
RNSARCARDS, Nordic Action Cards for Maritime RNSAR

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Abstract

The RNSARCARDS action cards are meant to be used for coordinating search and rescue in a maritime radiological / nuclear emergency. The aim is to establish a common operational picture between the on duty RAD authority and the Search and Rescue Mission Coordinator (SMC) as quickly as possible to conduct an effective rescue operation. The action cards give operational guidance for the SMC and provide a checklist of the most relevant RN specific questions in order to conduct risk assessment and start appropriate actions.

RNSARCARDS are created based on the standard operating procedures described in the Nordic handbook for search and rescue in a maritime radiological / nuclear emergency (RNSARBOOK). RNSARCARDS are aimed to be used as a template for creating national procedures.

Key words

maritime search and rescue, radiological and nuclear emergency, emergency response, Nordic, action cards, guidelines, standard operational procedure

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ACTION CARDS FOR MARITIME RNSAR

RNSARCARDS



These action cards are meant to be used for coordinating search and rescue in a maritime radiological / nuclear emergency. The aim is to establish a common operational picture between the on duty RAD authority and the Search and Rescue Mission Coordinator (SMC) as quickly as possible to conduct an effective rescue operation. The action cards give operational guidance for the SMC and provide a checklist of the most relevant RN specific questions in order to conduct risk assessment and start appropriate actions.

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AWARENESS STAGE

Initial communication

Questions for initial assessment

- Name and call sign (or ship station identity)
- Position (lat/long)
- Nature of the emergency?
- Type of assistance needed?
- What type of vessel (nuclear propelled/cargo)?
 - Further information gathering for NPV -> page 4
 - Further information gathering for cargo -> page 5
- How many people on board?
- Is there a danger of radioactive/nuclear material or reactor being compromised?
- Is there a danger of losing propulsion?
- Weather conditions? Will they affect the RN situation?
- Do you have any equipment on board to deal with the emergency?

In case of MAYDAY and risk of radiation, include maritime safety information or restricted area for vessels in the MAYDAY RELAY.

! The common measuring unit of radiation is Sievert (Sv). Note down the unit and dose rate and communicate it to the RAD authority.

Sievert per hour (Sv/h)	MilliSievert per hour (mSv/h)	MicroSievert per hour (µSv/h)
1 Sv/h	= 1000 mSv/h	= 1'000'000 µSv/h

Other units that may be mentioned:

