from a potential accident at the Kola NPP. Two aspects are considered: Transport of pollutants as seen from the longer time scale. This involves trajectory analysis as a tool for describing the air pollution transport pattern (statistics) and screening a large data set of meteorological data for the selection of weather situations suitable for episode studies: Episode studies using DNMI's dispersion model "Severve Nuclear Accident Program" (SNAP) for the selected episodes, and make use of IFE's source term assessment. This report focuses mainly on the first of these aspects and is denoted as Part I.
Keywords:	Emergency response, nuclear accident, long-range transport, trajectory analysis, probabilistic approach, travel-time statistics, selection of episodes
Remarks:	-

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Title	Nuclear Threats in the Vicinity of the Nordic Countries. Final Report of the Nordic Nuclear Safety Research Project SBA-1
Author(s)	Inger Margrethe H. Eikermann
Affiliation(s)	Norwegian Radiation Protection Authority
ISBN	87-7893-120-7
Date	November 2002
Project	NKS/SBA-1
No. of pages	30
No. of tables	1
No. of illustrations	11
No. of references	6
Abstract	The acute phase of a nuclear accident and the possibility of high exposure of the populations are always the most important threats in the emergency preparedness work. Radioactive contamination from an accident can however also cause long term effects for land use and enhanced doses to special population groups and economic problems for agriculture, reindeer industry, hunting, tourism and recreation. For planning purposes it is always valuable to be aware of surrounding radiation hazards and other potential threats. Thus, mapping such threats in a Nordic context is an important factor in emergency preparedness in the area. This report presents a cross-disciplinary study from the NKS research program 1998-2001. The scope of the project was to prepare a "base of knowledge" regarding possible nuclear threats in the vicinity of the Nordic countries. This base of knowledge will, by modern information technology as different websites, be made available to authorities, media and the population. The users of the websites can easily get information on different types of nuclear installations and threats. The users can get an overview of the situation and, if they so wish, make their own judgements. The project dealt with a geographical area including North-west Russia and the Baltic states.
Key words	The results from the different activities in the project were generated in a web based database called the "the base of knowledge". Nuclear threats, Nordic countries, nuclear power plants, nuclear ship, nuclear waste, literature database, base of knowledge, web-accessed information, atmospheric transport, decommissioning of submarines, nuclear installations, waste management, radioactive contamination in marine environment, radioactive sources, criticality analysis.

Available from the NKS Secretariat, P.O. Box 30, DK-4000 Roskilde, Denmark.
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