On Nordic handbook for search and rescue in a maritime radiological / nuclear emergency

(NKS-B RNSARBOOK)

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Nordic Nuclear Safety: Research, Operations and Beyond. Joint NKS-R and NKS-B Seminar, Finlandshuset, Stockholm, 24-25 May 2022

DSA

Direktoratet for strålevern og atomsikkerhet

Norwegian Radiation and Nuclear Safety Authority

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On Nordic handbook for search and rescue (SAR) in a maritime radiological / nuclear (RN) emergency (NKS RNSARBOOK)

RNSARBOOK

Goal:

Produce a handbook that provides harmonized guidelines and recommendations for the handling of maritime SAR operations involving radiological/nuclear material by Nordic SAR- and RAD authorities.

Fotos: Håkon Kjøllmoen / KV Svalbard*

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ICELANDIC RADIATION SAFETY AUTHORITY

NORD University

DSA Norwegian Radiation and Nuclear Safety Authority

RNSARBOOK partners

A cooperation between Nordic SAR- and RAD authorities and academia.

Nordic Radiation Authorities:

DSA, Norway (project lead)
DEMA, Denmark
IRSA, Iceland

We are grateful for additional contributions also by **SSM**, **MSB** and **STUK**.

Nordic SAR Authorities:

Joint Rescue Coordination Centre Norway (project co-lead), Norway
Joint Rescue Coordination Centre Denmark
Icelandic Coast Guard
Finnish Border Guard

Academia:

NORD University, Bodø, Norway.
Also included a Master student thesis project in emergency management.

RN-sources at sea

Nuclear-powered vessels (NPVs)

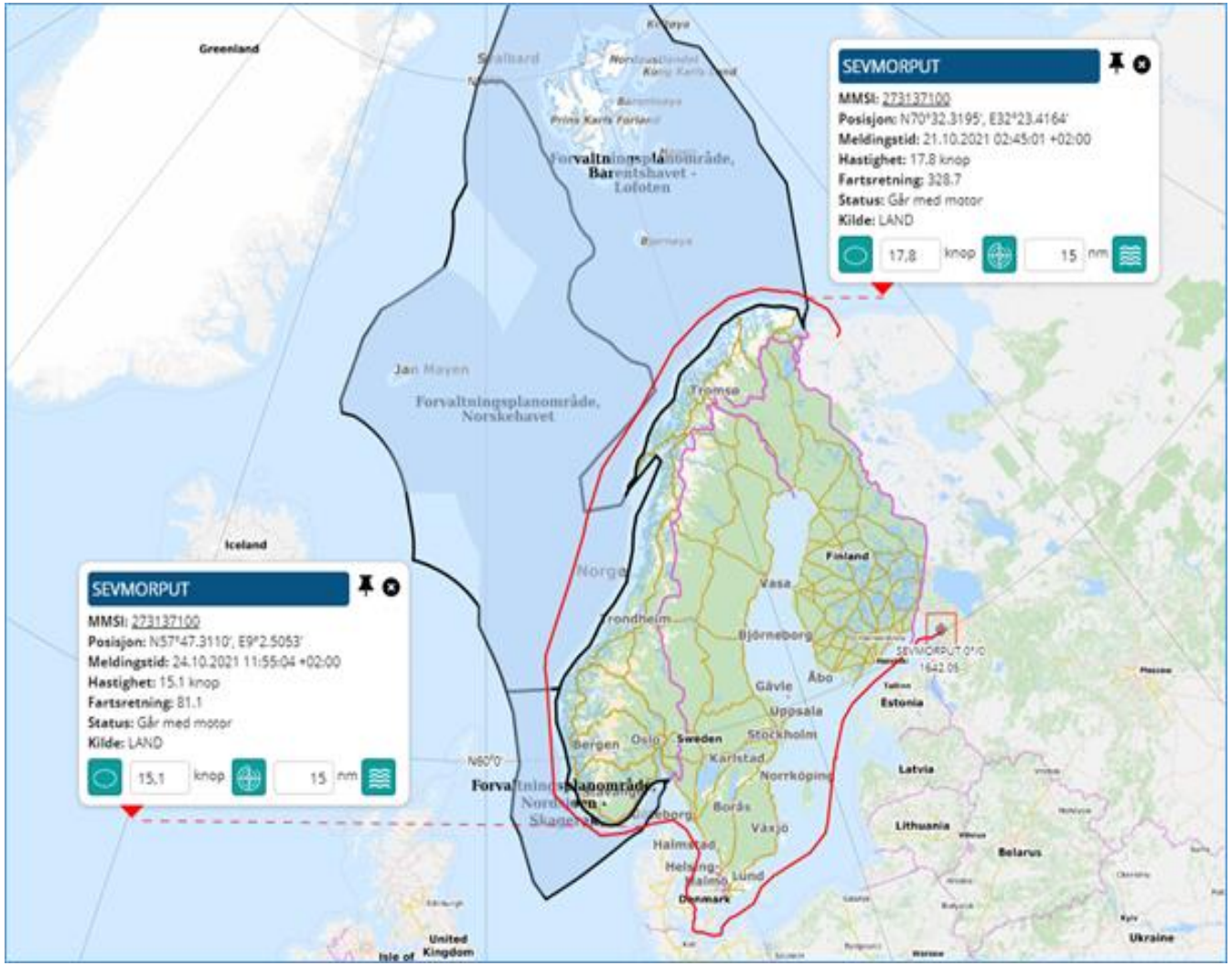
- Military NPVs
- Civilian ice breakers and one cargo ship

