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Maritime Nuclear Emergency Preparedness and Response – Tools and Monitoring

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Abstract

The aim of the NKS-B MAREPR project was to address emergency preparedness challenges, and to further develop, adapt or adjust coordinated tools for information exchange, request for assistance and measuring and monitoring standards for events related to nuclear-powered vessels or ships carrying radioactive material. During the project, there were two workshops. The first, in Tromsø (Norway) 22-23 August 2024, was related to new nuclear threats and hazards, existing emergency preparedness and response systems in the Arctic and the High North, development of new monitoring systems for maritime accidents (drones), experiences from recent exercises, and recommendations from earlier projects. The second, in Tòrshavn (Faeroe Islands) 12-13 March 2025, was related to recommendations regarding tools, measurement strategies, mobile measurements, and environmental monitoring.

Key words

Maritime, emergency preparedness, tools, monitoring, Nordic countries

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Maritime Nuclear Emergency Preparedness and Response – Tools and Monitoring

Final Report from the NKS-B MAREPR activity

(Contract: AFT/B(24)6)

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Acknowledgements

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1. Introduction

The Nordic countries are surrounded by large ocean areas where there is frequent traffic of foreign nuclear-powered vessels both naval and civilian, and ships carrying nuclear or radiological materials. In addition, several Nordic countries receive visits from NATO nuclear-powered vessels and/or have traffic of nuclear-powered vessels in their territorial waters. This activity has increased the last years, and is expected to increase further due to the geopolitical situation and climate change. The expansion of NATO to Finland and Sweden will have large implications in the geopolitical situation regionally for the Nordic countries, and may give increased traffic of nuclear-powered vessels also in the Baltic Sea, in addition to the existing traffic in Arctic waters.

A number of previous NKS projects have been fully or partly related to understanding the hazard represented by these vessels. The aim of the NKS-B MAREPR project was to address emergency preparedness challenges, and to further develop, adapt or adjust coordinated tools for information exchange, request for assistance and measuring and monitoring standards for events related to nuclear-powered vessels or ships carrying radioactive material.

The project followed-up key findings from the international Arctic Reihn exercise in Norway in 2023, such as e.g. the need to address shortcomings in the international recommendations under the International Maritime Organization (IMO) and IAEA for emergency response regarding nuclear and radiological hazards at sea. There is a need in the Nordic countries for further development and harmonization of emergency response measurement strategies, mobile measurements, and environmental monitoring. The NKS-B MAREPR project followed-up the need for implementation of the results and experiences from the NKS-B RNSARBOOK and NKS-B RNSARCARDS projects related to procedures for first responders. Utilization of newly developed tools, such as International Advanced Visualization and Integration of Data (iAVID) and Rapid Source Term Prediction (RASTEP) was addressed.

During the project, there were two workshops. The first workshop was in Tromsø (Norway) 22-23 August 2024, and was related to existing emergency preparedness and response systems in the Arctic and the High North, experiences from recent exercises (including Arctic Reihn in Norway in 2023), and recommendations from earlier projects. The second workshop was in Tòrshavn (Faeroe Islands) 12-13 March 2025, and was related to recommendations regarding tools, measurement strategies, mobile measurements, and environmental monitoring.

The project focused on knowledge sharing of monitoring strategies and protective actions. Existing emergency preparedness and response systems in the Nordic countries regarding nuclear and radiological hazards at sea were presented and discussed at the workshops, including knowledge sharing and experiences regarding tools, measurement strategies, mobile measurements, environmental monitoring, and protective actions.

Approximately 25 participants from all Nordic countries, including the Faeroe Islands, were involved in the workshops.

2. Project working group

The NKS-B MAREPR seminar was organised by the Norwegian Radiation and Nuclear Safety Authority (DSA), the Joint Rescue Coordination Centre of Norway (JRCC), the Danish Emergency Management Agency (DEMA), the Swedish Radiation Safety Authority (SSM), the Icelandic Radiation Safety Authority (IRSA), the Icelandic Coastguard, the Radiation and Nuclear Safety Authority of Finland (STUK), and the Faroese Safety Authority (FSA).

