



# Hunterston B Power Station

## Hunterston B Power Station REPPIR Consequences Report

### The Radiation (Emergency Preparedness and Public Information) Regulations 2019

<b>Originated By:</b>	Emergency Planning Group	<b>Date:</b>	May 2022
<b>Reviewed By:</b>	Emergency Preparedness Engineer	<b>Date:</b>	May 2022
<b>Approved By:</b>	Technical and Safety Support Manager	<b>Date:</b>	May 2022

Revision	Amendment	Date
000	Full revision of the consequence report for the defuelling site status.	May 2022

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## Purpose

This consequence report is required in regulation 7 of Radiation (Emergency Preparedness and Public Information) Regulations (REPPIR) 2019 for the Local authority to determine a Detailed Emergency Planning Zone (DEPZ). It sets out the technical justification for the minimum distance for the DEPZ around Hunterston B nuclear power station.

The key priority for EDF Energy Nuclear Generation Ltd (EDF NG) is the safe, reliable generation of electricity. Generating safely means the prevention of accidents, recognising the potential hazardous situations or malicious acts that may cause harm to the public, our staff, the environment, or the reputation of the company and managing these events should they occur

The likelihood of an event occurring at Hunterston B power station is minimised through safety considerations in the siting, design, construction and operation and the granting and compliance with a nuclear site licence regulated by the Office for Nuclear Regulation (ONR). A Nuclear Site Licence is granted only after the ONR has fully satisfied that the licensee is a capable operator and has made an adequate safety case for the station and developed appropriate safety standards. The implementation of these standards demonstrates that an accidental event which might lead to the release of even small amounts of radioactivity is extremely low.

Despite constant vigilance, the safeguards incorporated into the design and operation of plant and support systems, and a positive accident prevention culture, hazardous situations that challenge control can occur. Having well-rehearsed emergency arrangements in a state of readiness, as required by REPPIR 2019, provides an additional layer of protection to mitigate the effects of unforeseen events.

This consequences report is developed from REPPIR regulations 4 and 5, requiring the operator, EDF Energy, to conduct an evaluation of the work with ionising radiation at Hunterston B power station to identify the hazards which could cause a radiation emergency, as defined in REPPIR regulation 2 and to assess the potential consequences of a full range of emergencies.

This revised consequences report has been completed in line with regulation 6 of REPPIR due to the occurrence a material change in the work with ionising radiation at Hunterston B Power Station. Regulation 6 (1) requires that when a material change in the work with ionising radiation occurs, a review of the hazard evaluation is completed.

On the 7<sup>th</sup> January 2022 Hunterston B ceased generation permanently and moved into its “defueling phase”. EDF considers that this is a material change and has therefore reviewed the hazard posed by the site and the consequences of that hazard. The results of this reassessment are set out in this report.

## 1 Consequence Report

<b>1.1 Name and Address of the Operator</b>	EDF Energy Nuclear Generation Ltd. Barnett Way Barnwood Gloucester Gloucestershire GL4 3RS	
<b>1.2 Premises details</b>	Address	Hunterston B power station West Kilbride Ayrshire KA23 9QX
	Location	All distances mentioned in this report are a radius from the premises centre point Grid Reference NS 18570 51455, which is the centre of the reactor building and the location of the Irradiated Fuel Disposal Facility.
	Date of commencement of work with ionising radiation	Work with ionising radiation has already commenced at Hunterston B. The construction of the station started in 1968 and the station started generating electricity in 1976. Hunterston B permanently ceased generating electricity on the 7 <sup>th</sup> January 2022 and moved into its defueling phase.

**1.3 Recommended Minimum Geographical Extent – Detailed Emergency Planning (DEPZ)**

The Detailed Emergency Planning Zone for the site should be no smaller than 1.08km from the centre point noted above in section 1.2.

**1.4 Recommended Distances for Urgent Protective Actions (sheltering, stable iodine tablets & evacuation)**

The rationale for the distances and timings for the recommendations in this section are set out in section 1.7.

The assessments required under REPIR indicate detailed planning is justified for the urgent protective action of sheltering within a distance of 1.08km from the site for protection of the public.

The protective action should be capable of being enacted as soon as is practical after the declaration of a Radiation Emergency has occurred to maximise the averting of dose.

Stable iodine is not justifiable as an appropriate protective action due to a reduction in radioiodine isotopes.

Appropriate arrangements should be considered in this area for individuals for whom it is not possible to offer appropriate shelter in solid buildings. This may include transient individuals, such as those using local recreational facilities.