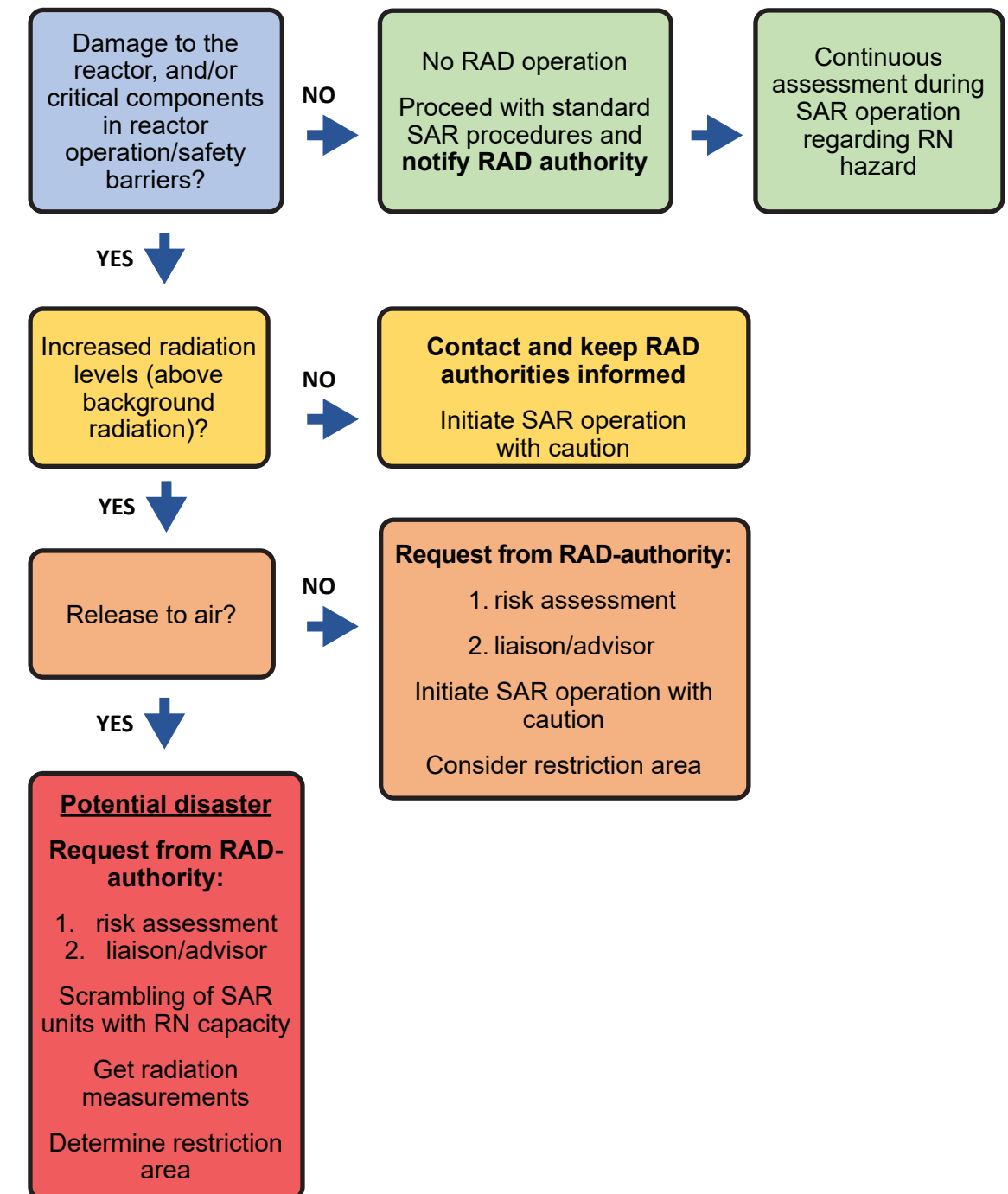
SI unit	US equivalent
1 Sievert (Sv)	100 Röntgen equivalent man (rem)
1 Gray (Gy)	1 000 rad (rad)
1 Becquerel (Bq)	2,703 x 10 ⁻¹¹ Curie (Ci)

Information gathering for nuclear propelled vessel

The RAD authority will need this information to make a risk assessment.

<input type="checkbox"/>	Reactor integrity/damage <ul style="list-style-type: none"> Is the reactor stable? Are the reactor cooling systems working properly? Are the back-up safety systems working properly? <p>! If there is any damage to the reactor, there is a RISK of reactor meltdown and release of radionuclides to the surrounding environment.</p>
<input type="checkbox"/>	Is there radioactive release? If yes: <ul style="list-style-type: none"> Start and stop time of release (UTC)? Is the release on-going? Position of the ship when the release occurred? If no: <ul style="list-style-type: none"> Is release expected?
<input type="checkbox"/>	Increased radiation levels? If yes, ask next question.
<input type="checkbox"/>	Level of radiation <ul style="list-style-type: none"> Number and unit -> Always spell out the unit of measurement! e.g. 1 microsievert per hour Time of the measurement (UTC)
<input type="checkbox"/>	Location of the reactor on board
<input type="checkbox"/>	Have you put RN Personal Protective Equipment on? <ul style="list-style-type: none"> How long is it safe for you to stay on board with the equipment you have? Have you taken any measures to protect persons on board?

