
Scenarios and table top exercise concept on
events related to traffic of nuclear-powered
vessels and transportation of spent nuclear
fuel along the Nordic coastline (COASTEX):

Report no. 3 - Final report from the NKS-B
COASTEX activity

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Abstract

There is a notable maritime traffic of nuclear-powered civilian vessels (ice-breakers and cargo ships), nuclear-powered military vessels and maritime transports of spent nuclear fuel and other radioactive materials along the Nordic coastlines and in the Arctic. This traffic represents a risk for potential accidents and events resulting in radioactive contamination and spread of radioactive materials into the Nordic and Arctic marine and terrestrial environments. These kinds of events request a good preparedness, possibility for a direct cooperation between neighbouring countries as well as interaction, assistance and coordinated activities to manage the situation, including mitigation.

In 2015, the NKS-B NORCOP-COAST project identified several needs for further improvement of maritime emergency preparedness and cooperation, including the need for definition of relevant scenarios with follow-up exercises in the Nordic countries. To address this issue, the NKS-B COASTEX project was initiated, as a follow-up.

This report provides an overview on the COASTEX project implementation, divided into two stages:

- 1) Development of a scenario bank with relevant maritime scenarios, describing different aspects and issues concerning events related to the traffic of nuclear-powered vessels and maritime transports of spent nuclear fuel as well as other radioactive materials along the Nordic coastline;
- 2) Development of a practical exercise guide to be used when planning and exercising these scenarios.

To develop scenarios and an exercise guide, two project workshops were organized: on 30-31 May 2016 in Tromsø, Norway and on 12-13 October 2016 in Reykjavik, Iceland, where authorities from Norway, Sweden, Denmark and Iceland contributed.

The produced “*COASTEX Scenario Report: nine maritime accident scenarios*” – Report no.1 and the “*COASTEX Exercise guide*” – Report no.2 of the NKS-B COASTEX project are attached to this report.

Key words

Nordic coastline, the Arctic, maritime accident scenarios, nuclear emergencies, scenario elements, radioactive cargo, radioactive sources, nuclear icebreaker, nuclear-powered vessels, floating nuclear power plant, cross-border preparedness.

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Scenarios and table top exercise concept on events related to traffic of nuclear-powered vessels and transportation of spent nuclear fuel along the Nordic coastline

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DISCLAIMER

The views expressed in this document remain the responsibility of the authors and do not necessarily reflect those of NKS. In particular, neither NKS nor any other organisation or body supporting NKS activities can be held responsible for the material presented in this report.

1. Introduction

Maritime traffic along the Nordic coastlines and in the Arctic includes traffic of nuclear-powered icebreakers and military vessels as well as transport of spent nuclear fuel and other radioactive materials. This traffic represents a risk for potential accidents and events resulting in radioactive contamination and/or spread of radioactive materials into the Nordic marine and terrestrial environments. These kinds of events request a good preparedness, possibility for a direct cooperation between neighbouring countries as well as interaction, assistance and coordinated activities to manage the situation, including mitigation. The uncertainty and complexity in the situation, and the large possible consequences for health, environment, local communities, industries and other societal matters, put additional pressure on monitoring and responding authorities, coastguards and rescue services.

In 2015, the NKS NORCOP-COAST project identified several needs for further improvement of maritime emergency preparedness and cooperation, including the need for definition of relevant scenarios with follow-up exercises in the Nordic countries. This would contribute to better emergency preparedness and response capabilities along the Nordic coastline and in the Nordic countries (Nalbandyan *et al.*, 2016).

The NKS-B COASTEX project “*Scenarios and table top exercise concept on events related to traffic of nuclear-powered vessels and transportation of spent nuclear fuel along the Nordic coastlines*” was initiated by the Norwegian Radiation Protection Authority in collaboration with the Swedish Radiation Safety Authority, the Icelandic Radiation Safety Authority and the Danish Emergency Management Agency as a follow-up of the identified needs in the previous work.