The assessments indicate evacuation is justified within 300m. This area does not include permanently/regularly occupied residences or commercial properties, therefore it is not recommended that planning is conducted in detail to evacuate the public as a default action within the detailed emergency planning zone. Evacuation within the DEPZ should be considered in outline planning arrangements in the event of a severe accident.

It is recommended that immediate advice be issued to restrict consumption of leafy green vegetables, milk and water from open sources/rain water in all sectors of the Details Emergency Planning Zone and considered within 24 hours downwind of the site to a distance of 41km after taking appropriate expert advice.

<p><b>1.5 Recommended Minimum Geographical Extent – Outline Emergency Planning (OPZ)</b></p>	<p>It is recommended that the Outline Planning Zone for the site be set as per REPPIR regulation 9 (1) a) and schedule 5 – (category 2) at 30km.</p> <p>Urgent protective actions, other than consideration of food restrictions, are not recommended within the OPZ. Outline planning should consider the implementation of protective actions in the OPZ for a radiation emergency which is considered extremely unlikely.</p> <p>It is recommended that that the outline plan consider the process for the implementation of shelter and evacuation uniformly throughout the OPZ, with or without a warning period.</p> <p>Planning in outline will enable implementation of protective actions based on the assessments made during an event and determined as appropriate based on the justification of the potential for averting exposure.</p>
<p><b>1.6 Environmental pathways at risk</b></p>	
	<p>A radiation emergency at Hunterston B would take the form of a gaseous or particulate plume containing radioactive material. This would put the following environmental pathways at risk:</p> <ul style="list-style-type: none"> <li>• Grown foods – direct surface contamination and soil to plant</li> <li>• Animal products via ingestion</li> <li>• Water supplies through direct contamination and contaminated runoff</li> </ul>
<p><b>1.7 Rationale</b></p>	
	<p>SELECTION OF SOURCE TERM</p> <p>EDF Energy has considered a wide range of accident scenarios in the hazard evaluation process and selected a candidate release as the basis of the consequences assessment. The candidate release assumes the most pessimistic attributes from a number of fault sequences in terms of time to release and quantity of activity released it, therefore, does not correspond to the release from a specific individual fault. It covers faults in all facilities on site, and is specific to the defueling operations at the site.</p>

#### POPULATION VARIABLES

As recommended by the UK Health Security Agency the exposure to the following population groups has been considered

- infants (0-1 year)
- children (1-10 years)
- Adults

Adults have been identified as the most vulnerable group.

Dose to the foetus and to breast-fed infants has been considered and it has been determined that the protective measures required for these do not exceed those required by the most vulnerable group identified above.

#### IMPACT OF WEATHER VARIABLES

The most significant consequences off site will occur from airborne radioactivity. The impact of the consequences is dominated by the weather conditions transporting the radioactive material off site. Extremes of weather, in this context, relates to the amount of dilution of the radioactive material that occurs during transportation. While higher wind speeds transport radioactivity over greater distances, the plume tends to move faster and affects a narrower area. Slow moving wind, with little or no turbulence, reduces the dilution of the radioactivity and presents the worst-case conditions for a release of radioactive material, as the release of radioactivity remains more concentrated as it moves off the site.

This becomes relevant in terms of the potential exposure through inhalation (amount of radiation per breath) and direct exposure as the release cloud or plume passes overhead. A full range of the atmospheric conditions occurring in the UK have been considered, along with the impact of rain, as this can 'wash' radioactivity out of the cloud or plume leading to a build-up of deposited activity where the rain falls raising levels of radiation in the environment and the potential of increased exposure through ingestion and direct exposure. The weather conditions used to develop the distances recommended in this report account for over 95% of the expected conditions at Hunterston B from an assessment of historic weather data. This aligns with the UK Health Security Agency recommended methodology to take account of pessimistic consequences due to unfavourable weather conditions as set out in report PHE-CRCE-50.

#### EMERGENCY RESPONSE TIME VARIABLES

The effectiveness of the urgent protective actions is determined by when implementation is achieved relative to the release and passage of the radioactive material. It is assumed that the most limiting scenario occurs when the release commences before emergency plans are activated.

Despite best efforts to rapidly assemble the emergency response organisation to determine the protection strategy and to notify members of the public to take action, the delay in doing this will reduce the effectiveness of the protective measures. A conservative time factor for implementing the protective measures of

2 hours has been considered when assessing distances determined by the effectiveness of protective actions. However the distances recommended in this report are based on a best-case scenario where protective actions can be implemented in advance of exposure occurring.

