Nuclear Generation

The Radiation (Emergency Preparedness and Public Information) Regulations 2019

Hinkley Point B Power Station Consequences Report

Originated By:	Emergency Planning Group	**Date:**	September 2019
Reviewed By:	HPB Emergency Preparedness Engineer	**Date:**	October 2021
Approved By:	HPB Technical & Safety Support Manager	**Date:**	October 2021

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000	Inaugural Document	October 2021

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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 Hinkley Point B nuclear power station.

The key priority for EDF Energy Nuclear Generation (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 manage these events should they occur

The likelihood of an event occurring at Hinkley Point 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 consequence 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 Hinkley Point 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 “both on the premises and outside the premises considering any variable factors which have the potential to affect the severity of those consequences”.

1 Consequence Report

1.1 Name and Address of the Operator		EDF Energy Nuclear Generation. Barnett Way Barnwood Gloucester Gloucestershire GL4 3RS
1.2 Premises details	Address	Hinkley Point B Power Station Nr Bridgwater Somerset TA5 1UD
	Location	All distances mentioned in this report are a radius from the premises centre point Grid Reference ST21366 46128, which is the centre of the reactor building.
	Date of commencement of work with ionising radiation	Work with ionising radiation has already commenced at Hinkley Point B Power Station. The construction of the station started in 1967 and the station started generating electricity in 1976.

1.3 Recommended Minimum Geographical Extent – Detailed Emergency Planning (DEPZ)	It is recommended that the Detailed Emergency Planning Zone for the site be no smaller than 1km from the centre point noted above in section 1.2.
1.4 Recommended Distances for Urgent Protective Actions (Sheltering, Stable Iodine Tablets & Evacuation)	The assessments required under REPPIR indicate detailed planning is justified for the urgent protective actions of administration of stable iodine and implementation of sheltering within a distance of 1km from the site for protection of the public. The protective actions should be capable of being enacted as soon as is practical after the declaration of a Radiation Emergency has occurred or before a release starts to maximise the averting of dose. Stable iodine can be administered up to 5-8 hours following exposure as averting iodine inhalation dose of ~ 50% is still possible. Appropriate arrangements should be considered in this area for individuals for whom it is not possible to offer appropriate shelter and stable iodine tablets. This is likely to include a small number of transient individuals, e.g. walkers and local attraction visitors. The rationale for the distances and timings for recommending the detail planning for implementation of urgent protective actions is detailed below in section 2.6 The assessments indicate evacuation is justified within 250m, effectively inside the site fence, therefore there is no justification for planning in detail to evacuate the public within a 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 advice be issued within 24 hours 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 downwind of the site to a distance of 43km.
1.5 Recommended Minimum Geographical Extent – Outline Emergency Planning (OPZ)	As per REPPIR regulation 9 (1) a) and schedule 5 – category 2 - 30km. Default urgent protective actions, other than consideration of food restrictions, are not recommended within the OPZ. Outline planning should consider the implementation of urgent protective actions in the OPZ for a radiation emergency which is considered extremely unlikely. Planning in outline will enable implementation based on the assessments made during an event and determined as appropriate based on the justification of the potential for averting exposure.

1.6 Environmental pathways at risk

A radiation emergency at Hinkley Point B would take the form of a gaseous plume. This would put the following environmental pathways at risk:

- Grown foods – direct surface contamination and soil to plant
- Animal products via ingestion
- Water supplies through direct contamination and contaminated runoff

1.7 Rationale

SELECTION OF SOURCE TERM

EDF Energy has considered a wide range of accident scenarios in our 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

In summary, the candidate uses the shortest time to release, largest quantity of radioactivity and longest duration of release for determination of the potential consequences and distance to which implementation of countermeasures would be justified. It covers faults in all facilities on site, and all modes of plant operation.

POPULATION VARIABLES

The exposure to the following population groups have been considered

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

Particular attention is given to the exposure to infants as the most vulnerable group

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.

EMERGENCY RELEASE AND 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. The duration of the candidate release is approximately 5 hours at which point the release will effectively terminate because the depressurisation of the Reactor Coolant System results in limited motive force to expel radioactivity, or because emergency actions have re-established containment.