The project resulted in three reports:

1. Report no. 1 - the “*COASTEX Scenario Report: nine maritime accident scenarios*”,
2. Report no. 2 - the “*COASTEX Exercise guide*”,
3. Report no. 3 - the “*Final Report from the NKS-B Project COASTEX*”.

The reports are available on the NKS website <http://www.nks.org/>.

The report “*COASTEX Scenario Report: nine maritime accident scenarios*” (Attachment 1) is the first of the three reports of the NKS-B COASTEX project. The report provides methodology and framework for scenario development, including building blocks in scenarios, phases, trigger events and possible effects. Additionally, the report provides a developed scenario bank with the description of nine maritime scenarios for nuclear accidents related to the traffic of nuclear-powered vessels and transports of spent nuclear fuel and other radioactive materials. The nine scenarios are based on input from the participant countries in the project. They reflect different needs and experiences identified by the participants.

The target groups for these scenarios and follow-up exercises are the potentially affected monitoring and responding authorities, radiation safety authorities, coastguard and rescue services.

The report “*COASTEX Exercise guide*” (Attachment 2) is the second report of the NKS-B COASTEX project. It provides a straightforward guide on how to use the structured scenarios

in planning and conducting exercises. The report describes how to facilitate timely, effective and compatible exercises on decision making by response organisations in emergency situations.

The present report “*Final Report from the NKS-B Project COASTEX*” is the last report of the NKS-B COASTEX project that provides an overview over project implementation.

2. Project implementation

The implementation of the NKS COASTEX project included two parts:

- 1) Development of a scenario bank with relevant scenarios describing different aspects and issues concerning events related to the traffic of nuclear-powered vessels and maritime transports of spent nuclear fuel as well as other radioactive materials along the Nordic coastline;
- 2) Development of a practical table-top exercise concept or an exercise guide to be used when exercising these scenarios.

To plan the project implementation and activities, two kick-off video-meetings via Skype/Lync were organised between the Lead Partner from Norway (NRPA) and partners from other Nordic countries. Meeting 1 was held on 6th of April 2016 between Norway, Iceland and Denmark; and Meeting 2 - on 15th of April 2016 between Norway, Sweden and Finland.

Finland (STUK) had expressed an interest to participate in the project activities and was involved in the kick-off meeting, however, the further involvement was not possible due to limited manpower/work resources.

Atomkameratene AS from Norway were involved in the project as consultants to contribute with expertise in emergency preparedness and exercise planning.

For effective implementation of the project, two project workshops were organized: a one-day workshop in Tromsø, Norway in May 2016 and a two-day workshop in Reykjavik, Iceland in October 2016.

3. Project workshop in Tromsø, Norway

In the frames of the NKS COASTEX project, a joint workshop was organized and hosted by NRPA in the FRAM – High North Research Centre on Climate and the Environment in Tromsø, Norway on 30-31 May 2016 where authorities from Norway (NRPA), Denmark (DEMA NUC), Sweden (SSM) and Iceland (IRSA) took part.

The overall objective of the workshop was to:

- Present suggestions for different scenarios by partner countries and to choose the ones that should be included in the final scenario-bank (Session I);
- Discuss the format for presentation of scenarios in the ‘scenario-bank’ (Session II);

- Discuss the contents and the format of the ‘table top exercise concept/exercise guide’ (Session III);
- Discuss follow-up and divide tasks between partners.