No assumptions should be made about the availability of a warning period to enact the emergency response and protective actions. Whilst faults could develop which would give a warning period before a release of radiation from the site it should not be assumed that this would be the case. Therefore any protective actions and emergency plans should be based on the conservative basis that no warning period would be available and should therefore be capable of being activated as soon as possible.

**PUBLIC PROTECTION GUIDANCE**

The UK Health Security Agency provide the UK guidance for emergency planning thresholds on dose for guiding decisions on actions. Emergency Reference Levels (ERL's) are dose criteria that apply to the justification and optimisation of sheltering-in-place, evacuation and administration of stable iodine. These are most appropriately expressed in terms of averted dose and are given in the table below.

**Recommended ERLs for the planning of sheltering-in-place, evacuation and administration of stable iodine protective actions**

	Effective dose or organ dose	Averted dose (mSv) <sup>a</sup>	
		Lower	Upper
Sheltering	Effective	3	30
Evacuation	Effective	30	300
Stable iodine	Thyroid <sup>b</sup>	30	100

<sup>a</sup> In recognition of their higher cancer risk, the doses are those potentially averted in young children  
<sup>b</sup> mSv equivalent dose to the thyroid

The key objective with planning and deploying urgent protective actions is to achieve more good than harm in context of the risks from radiation exposure and the risks associated with the protective measure. Hence the arrangements in place should be proportionate to the risk and offer a trade-off between protection against radiation dose and the detriments that protective actions can have when implemented.

**APPLICATION OF THE EMERGENCY REFERENCE LEVELS**

The recommended minimum distance for detailed emergency planning is based on consideration of distances to which it would be proportionate to administer the urgent protective actions of evacuation, shelter and stable iodine based on the potential for those protective actions to avert dose in line with the Emergency Reference Level methodology.

As indicated in REPPiR, the lower ERLs are used in the determination of the distance for justifying detailed planning for implementing urgent public protective measures.



#### DISTANCE TO LOWER ERL FOR STABLE IODINE

One of the most significant hazard changes that occurs at a defueling nuclear power station is the reduction in radioactive iodine isotopes. Whilst these isotopes make up the largest part of a potential release from a generating nuclear reactor, once that reactor is shut down they reduce very quickly through the normal process of radioactive decay. Around 90 days after the process of fission stops within the reactor there is no longer sufficient radioactive iodine to give enough of a thyroid dose to justify the use of stable iodine tablets as a protective action.

The second reactor at Hunterston B shut down for the final time on the 7th January 2022. Therefore after the 7th April 2022 it is no longer justifiable to recommend stable iodine as a protective action for Hunterston B for either detailed or outline planning.

The assessments show that at 200m from the release point (roughly the site fence) an infant (the most vulnerable group for this specific exposure) would receive a maximum of 0.35mSv thyroid dose. It would therefore not be possible to avert sufficient dose to meet the lower reference level to justify stable iodine prophylaxis.

Furthermore, any residual radio-iodine in the source term will continue to decay with time, which will diminish the risk even further as the defueling programme progresses

#### DISTANCE TO LOWER ERL FOR SHELTERING

The distance across which it is justifiable to recommend shelter as a protective action has been calculated as ~1080m from the centre point between each reactor based on the lower emergency reference level for an adult, identified as the most vulnerable group. This distance is calculated accounting for the Dose Reduction Factors set out in Schedule 3 of REPPiR.

#### DISTANCE TO LOWER ERL FOR EVACUATION

The distance across which it is justifiable to recommend evacuation as a protective action has been calculated as ~300m from the centre point between each reactor based on the lower emergency reference level for an adult, identified as the most vulnerable group.

This area is contained within the site fence in a number of directions and exceeds it by approximately 150m elsewhere. This distance falls some way short of the nearest residential building (~700m) and does not reach the boundary with Hunterston A Power Station (~350m). It is therefore judged that the use of evacuation as a default urgent protective action within the Detailed Emergency Planning Zone is not justified. Evacuation within the DEPZ should be considered in outline planning arrangements in the event of a severe accident.

#### DISTANCES FOR FOOD RESTRICTIONS

Averting exposure to radiation through ingestion of locally produced food stuffs and drinking water within the DEPZ is recommended, however due to the delay in exposure and the significant variables advice to areas beyond the DEPZ should be issued within 24 hours from the start of the release and should consider advice given by relevant expert organisations.