For nuclear propelled vessel



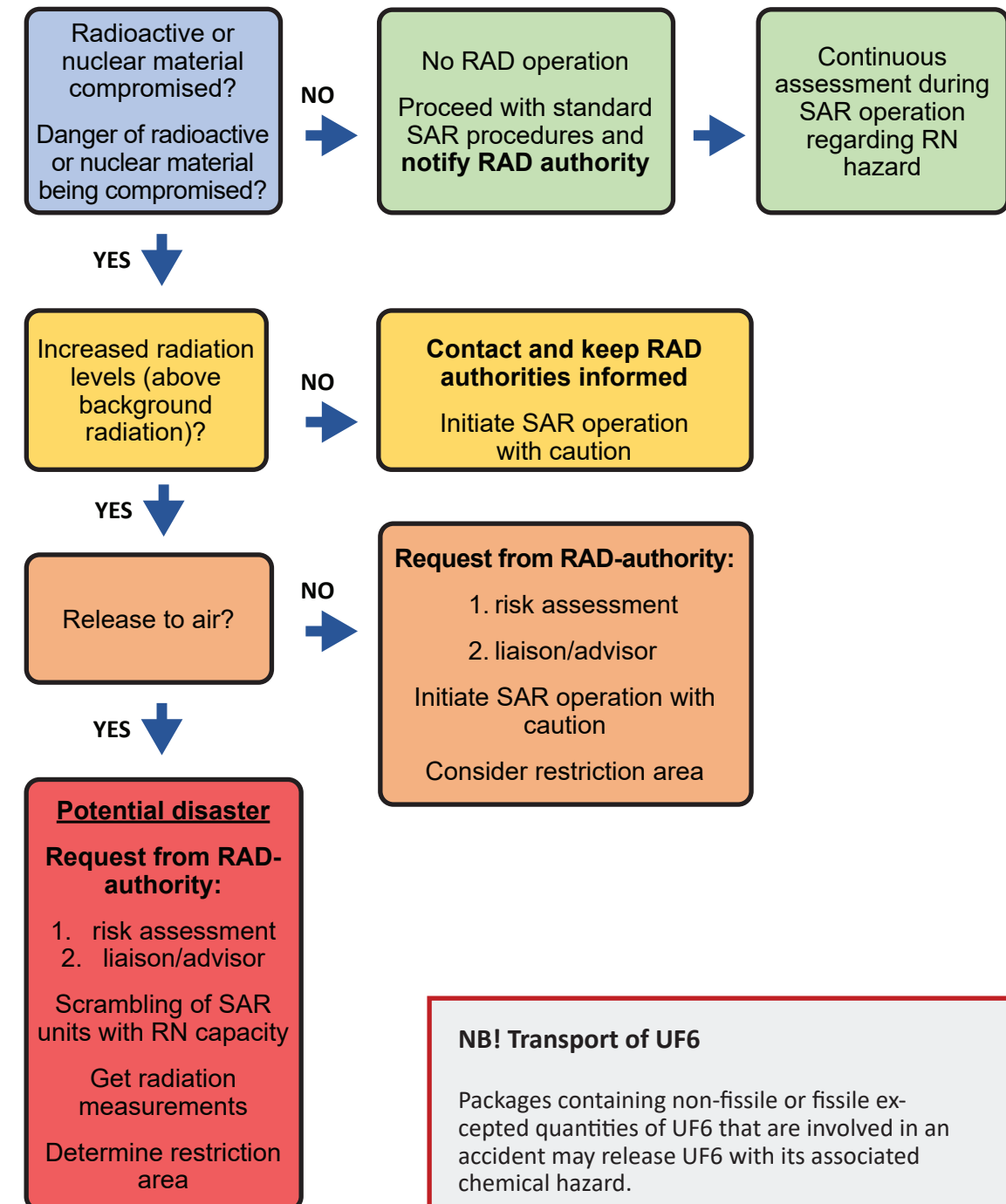
Information gathering for vessels transporting radioactive material

The RAD authority will need this information to make a risk assessment.

<input type="checkbox"/>	UN number / Package type (see table below for reference)
<input type="checkbox"/>	Specifications of RN material: <ul style="list-style-type: none"> Name of RN material? Activity levels (in Becquerel or Curie)? Weight?
<input type="checkbox"/>	Increased radiation levels? If yes, ask next question.
<input type="checkbox"/>	Level of radiation <ul style="list-style-type: none"> Number and unit -> Always spell out the unit of measurement! e.g. 1 microsievert per hour Distance from measurement probe to radiation source? Time of the measurement (UTC)?
<input type="checkbox"/>	Is RN material compromised / danger of being compromised?
<input type="checkbox"/>	Is there danger of release to air?
<input type="checkbox"/>	Location of RN material on board?
<input type="checkbox"/>	Have you put RN Personal Protective Equipment on? <ul style="list-style-type: none"> How long is it safe for you to stay on board with the equipment you have? Have you taken any measures to protect persons on board?