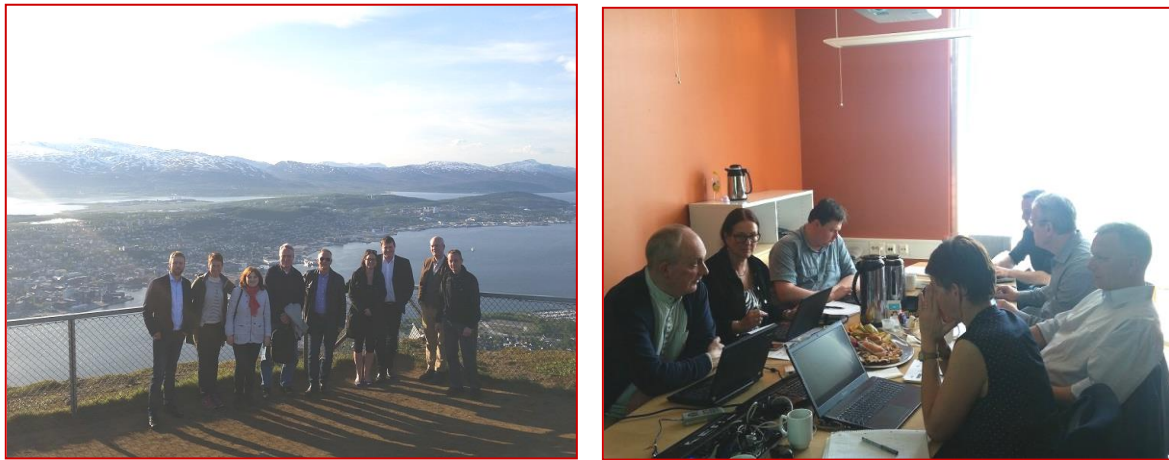


Figure 1. Participants of the NKS-B COASTEX Workshop on the mountain Storsteinen (left) and at the Fram Centre in Tromsø, Norway (right). *Photos: Anna Nalbandyan, NRPA.*

In total, seven potential scenarios were suggested and discussed at the workshop:

Scenario 1. Release of radioactive materials into the ocean or a rumour about that. IRSA, Iceland.

Scenario 2. Accident involving nuclear icebreaking freighter in Danish waters. DEMA NUC, Denmark.

Scenario 3. A dirty bomb using a Sr-90 source from an unmanned lighthouse of Soviet construction. SSM, Sweden.

Scenario 4. Containership on fire. SSM, Sweden.

Scenario 5. Accident involving high-enriched uranium (HEU). Helmuth Zika, SSM, Sweden.

Scenario 6. Accident involving nuclear submarine off the Norwegian Coast. NRPA, Norway.

Scenario 7. Unidentified ship with a large Cs-137 source. IRSA, Iceland.

A framework for scenario elements was discussed as well as a range of exercise categories which might be useful for further development of regional and Nordic cooperation. The aim of the framework was to systemize the scenario elements needed in each type of exercise.

At the end of the meeting, all partners were assigned tasks and responsibilities for further development of their particular scenario/s with the aim to present the drafts at the follow-up workshop in Reykjavik.

4. Project workshop in Reykjavik, Iceland

The 2nd Workshop of the NKS COASTEX project was organised and hosted by IRSA on board a school ship Sæbjörg at the Reykjavik harbour on 12-13 October 2016.

Using the opportunity and in cooperation with IRSA, project partners visited the CTBTO IMS radionuclide monitoring station ISP34 upon arrival to Reykjavik on 11th of October.



Figure 2. Participants of the NKS-B COASTEX project visiting CTBTO IMS station in Reykjavik. *Photos: Anna Nalbandyan, NRPA; Helmuth Zika, SSM; Tone Bergan, Atomkameratene.*

The overall aim of the Workshop was to:

- Present and discuss the developed drafts for scenarios and their integration in the ‘scenario-bank report’;
- Discuss the ‘table-top exercise concept/exercise guide’, format and contents;
- Discuss challenges in crisis management and goals for exercises;
- Plan the final report to NKS.

On 12 October, presentations from the three invited speakers were included in the agenda:

- Crisis Management in Iceland; Volcanic eruptions and long term operations – presented by Ágúst Gunnar Gylfason from the Department of Civil Protection and Emergency Management, Iceland;
- Exercises and how can we get the most out of them? Methodological approach to exercises – presented by Frank Kitching from the International Safety Research (ISR, Canada);
- Experiences from exercises in the Nordic countries. Why do we never learn? – presented by Tone D. Bergan from Atomkameratene, Norway.



Figure 3. Invited speakers and discussions at the NKS-B COASTEX Workshop in Reykjavik. *Photos: Anna Nalbandyan, NRPA.*

While discussing scenarios, it was decided to include two more actual scenarios:

Scenario 8: Towing of Russian Floating Nuclear Power Plant in Nordic waters. NRPA was responsible for development of this scenario.