Despite best efforts to rapidly assemble the emergency response organisation to determine the protection strategy, 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 factored into the recommended distances.

The quicker the public can be informed to implement protective action the more effective these will be in averting exposure. The distances recommended account for the eventuality that the protective actions can be implemented in advance of a release of radioactivity.

PUBLIC PROTECTION GUIDANCE

Public Health England (PHE) 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)[a]**	
		Lower	**Upper**
Sheltering	Effective	3	30
Evacuation	Effective	30	300
Stable iodine	Thyroid[b]	30	100

a In recognition of their higher cancer risk, the doses are those potentially averted in young children
b 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.

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.

APPLICATION OF THE EMERGENCY REFERENCE LEVELS

The recommended minimum distance for detailed emergency planning has been based on consideration of distances to which it would be proportionate to administer the urgent protective actions of evacuation, shelter and stable iodine. The nature of the AGR release means that iodine radionuclides are dominant and therefore stable iodine is appropriate as a protective action to the furthest distance.

DISTANCE TO LOWER ERL FOR STABLE IODINE

~830m has been calculated as the minimum technical distance for detailed planning based on the maximum distance to the lower ERL for an infant. This assumes 80% effectiveness caused from a potential delay in administration of approximately 1-2 hour from the start of exposure to the iodine in the release. ~990m is the equivalent distance calculated if stable iodine is administered before exposure to achieve 100% effectiveness, e.g. through arrangements for pre-distribution and early warning. For ease of communication and administration it is suggested the distances are increased to 1km

DISTANCE TO LOWER ERL FOR SHELTERING

The maximum technical distance calculated which justifies sheltering as a single protective action are smaller distances than for stable iodine at ~580m. It is therefore recommended that, this protective action is not extended beyond 1km without careful consideration and should be implemented coincidentally with administration of stable Iodine, following recommended public protection guidelines.

DISTANCE TO LOWER ERL FOR EVACUATION

EDF Energy's analysis indicates that, even for infants under worst case weather conditions, the lower ERL for evacuation is not met at distances greater than 300m. This area is largely contained within the site fence in most places and the closest public habitation to the site is approximately 1100m further away. Therefore there is no justification for planning in detail to evacuate the public within a detailed emergency planning zone. 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 is not considered to be an immediately urgent protective measure due to the delay in exposure and the ability to issue advice within 24 hours from the start of the release.

Assessments indicate that the radiation concentrations in milk under likely dispersion conditions would exceed the Euratom Maximum Permitted Levels (MPL) to a distance of ~ 41km and concentrations in unprocessed leafy green vegetables would exceed the MPLs to a distance of ~43km. It is recommended that for ease of communication the advice be issued for a single distance of 43km. This should also include advice against drinking of rainwater or water from open sources to the same distance.

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 1km for individuals for whom it is not possible to offer appropriate shelter and stable iodine tablets. This is likely to include a very small number of transient individuals, e.g. walkers and visitors to local attractions. The analysis shows that at 400m the maximum unprotected exposures for inhalation under average weather conditions would not meet the threshold to consider evacuation as an urgent protective

	action. However, the doses would be above the lower ERLs for sheltering and stable iodine, justifying their use as countermeasures. 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 evacuating them from the immediate area. 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 RECOMENDATIONS OF DISTANCE TO LOWER ERL The assessments indicate detailed planning is justified at Hinkley Point B power station within at least 1km and the urgent protective actions of administration of stable iodine and implementation of sheltering are justified within a maximum distance of 1km from the site for protection of the public. The protective actions should be capable of being enacted as soon as is practical after the declaration of a Radiation Emergency has occurred or before a release starts to maximise the averting of exposure. Stable iodine can be administered up to 5-8 hours following exposure as averting iodine inhalation dose of ~ 50% is still possible. Additional benefit would be achieved if the time to implement the actions is minimised following a release of radiation consideration should be given to the pre-distributed of stable iodine tablets within the area likely to be affected. Evacuation is not considered to be justified as a default protective action in the DEPZ.

2 Distribution

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Figure 1 – Recommended Minimum Distance for Detailed Emergency Planning