REPPIR Consequence Report 2022

SITE	SELLAFIELD
BUILDING NUMBER	VARIOUS
PLANT	SELLAFIELD SITE

DOCUMENTATION

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REVISION NUMBER	1.0
TITLE	Consequence Report to Meet the Requirements of the Radiation (Emergency Preparedness & Public Information) Regulations [REPPIR] 2019 – Regulation 7
DATE	07/10/2022

Introduction

This Consequence Report has been prepared to meet the requirements of the Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPIR) 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.

REPPIR Regulation 4 requires the operator, Sellafield Ltd, to conduct a hazard evaluation of fault scenarios which could cause a radiation emergency (as defined in REPPIR Regulation 2). REPPIR 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

1.

a. The name and address of the operator:

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

Company Registration No 1002607.

b. 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.

c. 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 REPPIR Schedules 1 and 2.

2. Basis for recommended protective action distances

a. A hazard evaluation has been undertaken to meet REPPIR 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 REPPIR 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 9 aerial release hazard scenarios in relation to detailed planning.

c. All aerial release assessments have been undertaken using the PACE modelling software developed by the UK Health Security Agency, the advanced NAME atmospheric dispersion model developed by the UK Met Office and the probabilistic analysis of historical weather. The shelter and evacuate distances for pessimistic weather represent the 95th percentile of results based on historical weather variations.

d. 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.

e. The consequence assessment considers aerial releases from the geographic site centre (NY029038). The minimum perimeter distance is approximately 500 m from the site centre.

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 the UK Health Security Agency[1]. 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 foodstuffs.

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 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

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

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
Stack Release	1.0 km	2.0 km	
Pond Release	0.1 km	0.5 km	
Recommendation:	5.3 km		Within 1 hour
Rationale:	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. In this case, the aerial release occurs without warning and primarily presents an inhalation dose hazard. Sheltering is advised in all directions around the site. Precautionary sheltering may be possible for other scenarios. 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.		

[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:	The Seismic Release is the only hazard scenario that requires public evacuation. The recommended distance provides protection for the full range of age groups and weather conditions considered by the consequence assessment. Evacuation should be sector-specific and implemented in a phased and controlled manner to avoid unnecessary inhalation dose exposure. Precautionary evacuation of sectors outside the plume should be considered if they are at risk from wind direction changes. 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.		

[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:	Shelter and exclude	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 to shelter and exclude members of the public from entering the area around the site likely to be affected (the 250 m section of road C4037), to avert dose at the lower Emergency Reference Level by sheltering (3 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.	

LONGER-TERM PROTECTIVE ACTION – FOOD RESTRICTION				
Scenario	**Distance [5]**			
	Milk		**Green Vegetables**	
	Average Weather	**Pessimistic Weather**	**Average Weather**	**Pessimistic Weather**
Seismic Release	0 km	0 km	6.7 km	22.9 km
Retrievals Fire	13.5 km	78 km	52.2 km	116.2 km
Pipebridge Leak	0.2 km	1.3 km	2.6 km	7.7 km
Stack Release	12.7 km	74.1 km	78.4 km	186.7 km
Criticality Gaseous	0 km	0 km	2.6 km	4.6 km
Waste Storage Fire	2.6 km	8.0 km	14.1 km	23.6 km
Ventilation Leak	0.1 km	0.7 km	2.5 km	11.3 km
Pond Release	0.1 km	0.5 km	0.8 km	3.3 km
Loss of Cooling	0 km	0 km	6.1 km	15.1 km
Recommendation:	78 km		186.7 km	
Rationale:	The milk restriction distance for the Retrievals Fire and green vegetables restriction distance for the Stack Release are bounding for the full range of hazard scenarios and weather conditions considered by the consequence assessment. For all other scenarios, the 50 km outline planning distance is bounding for food restrictions. The time required to implement food restrictions is advised during an event by the Food Standards Agency. Water restrictions are advised during an event by the Environment Agency.			

[5] Distance required to restrict food at the Maximum Permitted Level advised by the UK Health Security Agency in PHE-CRCE-049, 2019.

4. The following recommendations are made for outline planning:

OUTLINE PLANNING ZONE	
Set by Regulation:	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.

5. Summary of changes between the 2019 and 2022

a. The overall effect of changes between 2019 and 2022 is relatively limited.

b. The list of release scenarios remains the same as 2019 with one exception – the Cooling Tower release is no longer relevant to detailing emergency planning so is not presented in the Consequence Report.

c. The source term data used to characterise the type and amount of material released is very similar to 2019 with most scenarios either staying the same or featuring relatively minor changes.

d. The Seismic Release continues to be the most important scenario for informing detailed emergency planning arrangements and produces nearly identical outputs to 2019.

e. The technical distance recommended by Sellafield Ltd to the local authority for informing the geographic extent of detailed emergency planning remains at 5.3 km for sheltering and 1.8 km for evacuation.

f. The Stack Release continues to be ranked second by shelter distance but has moderately increased, the Pond Release is ranked third but its shelter distance remains unchanged, and the Pipebridge Leak shelter distance now falls within the site boundary so is not presented in the Consequence Report.

g. Longer-term protective action distances for milk and green vegetables have changed moderately due to source term revisions.