UN number marking	Other/package type	Hazard
2908, 2909, 2910, 2911	None	Non hazardous Exposure: Very low Contamination: Insignificant
2912, 2913, 3321, 3322, 3324, 3325, 3326	Type IP-1, Type IP-2, LSA, SCO	Possibly hazardous if inhaled or ingested Exposure: Very low Contamination: Possible
2915, 3327, 3332, 3333	Type A	Possibly hazardous Exposure: Medium – High (Type A), High (Type B + C) Contamination: Possible
2916, 2917, 3328, 3329	Type B	
3323, 3330	Type C	
2977, 2978	UF6 package	Hazardous – especially if exposed to water Exposure: High Contamination: Possible

For vessels transporting radioactive material



NB! Transport of UF6

Packages containing non-fissile or fissile excepted quantities of UF6 that are involved in an accident may release UF6 with its associated chemical hazard.

The main hazard of UF6 to persons is when exposed to water. HF will form, which is very corrosive and poisonous.

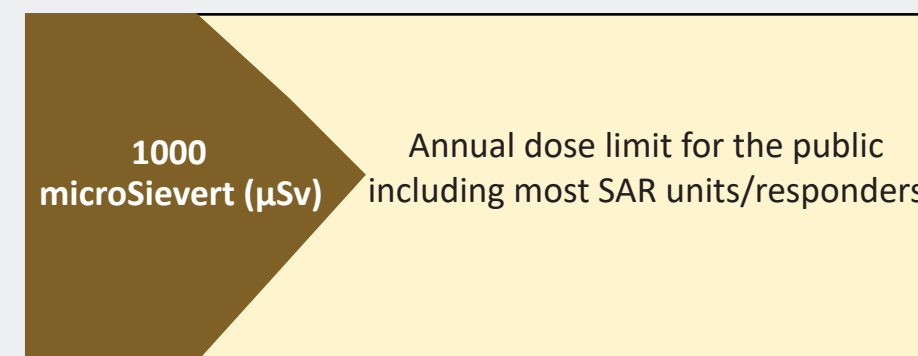
INITIAL ACTION STAGE

Even if risk of release to air, it is possible to start a SAR operation and deploy SAR units for possible evacuation operation in cold zone.

Initial actions:	
<input type="checkbox"/>	Contact and maintain close liaison with national RAD authority
<input type="checkbox"/>	Notify other emergency authorities/stakeholders <ul style="list-style-type: none"> E.g. Health services, fire and rescue services, police, MET office, voluntary organizations, coastal authorities, military, environmental agency, ship owner, etc.
<input type="checkbox"/>	Find asset that can measure radiation on-scene
<input type="checkbox"/>	Inform, alert or dispatch SAR units <ul style="list-style-type: none"> ! Saving lives has the highest priority. Which SAR units have RAD measurement capacities? Check page 15. If radiation levels are expected to be higher than 1000 microsievert for SAR unit, prepare additional crew.
<input type="checkbox"/>	Consider establishing restriction area for vessels and aircraft <ul style="list-style-type: none"> Contact VTS and ATS ! Whenever radiation, even if no risk of release to air: <ul style="list-style-type: none"> → Establish immediate restriction area of 0.1 nautical mile, including NO-FLY zone for all vessels and aircraft Broadcast maritime safety information to other vessels
<input type="checkbox"/>	Consider notifying adjacent RCCs or RSCs <ul style="list-style-type: none"> Consider the need for additional SAR resources or RN equipment from other countries, e.g. MIRG teams If the incident is bordering to or the weather conditions may push release towards neighbouring SAR regions
<input type="checkbox"/>	Start considering areas for decontamination

! Dose rates dictate how long SAR units or other people may stay near the vessel before total received dose exceeds threshold levels.

→ For example: if the distress vessel reports measurements of 10 microSievert per hour ($\mu\text{Sv/h}$), one can stay in the area for 100 hours before 1000 microSievert is received.



! Avoid exposure of SRU personnel above limits and avoid contamination of helicopter.

! Pre-determined safety zones. Need real-time measurements on-scene.

	Cold zone	Warm zone	Hot zone
Dose rate	0,2 – 0,8 Microsievert per hour ($\mu\text{Sv/h}$)	0,8 – 100 Microsievert per hour ($\mu\text{Sv/h}$)	>100 Microsievert per hour ($\mu\text{Sv/h}$)
Maximum hours of exposure allowed	Unlimited, background radiation	1250 hours (0,8 $\mu\text{Sv/h}$) - 10 hours (100 $\mu\text{Sv/h}$)	Less than 10 hours

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PLANNING STAGE

Action points:

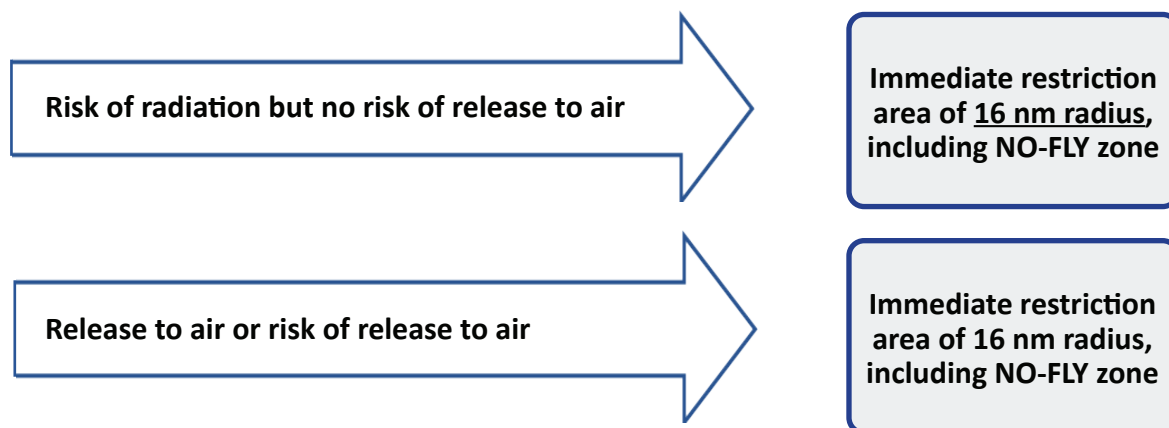
- ! Planning should be based on actual on-site measurements and prognosis -> set limits for warm and hot zone based on this!
- ! SAR units conducting monitoring and measurement tasks must have the appropriate Personal Protective Equipment and have adequate training in measuring radioactivity

<input type="checkbox"/>	Assess risk, possible rescue procedures, and monitoring plan together with the RAD authority <ul style="list-style-type: none"> ○ Request dispersion models ○ Request assessment of worst-case scenario
<input type="checkbox"/>	Report all values from on-site measurements, including low ones
<input type="checkbox"/>	Ask RAD authority to define safety zones <ul style="list-style-type: none"> ○ Safe direction to approach, route, and continuous monitoring of the hot zone
<input type="checkbox"/>	Assess need for evacuation
<input type="checkbox"/>	Ask to make the vessel ready for emergency towing
<input type="checkbox"/>	Remind SAR units about iodine tablets
<input type="checkbox"/>	Continuous contact with other agencies
<input type="checkbox"/>	Getting overview of injured/contaminated people, their location on the ship
<input type="checkbox"/>	Replacement of personnel, materials, and equipment <ul style="list-style-type: none"> ! Consider decontamination of personnel and equipment

Determination of restriction area

1. Determine an immediate restriction area for all vessels and aircraft where access can be granted by SMC/OSC.
2. Inform maritime traffic about the restriction area.
3. Inform relevant authorities of warnings and access to the restriction area.

Pre-planned restriction areas for RN-incidents¹:

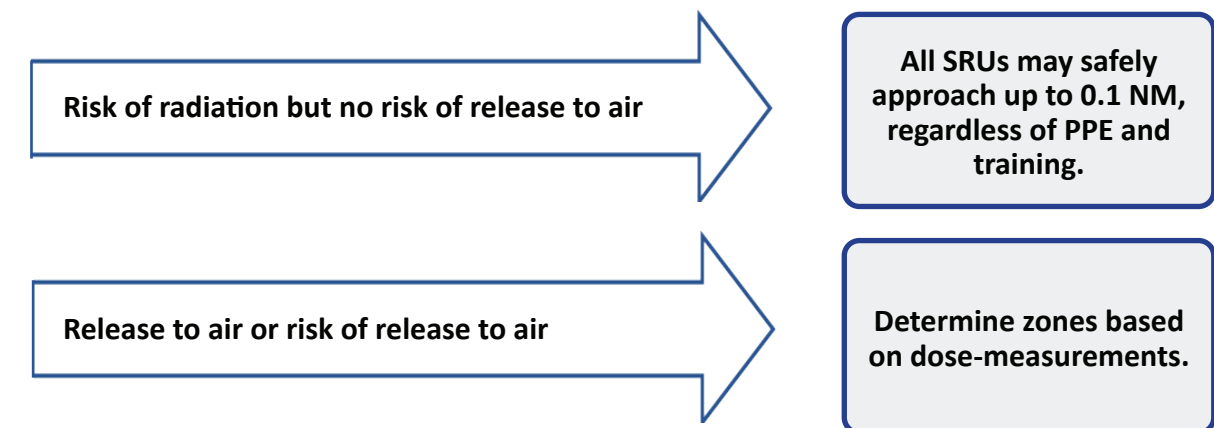


4. The immediate restriction area should be adjusted after consulting the RAD – authorities.

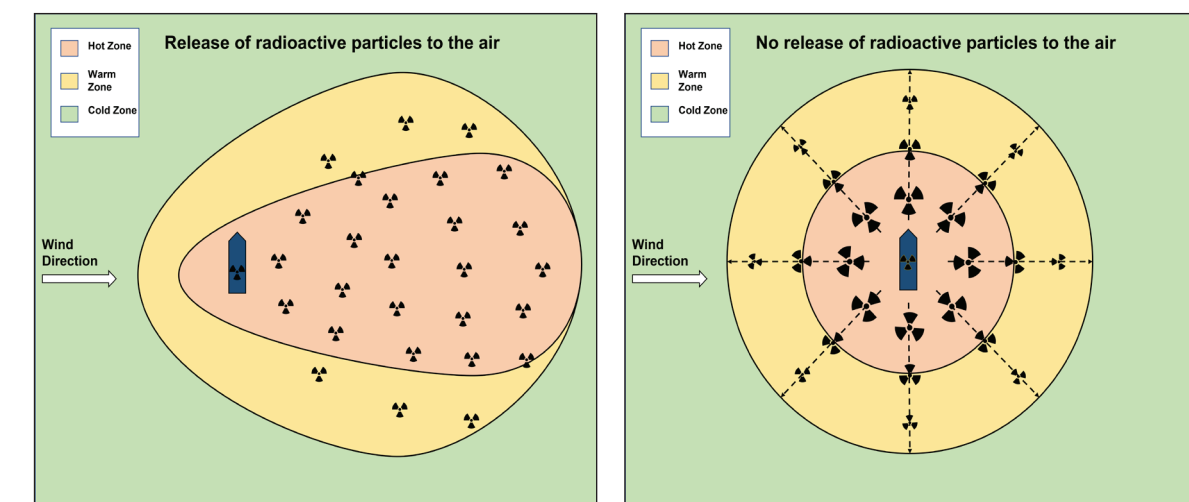
¹ Based on NATO-standard ATP-45 Edition F Version 2, March 2020, in accordance with IAEA recommendations

Determining safety zones / area of SAR action

Real-time dose rate measurements must be done on-scene to determine radiation safety zones:



	Cold zone	Warm zone	Hot zone
Dose rate	0,2 – 0,8 Microsievert per hour ($\mu\text{Sv/h}$)	0,8 – 100 Microsievert per hour ($\mu\text{Sv/h}$)	>100 Microsievert per hour ($\mu\text{Sv/h}$)
Maximum hours of exposure allowed	Unlimited, background radiation	1250 hours (0,8 $\mu\text{Sv/h}$) - 10 hours (100 $\mu\text{Sv/h}$)	Less than 10 hours



OPERATIONS STAGE

Resources and SRUs (as reminder)	<p>Consider and assess the full/limited capabilities of the resources on-site:</p> <ul style="list-style-type: none"> Capacity for RN detection and monitoring Capacity for decontamination and first aid / emergency medical care Available personal protective equipment, response equipment Consider tasks within/outside the restriction area Limitations for helicopter if contaminated Ability to monitor and maintain SRU own safety is crucial <p>Consult SAR units and teams/OSC about:</p> <ul style="list-style-type: none"> Personal protective equipment Detection and measurement equipment Decontamination procedures Onboard plan and tasks
On-scene operations	<p>Continuous radiation measurements on site</p> <ul style="list-style-type: none"> Keep dialogue with RAD authorities <p>Consider evacuation to lifeboats in order to get further away from the vessel, upwind if release to air.</p> <p>Entry and exit points to warm and hot zone</p> <ul style="list-style-type: none"> Record entry and exit times of SRUs Remind SRUs of monitoring maximum exposure times and doses <p>Consider executing emergency towing to avoid plume, shore, hazard, or populated area.</p>

Planning for decontamination

Decontamination procedures are only to be activated when there is a release to air or risk of release to air.