Sea transport of RN-materials

- spent nuclear fuel
- high-level radioactive waste
- other sources

New and emerging sources

- Floating nuclear power plants
- Submerged reactor technology
- Military and other sources



Example: AIS-tracking showing a journey by the nuclear-powered containership Sevmorput from Murmansk to St. Petersburg in October 2021 (image courtesy of Norwegian Vessel Traffic Service).

Previous work in the Arctic Council EPPR working group

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ARCSAFE

- Emergency response may be compromised due to lack of knowledge and a heightened perceived risk.
- There is need for building trust between RN experts and emergency workers / emergency helpers.

RADEX

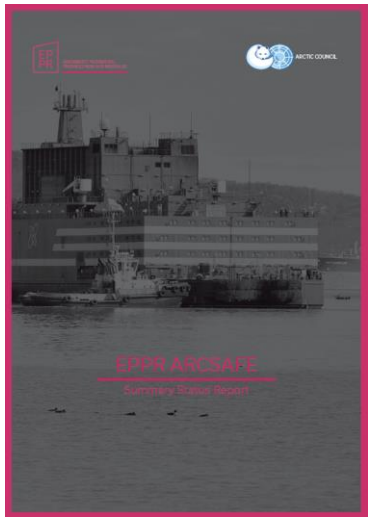
- TTX demonstrated the very complex nature of handling a RN-SAR emergency at sea.

RADSAR

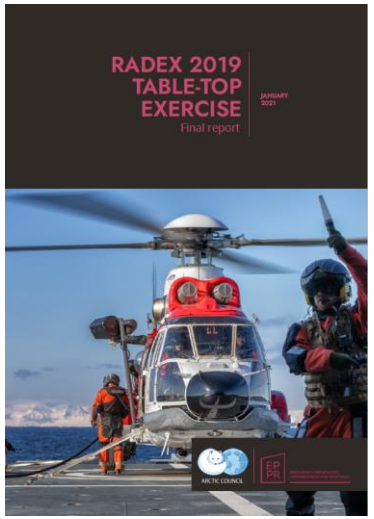
- SAR and other emergency workers may have very limited knowledge, equipment and training to handle maritime RN-scenarios

RN RISKS

- Moderate and increasing risk: NPVs and transport of fNPPs
- Low but increasing risk: Small modular nuclear reactors, transport of nuclear materials.

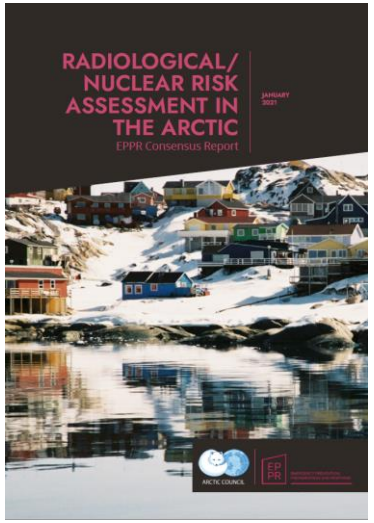


ARCSAFE



RADEX

RADSAR



RN RISKS

ARCTIC COUNCIL

EP PR
EMERGENCY PREVENTION, PREPAREDNESS AND RESPONSE

AVAILABLE AT WWW.EPPR.ORG

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RNSARBOOK also builds on previous NKS-projects

Examples, previous projects on potential maritime accidents (reports available at www.nks.org):

NUCVESS: Inventory and Source Term Evaluation of Russian Nuclear Power Plants for Marine Applications (NKS-139, 2006)

MARENUC: A Nordic Approach to Impact Assessment of Accidents with Nuclear-Propelled Vessels (NKS-268, 2012)

NORCOP-COAST: Nuclear icebreaker traffic and transport of radioactive materials along the Nordic coastline: response systems and cooperation to handle accidents (NKS-362, 2016)

COASTEX 1- 3: Scenarios and tabletop exercise concept on events related to traffic of nuclear-powered vessels and transportation of spent nuclear fuel along the Nordic coastline (NKS 390-392, 2017)

CRESCENT (ongoing) - Credible release scenarios for nuclear-powered vessels operating in Nordic waters.