Project working group participants from the different organisations were:

- From DSA: Inger Margrethe Eikelmann and Øyvind Gjølme Selnæs
- From JRCC: Tore Hongset
- From DEMA: Agnieszka Ewa Hac-Heimburg
- From SSM: Josefine Palmcrantz
- From IRSA: Gísli Jónsson
- From the Icelandic Coastguard: Auðunn Kristinsson
- From STUK: Aleksi Mattilä
- From FSA: Óli á Grindafløtti

3. Workshop 1 in Tromsø 22-23 August 2024

The first NKS-B MAREPR workshop was held at the Fram Centre in Tromsø, Norway, on 22 and 23 August 2024.

Thursday 22 August 2024

09:00 – 09:30	Opening and presentation of participants Impact of climate change on nuclear safety, changes in the security policy situation and history of visits of nuclear-powered vessels to Norway Inger Margrethe Eikelmann, DSA

Session: Nuclear activities in the Arctic and the High North

09:30 – 10:15	Nuclear Russia and the High North – Focus on maritime activities Thomas Nilsen, The Barents Observer
10:15 – 10:30	Coffee break
10:30 – 11:00	New nuclear-powered vessels and EPR challenges, emerging future technologies and activities Ole Reistad, Det norske veritas (DNV)
11:00 – 11:15	Report from VTS NOR on civilian nuclear traffic in the High North since 2018 Alexander Kvisvik Pedersen, Norwegian Coastal Administration (NCA)/ Norwegian Vessel Traffic Service (NOR VTS) Analytical Unit
11:15 – 11:30	Questions
11:30 – 12:30	Lunch

Session: Existing regulation for maritime traffic and cooperation

12:30 – 13:00	Regulation and requirements re. safety, security and EPR for visits of nuclear-powered vessels to Norway Tone Bergan, DSA
13:00 – 13:15	Regulation of marine traffic in Norwegian waters Kjell Vidar Haugen, NCA/NOR VTS Vardø

Session: Emergency preparedness and response in the Arctic and the High North

13:15 – 13:45	Emergency preparedness for visiting nuclear submarines at the Tromsø port Håvard Malmedal, Tromsø fire and rescue service
13:45 – 14:15	Rescue operations involving RN, cooperation agreement JRCC/DSA Tore Hongset, JRCC
14:15 – 14:45	Experiences from visits of nuclear submarines on Faeroe Islands Óli á Grindafløtti, Faroese Safety Authority

14:45 – 15:00	EPR arrangements and monitoring strategies in Sweden Jonas Boson, SSM
15:00 – 15:15	Coffee break
15:15 – 15:30	Experience from visits of nuclear submarines in Iceland Gísli Jónsson, IRSA
15:30 – 16:00	RescEU CBRN stockpiling project Olli-Pekka Rauhala, STUK
16:00 – 16:20	Drones with RN measurement capacities and other measuring capacities Lars Jensen, DSA
16:20 – 16:30	Summing up, day 1

Workshop dinner at Maskinverkstedet, Vervet

Friday 23 August 2024

Session: Result and recommendations from earlier projects and exercises

09:00 – 09:30	Experiences from recent exercises, Arctic Reihn 2023 and others All
09:30 – 09:45	NKS Projects: NKS COASTEX, NKS CRESCENT and others Øyvind Gjølme Selnæs, DSA
09:45 – 10:00	Coffee break
10:00 – 10:20	Determining the source term for a hypothetical nuclear submarine using ACCIDENT and ORIGEN codes Naeem Ul Syed, DSA
10:20 – 10:50	Training, marine capacities and exercise tools in the Norwegian Defense Stig Grønvold, Norwegian Defense
10:50 – 11:10	Consequence assessment of nuclear-powered vessel accidents and floating nuclear power plant transit accidents in the Arctic region Mikko Voutilainen, STUK
11:10 – 11:30	Summing up, day 2
11:30 – 12:00	Lunch
12:00 – 15:00	Excursion to the Tromsø Industry Port Grøtsund

4. Workshop 2 in Tòrshavn 12-13 March 2025

The second NKS-B MAREPR workshop was held at Brandan Hotel in Tòrshavn, Faeroe Islands, on 12 and 13 March 2025.