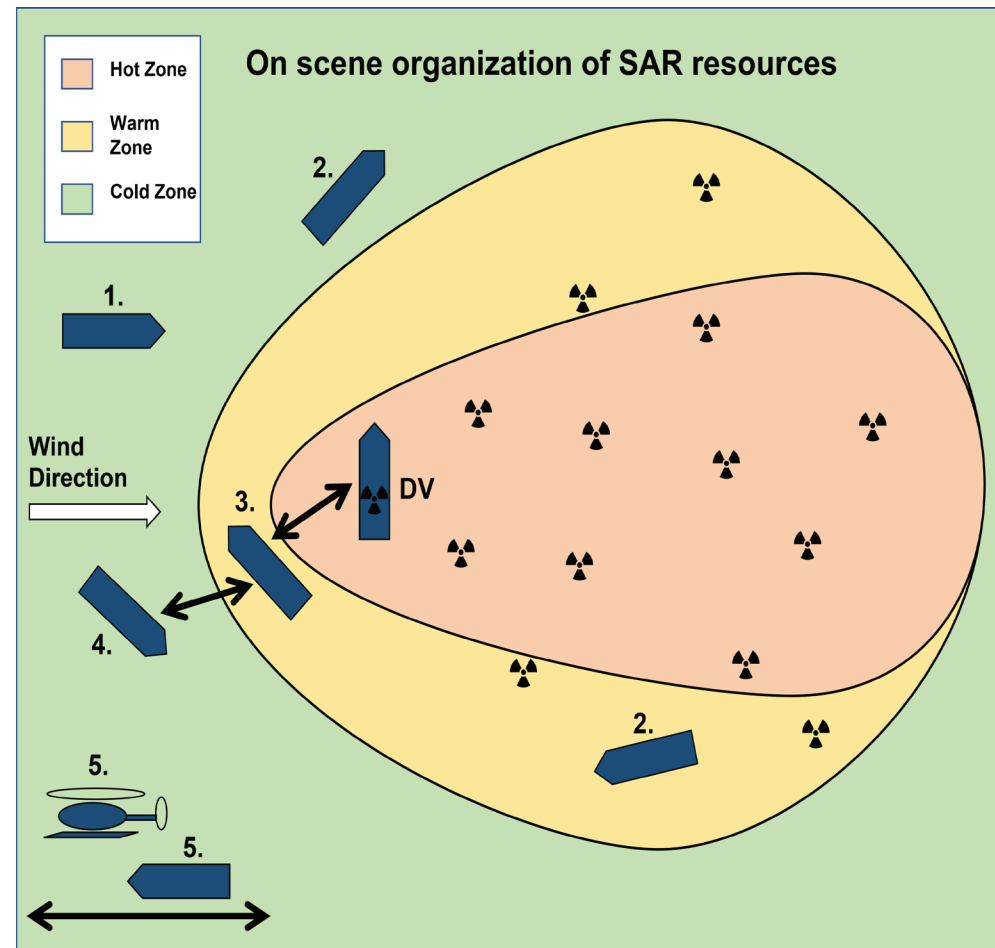
Step 1

Emergency decontamination	<p>! Lifesaving medical measures will have priority over emergency decontamination. Victims can be transported without passing through the emergency decontamination station if the condition of the patient requires expedited measures that only can be provided in another location.</p> <ul style="list-style-type: none"> Establish an area on land or designate vessel with the capabilities to conduct decontamination <ul style="list-style-type: none"> Location: in proximity of the vessel in distress outside the hot zone. Position: Upwind. Facilities: easy access to hot zone, fresh water supply, adequate PPE, capacity to provide clean transition to cold zone If this is not possible, other options are to hose people with water, dip in the sea, wrap them in a blanket before transport.
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Step 2

Decontamination of SRUs (for information)	<ul style="list-style-type: none"> SRUs, including personnel, vehicles and equipment are to be decontaminated as soon as possible. Especially if they need to be used in the operation for a long time or if needed for other missions. Decontamination procedures should be arranged following the advice of the competent national radiation authority. <p>! Facilities to handle contaminated materials/equipment must be prepared offshore and onshore asap or before the SRUs return to land.</p>
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Possible organization of on-scene operations/decontamination in a situation with a risk of release of radioactive material to air (contamination risk):



Possible tasks for SAR assets while decontaminating

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)

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Helpful tools and tables

Overview of the national agencies and organizations with RN capacity - template

This table is meant as a template for the national SAR and RAD authorities to fill in. Dedicate a responsible authority to update the table annually.