Assessments indicate that the radiation concentrations in milk under the most onerous dispersion conditions would exceed the Euratom Maximum Permitted Levels (MPL) to a distance of ~19km and concentrations in unprocessed leafy green vegetables would exceed the MPLs to a distance of ~41km. It is recommended that expert advice is sought in the setting of food restrictions outside of the DEPZ due to the number of variables involved.

Analysis shows that the distance to which food restrictions would be required will vary significantly based on the weather factors on the day with the presence of rain having a significant influence. Whilst it may be necessary to implement food bans beyond the distances recommended it is considered proportionate to plan for the extent suggested, which can then be reviewed and adjusted as necessary by the appropriate authority once an appropriate emergency organisation has been established.

#### OTHER EMERGENCY PLANNING CONSIDERATIONS

Appropriate arrangements should be considered in the DEPZ to a distance of 1080m for individuals for whom it is not possible to offer appropriate shelter in solidly built buildings. This may include transient populations such as users of local recreational areas.

Whilst potential dose to such individuals is not expected to exceed the lower ERL for evacuation, the doses could be above the lower ERLs for sheltering. Appropriate arrangements will therefore be needed to ensure that any individuals that fall into this category can be adequately protected, which may be most practically achieved by removing them from the immediate area.

The likely characteristics of a release from the defueling station differ from those of a generating station. For the generating station the radiation emergency releases were dominated by the faults from a pressurised reactor which would have been most likely to lead to a discharge of hot CO<sub>2</sub> carrying radiation lasting in the region of 2-8 hours. For the defueling site the faults are dominated by issues involving the movement of spent nuclear fuel around the site – the “fuel route”. Faults on the fuel route are typically less dynamic with a slower release lasting over several days if unmitigated. These faults can offer more opportunities to mitigate or terminate the event before the majority of the radiological material has been released.

There are a range of potential events which could occur at the site which relate to conventional industrial hazards (e.g. fires, chemical spill) which may require an emergency response, including off site support, but do not lead to a release of radioactive material. These would be declared as a Site Incident. It is understood that such events could be perceived as a radiation emergency by the public, and

therefore all such events will include necessary notifications to relevant organisation so that reassurance requirements can be enacted.

#### SUMMARY OF RECOMMENDATIONS

The assessments indicate that detailed planning is justified at Hunterston B power station within at least 1080m and the urgent protective action of sheltering are justified within a maximum distance of 1080m from the site for protection of the public.

1080m is the minimum distance for the DEPZ. The local authority can choose to extend this in line with Regulation 8(1). It is not recommended that urgent protective actions be extended beyond the distances specified in this report without taking appropriate public protection advice as increasing protective actions beyond the recommended distances could do more harm than good.

The protective actions should be capable of being enacted as soon as is practical after the declaration of a Radiation Emergency (Off Site Nuclear Emergency) or before a release starts to maximise the averting of exposure.

Evacuation is not considered to be justified as a default protective action in the DEPZ.

Stable Iodine Tablets are not justified as a protective action for the defueling power station.

These recommendations demonstrate a significant reduction from the recommendations made during the implementation of REPP19 in January 2020. The recommendation for the generating station were a DEPZ of at least 2000m.

It is also important to note that the assessments used in the development of the minimum distances are based on a 90 days post shutdown reactor. The longer from shutdown, the more the hazard reduces. Therefore the distances given are to be considered bounding and would be demonstrated to be reduced if the assessments were conducted again at a later date.

## 2 Distribution

Station Director		Joe Struthers	EDF – Hunterston B Station
TSSM		Allison Adamson	EDF – Hunterston B Station
QMGH		Colin McCallum	EDF – Hunterston B Station
EPE		Jennifer Clark	EDF – Hunterston B Station
External Communications Manager		Fiona McCall	EDF
Louise Driver		Head of Emergency Planning	EDF
Josh Tarling		Emergency Planning Group	EDF
Craig Hatton	<i>External</i>	Chief Executive	North Ayrshire Council
Jane McGeorge	<i>External</i>	Coordinator	Ayrshire Civil Contingencies Team
Lesley Jeffery	<i>External</i>	Civil Contingencies Officer	Ayrshire Civil Contingencies Team
Stuart Fannin	<i>External</i>	Site Inspector	ONR
REPP19Compliance@onr.gov.uk	<i>External</i>	REPP19 Compliance Lead	ONR
David Hanratty	<i>External</i>	Principal Inspector EP&R	ONR
TSSM (Equivalent)	External	TSSM (Equivalent)	Hunterston A Station