Wednesday 12 March 2025

14:00 – 14:15	Welcome to the workshop Óli á Grindafløtti, Faroese Safety Authority
14:15 – 14:30	Opening and presentation of participants Summary from workshop 1 in Tromsø, 22-23 August 2024 Inger Margrethe Eikelmann, DSA

Session: Monitoring strategies and capacities, emergency preparedness in the Arctic and Baltic

14:30 – 15:20	Monitoring strategies and capacities at sea, environmental marine monitoring Presentation from each country (10 min)
15:20 – 15:35	Coffee break
15:35 – 15:50	New needs regarding marine monitoring in the Arctic Mark Dowdall, DSA (VTC)
15:50 – 16:05	EPPR project: Arctic RAD Capability Analysis (2021-2025) Inger Margrethe Eikelmann, DSA
16:05 – 16:20	Estimating radioactive releases from nuclear icebreakers after a hypothetical accident Naeem Ul Syed, DSA
16:20 – 16:35	Small Modular Reactors from an IAEA perspective Agnieszka Ewa Hac-Heimburg, DEMA
16:35 – 16:50	Civil-military cooperation – emergency preparedness and training Stig Grønvold, Norwegian Naval Training Establishment
16:50 – 17:05	Coffee break
17:05 – 17:20	First responders – monitoring the situation Håvard Malmedal, Tromsø fire and rescue service
17:20 – 17:45	EPD dose limit practices for different responders Presentations from each country (5 min)
17:45 – 18:00	Discussions and summing up, day 1

Workshop dinner at Brandan Hotel

Thursday 13 March 2025

Session: Exercises

09:00 – 09:15	ATOMEX Inger Margrethe Eikelmann, DSA
09:15 – 09:30	Arctic Reihn 2023, findings and following up Agnieszka Ewa Hac-Heimburg, DEMA
09:30 – 09:45	RNSARBOOK and RNSARCARDS – Implementation in the Nordic countries and in emergency management Tore Hongset, JRCC (VTC)/DSA
09:45 – 10:15	Discussion
10:15 - 10:30	Coffee break

Session: Emergency tools and aids

10:30 – 10:45	International Advanced Visualization and Integration of Data (iAVID) Gísli Jónsson, IRSA
10:45 – 11:00	Rapid Source Term Predication (RASTEP) Naeem Ul Syed, DSA
11:00 – 11:15	New Radar Installation to Oversee Naval Traffic in the GUIK Gap Óli á Grindafløtti, Faroese Safety Authority
11:15 – 11:30	Meteorological Challenges Related to Local Topography in Relation to Spreading Prognoses Óli á Grindafløtti, Faroese Safety Authority
11:30 – 11:45	Reporting on marine activity in the Arctic and using Barents Watch as a tool for crisis management Alexander Kvisvik Pedersen, Ocean and Coastal Vessel Monitoring Vardø, Norwegian Coastal Administration
11:45 – 12:00	Barents Observer-DSA cooperation Øyvind Gjølme Selnæs, DSA
12:00 – 13:00	Project follow-up, new RAD projects Discussion
13:00 – 14:00	Lunch
14:00 – 16:00	Excursion/tour in the Tòrshavn area

5 Workshop participants

The following organizations participated in the two workshops:

Norway:

- Det norske veritas (DNV)
- Norwegian Coastal Administration (NCA)/Norwegian Vessel Traffic Service
- Norwegian Defense
- Norwegian Joint Rescue and Coordination Centre (JRCC)
- Norwegian Radiation and Nuclear Safety Authority (DSA)
- The Independent Barents Observer
- Tromsø fire and rescue service, Municipality of Tromsø