3.9 Scenario 9: Accident involving nuclear icebreaking freighter in Danish waters

Source specification

Collision between the Russian nuclear icebreaking freighter "Sevmorput" and a Danish heavy bulk carrier ship.

Severe damage to the hull and subsequent grounding of "Sevmorput", during high tide, 70 km east of the Danish city Aarhus.

Low tide combined with possible damage to the reactor installation, leads to Loss-of-coolant accident (LOCA) and airborne release of radioactive substances from "Sevmorput".

3.7 Scenario 7: Containership on fire

Source specification

20 PWR fuel elements, containing about 15 metric tons of low-enriched uranium (LEU) in several B(U) containers loaded in one 20 foot CSC-container and ten 30B-cylinders with 30 metric tons of uranium hexafluoride (UF_6) loaded on three 20 foot flat racks.

Example scenarios from NKS COASTEX report no. 1 (NKS-390, 2017)

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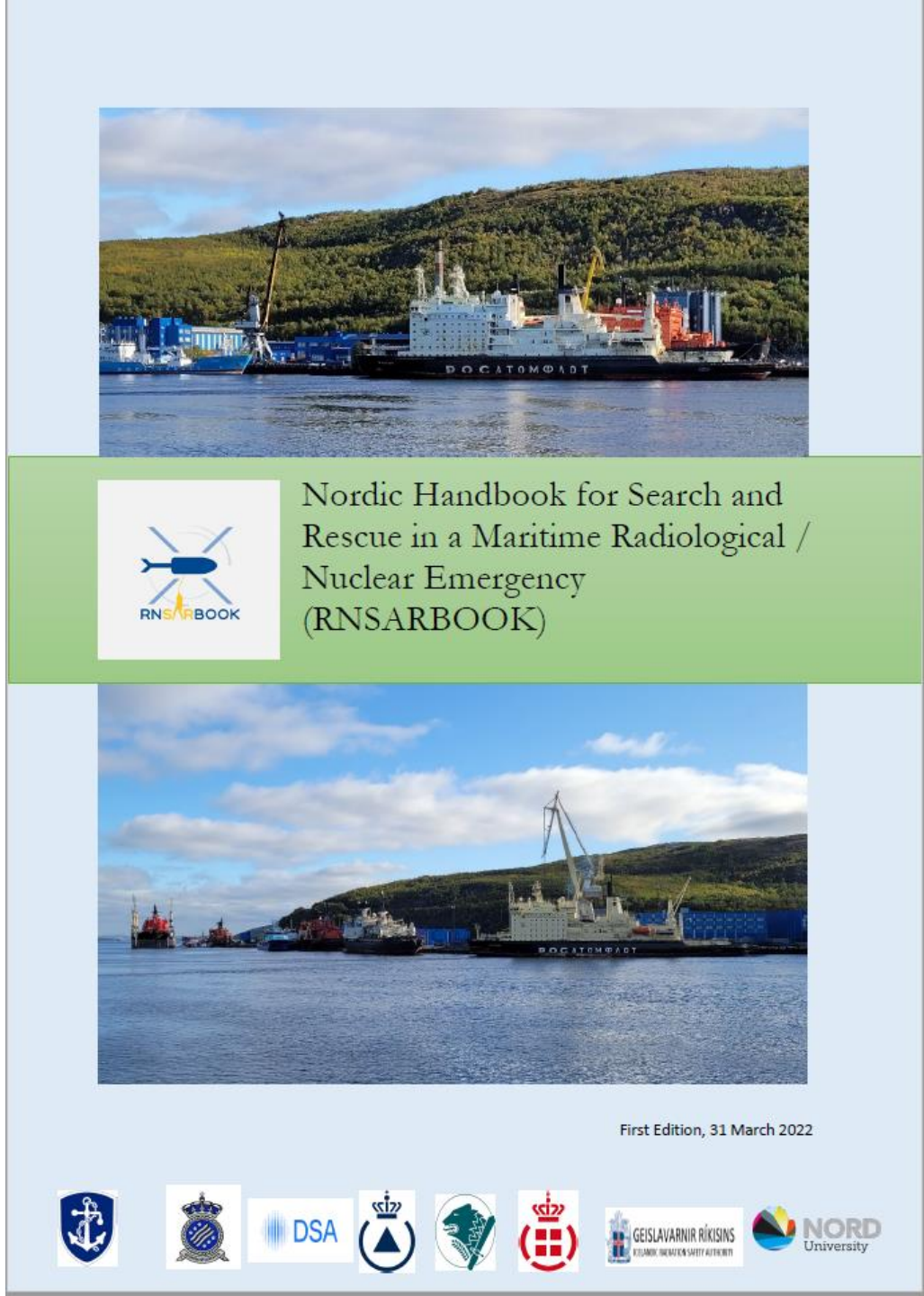
RNSARBOOK

Intentions of the handbook (RNSARBOOK):

- Provide harmonized guidelines and recommendations for the handling of maritime SAR operations involving radiological / nuclear material by Nordic SAR- and RAD authorities.