Scenario 9: M/S Sigrid transporting spent nuclear fuel is maliciously attacked. SSM got responsibility for development of this scenario.

For the wide and practical use of scenarios, in addition to the Scenario Report, it was decided to produce separate **Fact sheets for each scenario** where a description of source term and

hazard/risk assessment parts are also included vs. description of scenarios according to the development phases in the Scenario Report. Each partner was responsible to produce own Fact sheet in the same format agreed by partners. The Fact sheets are included as separate Appendixes at the end of the COASTEX Scenario Report.

While discussing the ‘table-top exercise concept’ vs. an ‘exercise guide’, it was decided that ‘the exercise guide’ is more suitable to the project results and generally could be used when organising different types of exercises (including a table-top), whereas the ‘table-top exercise concept’ is restricting the outcomes and achievements of the COASTEX project.



Figure 4. Participants of the NKS-B COASTEX Workshop on-board Sæbjörg ship – meeting place for the workshop in Reykjavik. *Photos: Anna Nalbandyan and Inger Margrethe H. Eikermann, NRPA.*

At the end, the challenges and target areas for future cooperation were discussed, and a follow-up of the implemented work proposed, that would underline further steps in cooperation and successful handling of potential maritime accidents.

5. Final results of the project and suggested follow-up

As a result of the NKS-B COASTEX project and cooperation, besides this Final project report, two other separate reports were produced that are attached as:

1. Attachment 1: COASTEX Scenario Report (including Fact sheets of scenarios at the end of the report).
2. Attachment 2: COASTEX Exercise Guide.

For the follow-up, relevant authorities in the Nordic countries and elsewhere are invited to use the developed ‘COASTEX Scenario Report’ and the ‘Exercise Guide’ documents while organising and carrying out national exercise/s in order to practise preparedness, response and coordination at different levels.

The target participants in the exercises and potential end users are the national authorities with responsibilities within this field, including monitoring and responding authorities, radiation safety authorities, coastguards, and rescue services.

The feedback and comments on these reports could be sent to the Lead Partner of this project - NRPA. Based on the results of the conducted exercises, the project partners aim to organise a follow-up NKS project to summarise the outcomes, needs for further development and/or improvement with an aim to organise a joint Nordic exercise.

6. Conclusions

The NKS-B COASTEX activity allowed to strengthen further the established network on maritime emergency preparedness and response between Nordic authorities and contribute to the improvement of capabilities in organising and carrying out the national and Nordic exercises.

It is our hope that the developed COASTEX Scenario Report, the COASTEX Fact Sheets, and the COASTEX Exercise Guide will become useful tools when developing scenarios and frameworks for future exercises in order to test capabilities, response and coordination in practice.

7. References

Nalbandyan A, Aas-Hansen Ø, Eikermann I.M, Lindgren J, Guðnason K, Peltonen T, Jensen J.V. Nuclear icebreaker traffic and transport of radioactive materials along the Nordic coastline: response systems and cooperation to handle accidents (NORCOP-COAST): Final report. NKS-362, Electronic report, Roskilde, Denmark, 2016, 36 pp. ISBN 978-87-7893-447-5.

Appendix I – Program of Workshop in Tromsø, Norway



NKS-B COASTEX

Scenarios and table top exercise concept on events related to traffic of nuclear-powered vessels and transportation of spent nuclear fuel along the Nordic coastline

Workshop in Tromsø, 30-31 May 2016

PROGRAM

Venue: FRAM – High North Research Centre on Climate and the Environment, Hjalmar Johansens gate 14, 9296 Tromsø, Norway (www.framsenteret.no), 4nd floor

30 May - Arrival of participants to Tromsø.

19:00-22:30 **Joint dinner hosted by NRPA at the Fjellstua restaurant:** <http://fjellheisen.no/en/>

