

REPPIR Consequence Report

SITE	SELLAFIELD
BUILDING NUMBER	VARIOUS
PLANT	SELLAFIELD SITE

Documentation

DOCUMENT No.	S&R-MSC(2019)020
REVISION NUMBER	1.1
TITLE	Consequence Report to Meet the Requirements of the Radiation (Emergency Preparedness & Public Information) Regulations [REPPIR] 2019 – Regulation 7
DATE	02/10/2019

Introduction

This Consequence Report has been prepared to meet the requirements of the Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPPIR) for compliance with Regulation 7. The Consequence Report will be provided to the local authority (Cumbria County Council) and to the regulator (Office for Nuclear Regulation). It sets out the technical justification for the minimum geographical extent for detailed emergency planning around the Sellafield nuclear licensed site.

REPPPIR Regulation 4 requires the operator, Sellafield Ltd, to conduct a hazard evaluation of fault scenarios which could cause a radiation emergency (as defined in REPPPIR Regulation 2). REPPPIR Regulation 5 requires a consequence assessment to be undertaken which considers a full range of radiation emergencies, for the purpose of determining the severity of potential impacts and recommending the minimum geographic distances for detailed and outline emergency planning.

Part 1 – Factual Information

The name and address of the operator:

Sellafield Limited
Hinton House
Birchwood Park Avenue
Risley
Warrington
WA3 6GR

Company Registration No 1002607

The Postal address of the premises where the radioactive substance will be processed, manufactured, used or stored, or where the facilities for processing, manufacture, use or storage exist:

Sellafield Ltd
Seascale
Cumbria
CA20 1PG

The date on which it is anticipated that the work with ionising radiation will commence or, if it has already commenced, a statement to that effect:

The Sellafield site has been carrying out nuclear operations since 1951 and continues to work with ionising radiation which could give rise to a radiation emergency.

The site's principal activities are nuclear fuel reprocessing, decommissioning and the operation of a number of waste storage facilities. The quantities of radioactive material present on the Sellafield site exceed the quantities of the relevant materials identified in REPPPIR Schedules 1 and 2.

2. Basis for recommended protective action distances

- a. A hazard evaluation has been undertaken to meet REPIR Regulation 4 that evaluates all hazards arising from the work undertaken which have the potential to cause a radiation emergency. A consequence assessment has been undertaken to meet REPIR Regulation 5 that considers a suitable and sufficient range of selected hazard scenarios.
- b. The consequence assessment has generated distances for emergency protective actions (sheltering, evacuation, stable iodine and food restrictions) for 10 aerial release hazard scenarios in relation to detailed planning. The aerial release assessments have been undertaken using the PACE modelling software developed by Public Health England.
- c. Three age groups have been considered: adult, 10y child and 1y infant. Doses to the foetus and breast-fed infant have not been assessed because the relevant hazard scenario radionuclides do not produce limiting doses in these cases.
- d. The consequence assessment considers aerial releases from the geographic site centre (NY029038). The minimum perimeter distance is approximately 500 m from the site centre.
- e. For the most significant hazard scenarios (those that require off-site sheltering at or beyond 500 m), the advanced NAME atmospheric dispersion model has been used in conjunction with probabilistic analysis of historical weather. A simple Gaussian dispersion model has been used for less significant hazard scenarios. The shelter and evacuate distances for pessimistic weather represent the 95th percentile of results based on historical weather variations.
- f. For compliance with Regulation 5 and Schedule 3, the recommended minimum distances are based on averting dose at the lower Emergency Reference Level advised by Public Health England¹. Urgent protective actions (shelter, evacuate and iodine) have been determined using the dose received from all exposure pathways over the two days following the start of the release.
- g. The following environmental pathways for radiation exposure have been considered:
 - inhalation of airborne material;
 - direct radiation from the aerial plume;
 - direct radiation from ground deposited material;
 - direct radiation from the on-site source;
 - inhalation of material resuspended from ground to air; and
 - ingestion of contaminated food.

Direct radiation from on-site sources is considered for the criticality hazard scenario and the direct radiation hazard scenario (for example, a leak of active liquor). An aerial release of gaseous fission products has also been assessed for the criticality hazard scenario.

- h. The consequence assessment assumes a 1 hour time delay before implementation of sheltering and a 2 hour time delay before implementation of

¹ Public Health Protection in Radiation Emergencies, PHE-CRCE-049, 2019.

evacuation. For example, sheltering after a 1 hour delay will avert the lower Emergency Reference Level dose at the recommended distance of 5.3 km.

However, it is important to note that the emergency arrangements will be capable of implementing protection actions in a shorter timeframe. This may include precautionary sheltering and evacuation before the start of a radiation emergency.

- i. There are other potential events (for example, non-nuclear hazards) that may require an emergency response, or could be perceived as a radiological hazard, but would not lead to a release of radiation on or off the site. These events would be classified by an appropriate emergency declaration state (for example, Operational Alert, Site Incident) – any necessary public reassurance requirements are included in the arrangements for the level of response.

Part 2 & Part 3 – Recommendations & Rationale

- 3. A distance of 5.3 km is recommended for the minimum geographical extent for detailed emergency planning around the Sellafield nuclear licensed site. This distance relates to the Seismic Release hazard scenario and is bounding for the full range of hazard scenarios, age groups and weather conditions considered by the consequence assessment. The full set of recommendations for detailed planning and their supporting rationale are detailed below.