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RNSARBOOK

The primary target audiences are SAR- and RAD-authorities and planners at the operational level:

- The handbook will provide guidance to SAR authorities with a responsibility to coordinate maritime SAR.
- RAD authorities that have a mandate in providing liaison and expert advice to the SAR authorities, as well as the possible involvement of specialized RAD measurement teams.

The handbook is NOT intended to be used during an ongoing SAR-operation when situational stress is high, but rather to be used for harmonized contingency planning and educational purposes by both SAR- and RAD organizations.

RNSARBOOK

Nordic Handbook for Search and Rescue in a Maritime Radiological / Nuclear Emergency (RNSARBOOK)

First Edition, 31 March 2022

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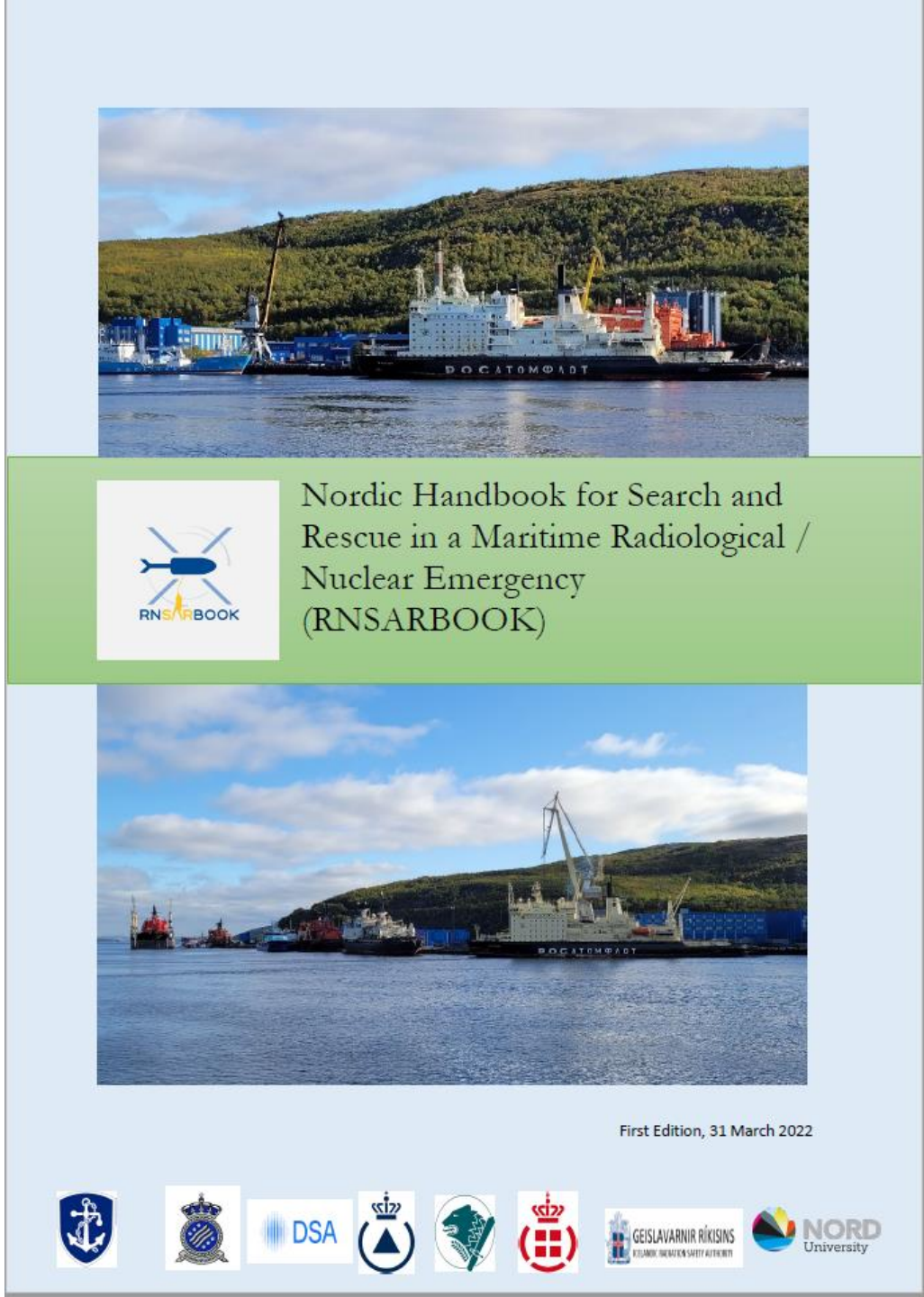
RNSARBOOK