Finland:

- Finnish Radiation and Nuclear Safety Authority (STUK)

Sweden:

- Swedish Radiation Safety Authority (SSM)

Iceland:

- Icelandic Coast Guard
- Icelandic Radiation Safety Authority (IRSA)

Denmark:

- Danish Emergency Management Agency (DEMA)

Faeroe Islands:

- Faroese Safety Authority
- Meteorological Institute of the Faroese Islands
- University of Faroese Islands

6. Conclusions

The aim of the NKS-B MAREPR project was to address emergency preparedness challenges, and to further develop, adapt or adjust coordinated tools for information exchange, request for assistance and measuring and monitoring standards for events related to nuclear-powered vessels or ships carrying radioactive material.

During the project, there were two workshops. The first workshop was in Tromsø (Norway) 22-23 August 2024, and was related to new nuclear threats and hazards, existing emergency preparedness and response systems in the Arctic and the High North, development of new monitoring systems for maritime accidents (drones), experiences from recent exercises (including Arctic Reihn in Norway in 2023), and recommendations from earlier projects. The second workshop was in Tòrshavn (Faeroe Islands) 12-13 March 2025, and was related to recommendations regarding tools, measurement strategies, mobile measurements, and environmental monitoring. Approximately 25 participants from all Nordic countries, including the Faeroe Islands, participated in the workshops.

There in an ongoing work in assessing and understanding nuclear risks and hazards, including through several NKS projects and projects under the Arctic Council. New and updated consequence assessments for hypothetical accidents involving the floating nuclear power plant Academician Lomonosov and the Russian nuclear icebreakers were presented at the workshops, and serve as examples of this.

However, there also needs to be a focus on improving international maritime nuclear emergency preparedness and response. Maritime nuclear emergency preparedness and response is challenging, both nationally and internationally. Maritime accidents and other events in the Arctic and Baltic sea region often happens in the vicinity of several countries, and necessitate joint operations and mutual assistance. These accidents often involve search and rescue operations, where rescue coordination centres and national coastguards in several countries are involved. This is particularly important for predominantly coastal countries, such as Norway, Iceland and the Faroese Islands. This was evident during the workshop in Tòrshavn, where a broad participation from the safety and emergency response authorities in the Faroese Islands showed the significance of maritime scenarios also in the Faroese nuclear emergency preparedness with their experience with e.g. visits from nuclear-powered vessels.

Joint operations and mutual assistance give needs for harmonisation through standardised procedures and systems between national authorities with responsibility for nuclear emergency preparedness, radiation protection and nuclear safety authorities, rescue coordination centres, and rescue assets.

The workshops show that cooperation between civil and military authorities and assets are challenging, and should be addressed in the future. The cooperation during the Arctic Reihn exercise in Bodø in 2023 that was demonstrated seemed to work well and experiences gained from this collaboration may serve as guidance and good practice.

International nuclear emergency preparedness and response with regard to cooperation and mutual assistance would benefit from the implementation of newly developed tools, such as analytical software, monitoring systems and strategies. Some examples, such as the International Advanced Visualization and Integration of Data (iAVID) and the Rapid Source Term Prediction software (RASTEP) were presented at the seminar. Both monitoring

capabilities and strategies may be improved in the Nordic countries in the future. Utilization of new technologies, such as drones, and revision of current monitoring strategies based on changes in nuclear threats and hazards, should be addressed.

Previous NKS projects, such as RNSARBOOK and RNSARCARDS, have developed tools for first responders in nuclear maritime emergency response. These tools could be better implemented in various organisations.

Joint Nordic guidelines and recommendations on protective actions are provided through the Nordic Flagbook. These guidelines may be further strengthened by also addressing maritime scenarios in particular. Working groups under IAEA are currently developing procedures for response during maritime emergencies, which could be implemented in Nordic guidelines in the future.

The importance of regular exercises with maritime radiological scenarios should be acknowledged.

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