31 May – Workshop, 09.00 – 17.00

08:45 – meeting of all participants at 1st floor, the Fram Centre

Chair: Inger Margrethe H. Eikermann, NRPA, Norway

- 09:00-09:15 **Welcome and presentation of participants**
- Introduction to the topic:** NRPA summing up the purpose of the project – further plans – target groups and what we want to achieve.
- 09:15-09:40 **Session I - Presentation of scenarios by countries followed by a discussion (15min+10min)**
- Scenario 1.** Release of radioactive materials into the ocean or a rumour about that, Kjartan Guðnason, Icelandic Radiation Safety Authority (IRSA), Iceland.
- 09:40-10:05 **Scenario 2.** Nuclear icebreaker scenario - an accident case when the marine water tightness goes and the icebreaker remains on the land. Jeppe Vøge Jensen, Danish Emergency Management Agency (DEMA).
- 10:05-10:30 **Scenario 3.** A dirty bomb using a recovered Sr-90 source from an unmanned light-house of Soviet construction. Helmuth Zika, SSM, Sweden.
- 10:30-10:45 **Coffee break**
- 10:45-11:10 **Scenario 4.** Containership with dangerous goods on fire. Helmuth Zika, SSM, Sweden.

- 11:10-11:35 **Scenario 5.** Accident involving high-enriched uranium (HEU). Helmuth Zika, SSM, Sweden.
- 11:35-12:00 **Scenario 6.** Nuclear icebreaker scenario – Svalbard. Øyvind Gjølme Selnæs, Norwegian Radiation Protection Authority (NRPA), Norway.
- 12:00-12:25 **Scenario 7.** Nuclear submarine case. Øyvind Gjølme Selnæs, Norwegian Radiation Protection Authority (NRPA), Norway.
- 12:25-12:45 **Discussion and summary of Session I**
- 12:45-14:00 **Lunch at the cafe Globus hosted by NRPA:** <http://www.globuskafe.no/>

Chair: Anna Nalbandyan, NRPA, Norway

- 14:00-15:30 **Session II – Scenario-bank**
 Introduction from Tone D. Bergan, Atomkameratene
 Identifying challenges that the scenarios should cover
 Target groups and identified lessons from previous experiences
 Common format for elements in the scenarios (source term, hazards, consequences, etc.). Inger Margrethe H. Eikermann and Øyvind Gjølme Selnæs, NRPA, Norway.
 Discussions
 Selection of scenario list
- 15:30-15:45 **Coffee break**
- 15:45-16:45 **Session III – Exercise guide**
 Introduction from Tone D. Bergan, Atomkameratene
 Discussion of the concept (ex. module-based guide, table-top concept, etc.)
 Moving towards “decision based” exercises.
- 16:45-17:30 Workshop summary
 Follow-up, division of tasks
 Drafting the program for the 2-days meeting in Reykjavik. Agenda points:
 - to present and discuss the developed scenarios and ‘scenario-bank document’;
 - to discuss the ‘exercise guide’ and contents;
 - to plan the final report to NKS.

1 April - *Departure of participants*

Appendix II – Participants of the Workshop in Tromsø, Norway

Country and representative	Organisation short	Organisation
NORWAY		
Inger Margrethe H. Eikermann	NRPA	Norwegian Radiation Protection Authority
Anna Nalbandyan	NRPA	Norwegian Radiation Protection Authority
Øyvind Aas-Hansen	NRPA	Norwegian Radiation Protection Authority
Øyvind Gjølme Selnæs	NRPA	Norwegian Radiation Protection Authority
Tone D. Bergan	Atomkameratene	Atomkameratene AS
SWEDEN		
Helmuth Zika	SSM	Swedish Radiation Safety Authority
Michael Wallin	SSM	Swedish Radiation Safety Authority
DENMARK		
Jeppe Vöge Jensen*	DEMA NUC	Danish Emergency Management Agency
ICELAND		
Kjartan Guðnason	IRSA	Icelandic Radiation Safety Authority

Appendix III – Program of Workshop in Reykjavik, Iceland



NKS-B COASTEX

Scenarios and table top exercise concept on events related to traffic of nuclear-powered vessels and transportation of spent nuclear fuel along the Nordic coastline

Workshop in Reykjavik, 12-13 October 2016

PROGRAM

Venue: School ship Sæbjörg, Reykjavik harbour

11 October - Arrival of participants to Reykjavik and accommodation at the Reykjavik Hotel Centrum (<http://en.hotelcentrum.is>)

17:00 - visit to the CTBTO IMS radionuclide monitoring station ISP34 for those interested.
All meet at the lobby of the Reykjavik Hotel Centrum at 17:00!