Other target groups are:

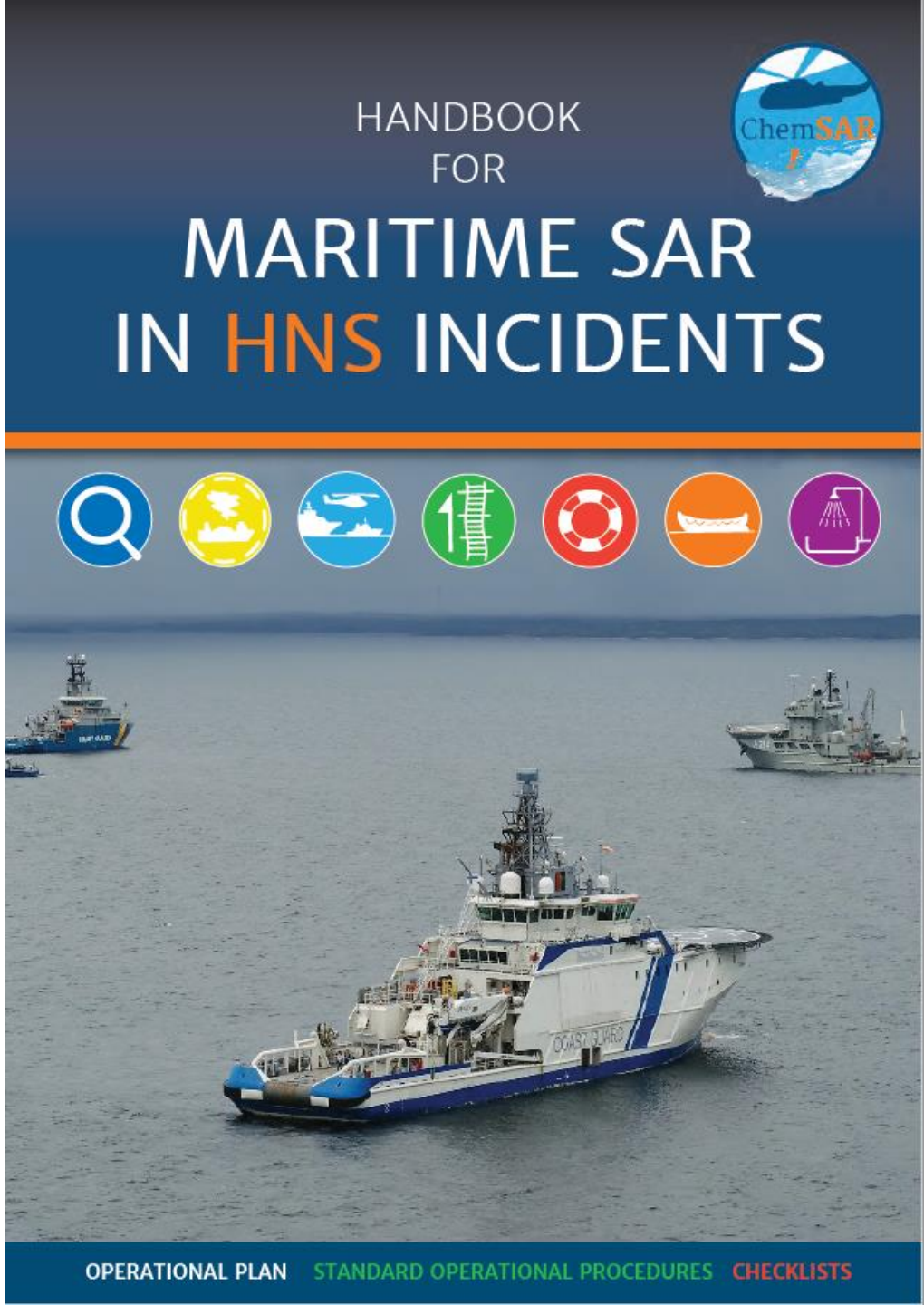
- First responders, special rescue teams, volunteers, environmental response authorities, shipping companies, vessel crews, and other stakeholders that might play a role or be affected by RNSAR operations.
- Such other stakeholders may use the handbook to improve their understanding of the topic and to further develop and adapt their own contingency plans and procedures to such events.



The ChemSAR Handbook

The format of RNSARBOOK was inspired by the ChemSAR Handbook ("*Handbook for maritime SAR in hazardous and noxious substances (HNS) incidents*"), led by the Finnish Border Guard.