Supporting Radiation Safety Authority	<i>Insert contact information here</i>		
--	--	--	--

Organizations with radiation measuring capacity		
Organization	Asset	Contact
<i>Insert list of organizations here</i>	<i>Insert list of assets here</i>	<i>Insert contact information here</i>

List of organization with the capability and Personal Protective Equipment to respond			
With release		No release	
Organization	Capability/PPE	Organization	Capability/PPE
<i>Insert list of organizations here</i>	<i>Insert which capability/PPE</i>	<i>Insert list of organizations here</i>	<i>Insert which capability/PPE</i>

Decontamination support	
Organization	Capability/location
<i>Insert list of organizations here</i>	<i>Insert which capability/location</i>

An overview of the health effects of radiation

LOW RADIATION DOSES		4-5 mSv	Annual average dose for the general population (including SRUs) originating from "natural radiation" as ionizing radiation of natural, terrestrial, or cosmic origin	Low radiation doses (under 100 mSv) do not pose an acute danger to living organisms and developing further sickness has a low probability
		1 mSv	Annual dose limit for the general population (including SRUs) in addition to natural radiation levels.	
		20 mSv	Annual dose limit for occupationally exposed workers.	
		≥ 50 mSv	Only for informed, voluntary personnel in life saving work and disaster mitigation (applicable in some Nordic countries).	
MODERATE RADIATION DOSES		≥ 100 mSv	Increased statistical chance for developing cancer as well as heart and lung problems at a later stage. Damage to a fetus can occur. Only for informed, voluntary personnel in life saving work and disaster mitigation (applicable in the EU and some Nordic countries)	Moderate doses of radiation (100 mSv – 1 Sv), can have effects at the cellular level. These effects do not cause further sickness necessarily; however, cancer and foster damage can occur.
		150 mSv	Temporary sterility in men	
		500 mSv	Small changes in blood. In exceptional cases a dose ≥ 500 mSv can be allowed. With doses higher than 500 mSv acute radiation symptoms could occur.	
HIGH RADIATION DOSES		> 1 Sv	Serious health repercussions	High doses of radiation (> 1–2 Sv) can cause acute life-threatening sickness (starting with acute radiation syndrome). Possible symptoms include nausea, diarrhoea, headache, fever, dizziness, weakness, and hair loss. With very high exposure during a short period, symptoms can develop in a matter of minutes.
		2 Sv	Lowest acute deadly dose. Nausea, erythema, low blood pressure	
		4 Sv	50% chance of survival	
		10 Sv	Not possible to survive	

Reference: RNSARBOOK

International alarming procedures for radiation authorities

RAD
<p>It is the responsibility of National Competent Authority (usually under RAD authority) to contact and alert international organizations, neighboring countries and resources related to radiological issues.</p> <ul style="list-style-type: none">▪ Alert IAEA via USIE▪ Alert EU via ECURIE▪ Request assistance via IAEA RANET mechanism²<ul style="list-style-type: none">○ RANET offers assistance with field assistance teams and external based support for radiation survey activities such as: measuring dose rates, fallout prognosis, establishing contamination levels, etc.○ Assessment and evaluation of radiological consequences of a perceived threat or actual incident or emergency and its possible evolution can be requested through RANET.▪ Request assistance via EU Civil Protection Mechanism³<ul style="list-style-type: none">○ Following a request for assistance through the Mechanism, the Emergency Response Coordination Centre (ERCC) mobilises assistance or expertise.○ The ERCC ensures rapid deployment of emergency support through a direct link with national civil protection authorities.○ Specialised teams and equipment can be mobilised at short notice for deployments inside and outside of Europe.○ Can be mobilized within few hours.

² Source: <https://www.iaea.org/services/networks/ranet>

³ Source: https://civil-protection-humanitarian-aid.ec.europa.eu/what/civil-protection/eu-civil-protection-mechanism_en

Example reporting template for dose rate

Date	Time (UTC)	Latitude	Longitude	Name of location	Dose rate Value	Unit
23-04-2017	09:25	Xx*xx*xx	Xx*xx*xx	Enter name	988	µSV/h

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Disclaimer:

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