12 October – Workshop, Day 1

- 09:00 Welcome, by project leader Inger Margrethe Eikermann (NRPA) and host Kjartan Guðnason (IRSA)
- 09:15 Update from the working group meeting in Tromsø in May, by Inger Margrethe Eikermann (NRPA)
- 09:30 The scenarios and the scenario bank, by Øyvind Gjølme Selnæs (NRPA)
 - Going through the scenarios
 - The scenario description structure
 - Comments and discussion
- 10:30 *Coffee break*
- 11:00 Crisis Management in Iceland; Volcanic eruptions and long term operations.
Ágúst Gunnar Gylfason, The National Commissioner of the Icelandic Police, Department of Civil Protection and Emergency Management (30 min. + questions/discussions)
- 12:00 *Lunch*
- 13:00 Exercises and how can we get the most out of them? Methodological approach to exercises, by Frank Kitching (ISR, International Safety Research)

- 14:00 Experiences from exercises in the Nordic countries. Why do we never learn?, by Tone D. Bergan (Atomkameratene)
- 14:30 *Coffee break*
- 15:00 Exercise guide, by Inger Margrethe Eikermann (NRPA)
- Defining target groups for the exercise guide
 - Design of the guide: presentation
 - Joint discussion
- 16:00 *Moving from the meeting venue to Harpa (discussions continue)*

13 October – Workshop, Day 2

- 09:00 Welcome
- Exercise guide, by Inger Margrethe Eikermann (NRPA) continues
- 10:15 Working session 1: Identified challenges in crisis management and exercise goals
- 11:30 *Lunch*
- 12:30 Working session 1: Identified challenges in crisis management and exercise goals continues
- 13:30 Working session 2: Working with the exercise guide
- 15:30 Summing up
- 16:00 New NKS proposal (deadline 14 October)
- Discussion
- 17:00 End of the day
- 18:00 *Dinner at Smurstöðin Restaurant, Harpa Concert Hall (ground floor), hosted by IRSA.*
- 19:30 *Concert with the Icelandic Symphony Orchestra at the Harpa Concert Hall*

14 October - Departure of participants

Appendix IV – Participants of the Workshop in Reykjavik, Iceland

Country and representative	Organisation short	Organisation
NORWAY		
Inger Margrethe Eikermann	NRPA	Norwegian Radiation Protection Authority
Anna Nalbandyan	NRPA	Norwegian Radiation Protection Authority
Øyvind Aas-Hansen	NRPA	Norwegian Radiation Protection Authority
Øyvind Gjølme Selnæs	NRPA	Norwegian Radiation Protection Authority
Tone D. Bergan	Atomkameratene	Atomkameratene AS
SWEDEN		
Helmuth Zika	SSM	Swedish Radiation Safety Authority
Michael Wallin	SSM	Swedish Radiation Safety Authority
DENMARK		
Jeppe Vöge Jensen*	DEMA NUC	Danish Emergency Management Agency
ICELAND		
Kjartan Guðnason	IRSA	Icelandic Radiation Safety Authority
Ágúst Gunnar Gylfason	Icelandic Police	Icelandic Police, Department of Civil Protection and Emergency Management
CANADA		
Frank Kitching	ISR	International Safety Research

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Affiliation(s)	¹ Norwegian Radiation Protection Authority, Section High North, PO Box 6606 Langnes, 9296 Tromsø, Norway ² Norwegian Radiation Protection Authority, P.O. box 55, 1332 Østerås, Norway ³ Swedish Radiation Safety Authority, S-171 16, Stockholm, Sweden ⁴ Icelandic Radiation Safety Authority, Raudararstigur 10, 150 Reykjavik, Iceland ⁵ Danish Emergency Management Agency, Datavej 16, 3460, Birkerød, Denmark
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