We have strived to ensure the guidelines and procedures of RNSARBOOK are based on international standards and guidelines from the International Atomic Energy Agency (IAEA), the Nordic guidelines and the International Aeronautical and Maritime Search and Rescue (IAMSAR) manual.



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Main contents of RNSARBOOK

RNSARBOOK

Part 1: RN in SAR operations

Ch. 1 Radiation and dose
Ch. 2 Safety of responders
Ch. 3 Radiological and nuclear emergencies at sea
Ch. 4 Operational Plan for RNSAR emergencies
Ch. 5 General Preparation and Exercises

The purpose of Part 1 is to offer a basic understanding of RN and its terminology to SAR authorities, offer a basic understanding of how this type of operations could play out and be handled, as well as an introduction to exercises that will benefit RNSAR operations.

Part 2: Standard Operational Procedures (SOPs) for RNSAR

Ch. 7 SOP 1 - Assessment of the incident
Ch. 8 SOP 2 - Determination of the restriction area
Ch. 9 SOP 3 - Arrival to the scene of incident
Ch. 10 SOP 4 – Boarding
Ch. 11 SOP 5 - Rescue Operation on board the distressed vessel
Ch. 12 SOP 6 - Evacuation and emergency towing
Ch. 13 SOP 7 - Decontamination

The SOPs represent the common ground thoughts on how an RN situation can impose on a SAR incident, seen from the RCC's level. The procedures can assist the RCC planners in developing their plans and action cards.
In addition, the SOPs can guide SAR responding units in harmonizing their own plans and action cards, ensuring that the plans and procedures developed are based on the same principles as the RCC's

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Examples on the contents of the handbook – Part 1

1.3 Types of ionizing radiation

The most important types of ionizing radiation are alpha, beta, gamma, x-rays and neutron radiation.

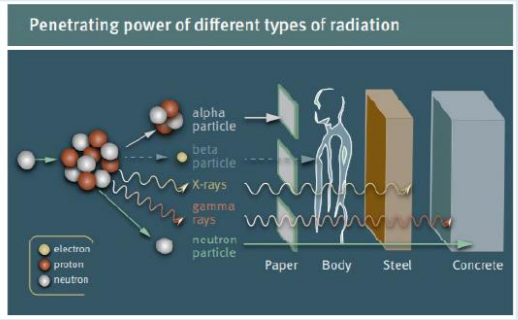


Figure 1: Penetration capacity (3)

Table 4: Examples of alarm thresholds

NB! The volume of an alarm on a personal dosimeter is typically 90 dB. In some cases, SRUs might not be able to hear the alarms due to loud ambient noise. Consequently, the SRUs should have routines to visually check the personal dosimeter or use other equipment, such as a dose rate meter, to monitor radioactivity (intensity and total received dose).

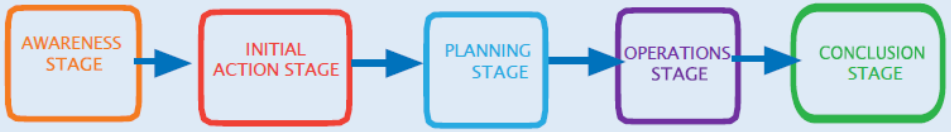
	Denmark	Finland	Iceland	Norway	Sweden
Dose rate alarm level	100 µSv/h	100 µSv/h	100 µSv/h	100 µSv/h	100 µSv/h
Dose alarm level	10 mSv	10 mSv	N/A	10 mSv	5 and 20 mSv