URGENT PROTECTIVE ACTION – SHELTER			
Scenario	Distance ²		Time to implement
	Average Weather	Pessimistic Weather	
Seismic Release ³	2.7 km	5.3 km	Within 1 hour
Pipebridge Leak	0.3 km	0.7 km	
Stack Release	0.4 km	1.0 km	
Pond Release	0.1 km	0.5 km	
Recommendation:	5.3 km		Within 1 hour

Rationale:	<p>The sheltering distance for the Seismic Release is bounding for the full range of hazard scenarios, age groups and weather conditions considered by the consequence assessment.</p> <p>In this case, the aerial release occurs without warning and primarily presents an inhalation dose hazard.</p> <p>Sheltering is advised in all directions around the site.</p> <p>Precautionary sheltering may be possible for other scenarios.</p> <p>The upper Emergency Reference Level dose (30 mSv) is not recommended for detailed emergency planning, but for information, the Seismic Release scenario produces a shelter distance that does not extend off-site in average weather and is 0.7 km in pessimistic weather.</p>
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² Distance required to avert dose at the lower Emergency Reference Level (3 mSv).

³ Distance based on 1 in 1000 year earthquake.

URGENT PROTECTIVE ACTION – EVACUATE			
Scenario	Distance ⁴		Time to implement
	Average Weather	Pessimistic Weather	
Seismic Release	0.8 km	1.8 km	Within 2 hours
Recommendation:	1.8 km		Within 2 hours
Rationale:	<p>The Seismic Release is the only hazard scenario that requires public evacuation.</p> <p>The recommended distance provides protection for the full range of age groups and weather conditions considered by the consequence assessment.</p> <p>Evacuation should be sector-specific and implemented in a phased and controlled manner to avoid unnecessary inhalation dose exposure.</p> <p>Precautionary evacuation of sectors outside the plume should be considered if they are at risk from wind direction changes.</p> <p>The upper Emergency Reference Level dose (300 mSv) is not recommended for detailed emergency planning, but for information, the Seismic Release scenario produces an evacuate distance that does not extend off-site even in pessimistic weather.</p>		

⁴ Distance required to avert dose the lower Emergency Reference Level (30 mSv).

URGENT PROTECTIVE ACTION – IODINE		
	Distance	Time to implement
Recommendation:	0 km	N/A
Rationale:	There are no detailed planning hazard scenarios that require an iodine protective action. The only scenario that produces iodine is a gaseous fission product release due to a criticality accident. In this case, the iodine distance is zero for the full range of age groups and weather conditions considered by the consequence assessment. A protective action for iodine is therefore not recommended.	

URGENT PROTECTIVE ACTION – CRITICALITY		
Scenario	Distance	Time to implement
Repeating Criticality	250 m section of road C4037	Within 1 hour
Recommendation:	Evacuation	Within 1 hour
Rationale:	In the event of a criticality event occurring, to mitigate the risk from a repeating criticality hazard, the recommended emergency response is exclusion of transient members of the public from the 250 m section of road C4037, to avert dose at the lower Emergency Reference Level by evacuation (30 mSv).	

URGENT PROTECTIVE ACTION – DIRECT RADIATION		
	Distance	Time to implement
Recommendation:	0 km	N/A

Rationale:	There are no detailed planning hazard scenarios for direct radiation from an on-site source (for example, a leak of active liquor) that would lead to an off-site dose of 1 mSv.
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NON-URGENT PROTECTIVE ACTION – FOOD RESTRICTION				
Scenario	Distance ⁵			
	Milk		Green Vegetables	
	Average Weather	Pessimistic Weather	Average Weather	Pessimistic Weather
Seismic Release	0 km	0 km	5.8 km	21.9 km
Retrievals Fire	0.9 km	5.7 km	2.0 km	16.1 km
Pipebridge Leak	0.6 km	2.9 km	5.3 km	16.6 km
Stack Release	13.8 km	72.5 km	64.5 km	137.5 km
Criticality Gaseous	0 km	0 km	3.9 km	7.6 km
Cooling Tower	0 km	0.4 km	0.7 km	5.2 km
Waste Storage Fire	2.6 km	8.0 km	14.1 km	23.6 km
Ventilation Leak	0.4 km	2.2 km	2.0 km	15.1 km
Pond Release	0.1 km	0.5 km	0.8 km	3.3 km
Loss of Cooling	0 km	0 km	0.2 km	1.2 km
Recommendation:	72.5 km		137.5 km	
Rationale:	<p>The food restriction distances for the Stack Release are bounding for the full range of hazard scenarios and weather conditions considered by the consequence assessment.</p> <p>For all other scenarios, the 50 km outline planning distance is bounding for food restrictions.</p> <p>The time required to implement food restrictions is advised during an event by the Food Standards Agency.</p> <p>Water restrictions are advised during an event by the Environment Agency.</p>			

⁵ Distance required to restrict food at the Maximum Permitted Level advised by Public Health England in PHE-CRCE-049, 2019.

4. The following recommendations are made for outline planning:

OUTLINE PLANNING ZONE	
Recommendation:	50 km
Rationale:	In accordance with Schedule 5, the Sellafield site is a Category 1 facility, involved in the processing of High Level Waste or storing in excess of 100 tonnes of Plutonium. As such, the 50 km distance for outline planning is applicable.