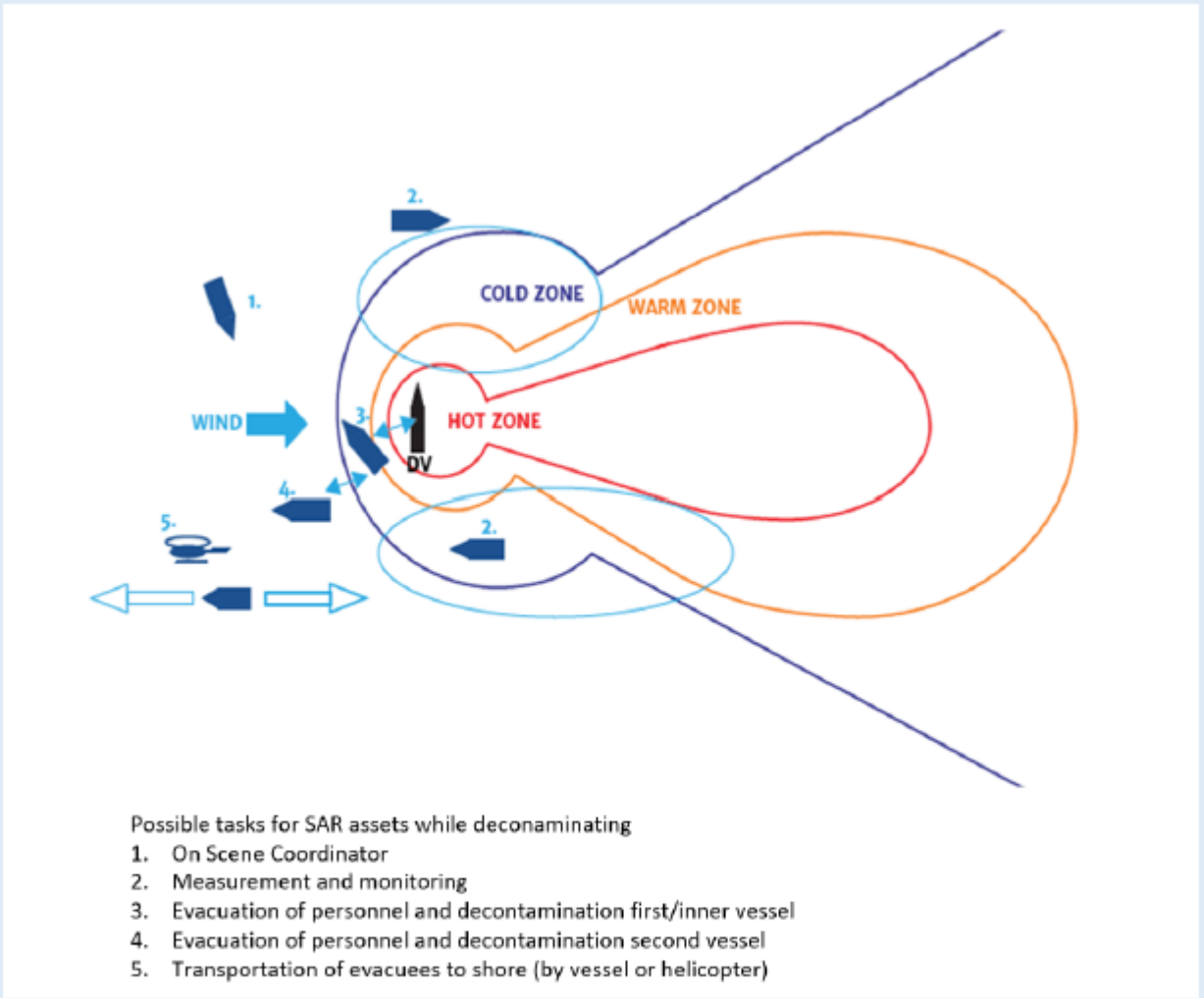
4 Operational Plan for RNSAR emergencies

This chapter offers an introduction to SAR operations in RN environments. The chapter is structured following the rescue operational stages presented by IAMSAR (26).

This operational plan is supplemented by the RNSAR SOPs.

The rescue operation stages:





Possible tasks for SAR assets while deconaminating

1. On Scene Coordinator
2. Measurement and monitoring
3. Evacuation of personnel and decontamination first/inner vessel
4. Evacuation of personnel and decontamination second vessel
5. Transportation of evacuees to shore (by vessel or helicopter)

Figure 16: Illustration of organization of decontamination stations in a situation with a risk of release of radioactive material to air (contamination risk). Modified from ChemSAR handbook (28)

Examples on the contents of the handbook – Part 2 (SOPs)

Example:

SOP 13 – Decontamination

13.1 Preparation

13.2 Establishing phase

13.3 Decontamination process

13.3.1 Emergency decontamination

13.3.2 Search and Rescue unit (SRU), crew and equipment decontamination

13.3.2 Decontaminated waste

13.3 Decontamination process

13.3.1 Emergency decontamination

Emergency decontamination is defined as the process where one must decontaminate the evacuees as quickly as possible even though one does not have a fully established site for decontamination. Emergency decontamination should be carried out as soon as possible to minimize the effects of radiation by removing contaminated particles. Emergency decontamination should be conducted at the decontamination point. Lifesaving medical measures have priority over (coarse) decontamination. Self- protection of the assisting and medical personnel must be assured (28).

There might occur situations where the medical condition of the patient goes first, and decontamination will have to be executed later. In such situations, the SAR personnel should ensure that the contamination on the injured person(s) is isolated as much as possible to avoid further contamination of the SRU.

Confirm that receiving hospitals are informed and have the capacity to respond to the situation.

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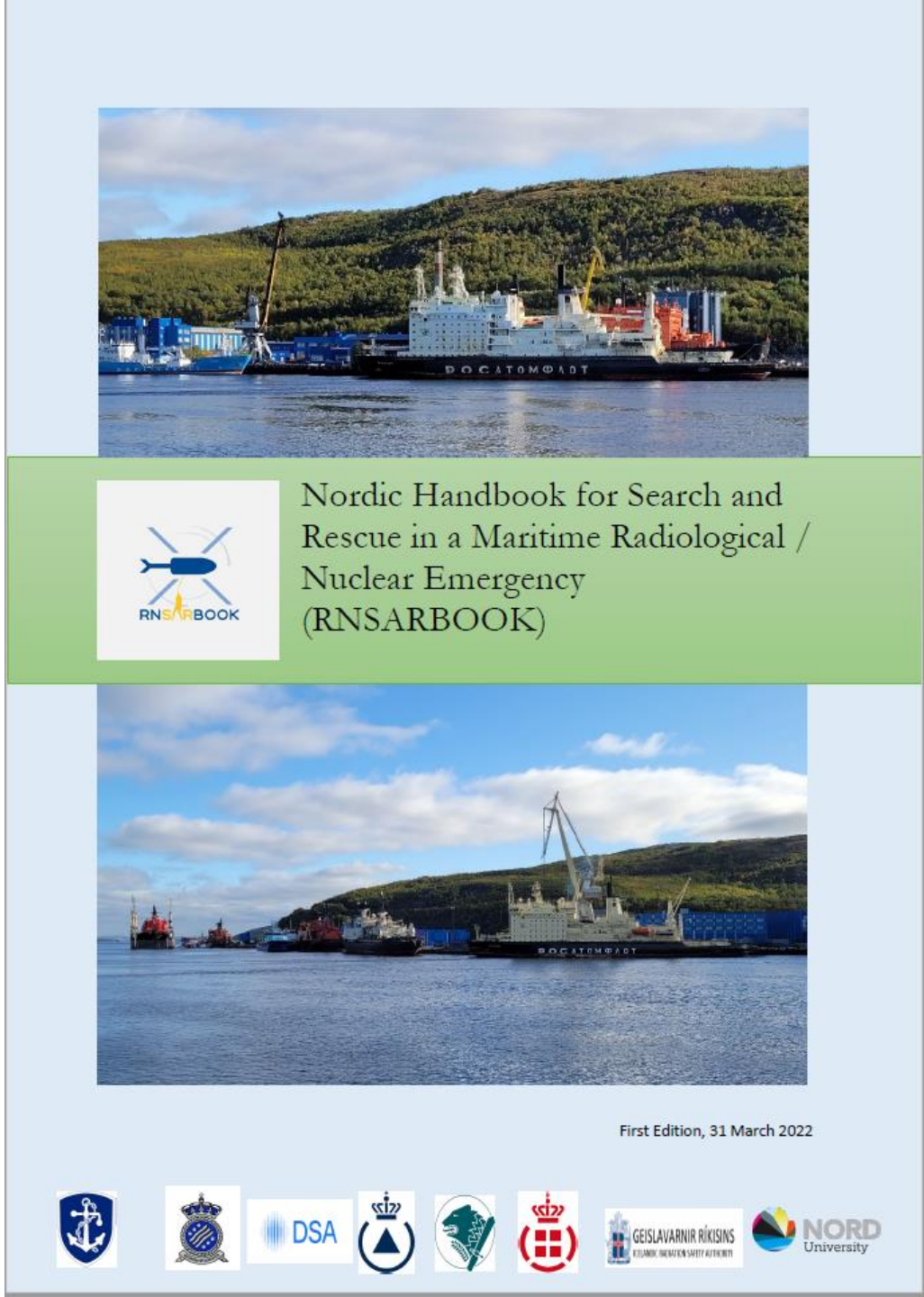
RNSARBOOK
next steps

Submitted to NKS 31.03.2022

- may be shared and used by relevant target groups (*f.ex.* Nordic RAD and SAR authorities) but not yet available online at nks.org

- Will be evaluated and revised as part of the follow-up NKS-B project RNSARCARDS. Will thereafter be available for all at nks.org.

"It is our intention that the RNSARBOOK should be an online resource which is revised based on experiences from its use, including following its intended use for the large EU-funded Arctic Radiation Exercise in the High North (ARCTIC REIHN 22)."



RNSARBOOK – some final thoughts

- We find the cooperation between Nordic RAD and SAR authorities enabled through this NKS-project very valuable and hopefully something we will benefit from and build on for years to come.

- We find the NKS cooperation and funding scheme a unique, efficient and robust mechanism to strengthen Nordic cooperation and gain important new knowledge and to the best of all.

Thank you for building this highly relevant forum and for the support to this project.

Fotos: Håkon Kjøllmoen / KV Svalbard*

Thank you for your attention!

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RNSARBOOK

«Painting black swans grey» - RNSARBOOK

Picture from the 2020 Copenhagen-meeting.