Nuclear Generation Limited

The Radiation (Emergency Preparedness and Public Information) Regulations 2019

Torness Power Station Consequences Report

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Contents

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 Torness 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 Torness 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 Torness 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 Ltd. Barnett Way Barnwood Gloucester Gloucestershire GL4 3RS
1.2 Premises details	Address	Torness power station Torness Dunbar East Lothian EH42 1QS
	Location	All distances mentioned in this report are a radius from the premises centre point Grid Reference NT 74539 75110, which is the centre of the reactor building.
	Date of commencement of work with ionising radiation	Work with ionising radiation has already commenced at Torness power station. The construction of the station started in 1980 and the station started generating electricity in 1988.

1.3	**Recommended Minimum Geographical Extent – Detailed Emergency Planning (DEPZ)**	The Detailed Emergency Planning Zone for the site should be no smaller than 2km 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 ~ 2km 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 in solid buildings and stable iodine tablets. This is likely to include a number of transient individuals, such as those using local recreational facilities. The rationale for the distances and timings for recommending the detail planning for implementation of urgent protective actions is provided below in section 1.7. The assessments indicate evacuation is justified within 300m. This area is predominantly inside the site fence, therefore there is no justification for planning 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 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)	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. 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. It is recommended that that the outline plan consider the process for the implementation of stable iodine distribution, shelter and evacuation uniformly throughout the OPZ, with or without a warning period. 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.
1.6 Environmental pathways at risk	
	A radiation emergency at Torness would take the form of a gaseous plume containing radioactive particulates 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 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 all modes of plant operation.

POPULATION VARIABLES

As recommended by Public Health England the exposure to the following population groups has 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

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 Torness from an assessment of historic weather data. This aligns with Public Health England's recommended methodology to take account of pessimistic consequences due to unfavourable weather conditions as set out in report PHE-CRCE-50.

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 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 of an hour or more 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

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 radiation emergency at Torness means that iodine radionuclides are the dominant hazard. Therefore, the distance to which the administration of stable iodine is considered proportionate is the greatest of any of the protective actions and is the distance used to determine the minimum size of the Detailed Emergency Planning Zone.

DISTANCE TO LOWER ERL FOR STABLE IODINE

The distance across which it is justifiable to administer stable iodine as a protective action has been calculated as ~2000m from the centre point of the site based on the lower emergency reference level for an infant, identified as the most vulnerable group. This assumes the maximum possible benefit afforded by this protective action by it being administered before or very shortly after exposure.

Whilst it is accepted that there may be a delay in notifying the public of a radiation emergency, resulting in the protective action being less effective, it is considered appropriate for public protection to base the distance given in this report by considering the most effective outcome.

DISTANCE TO LOWER ERL FOR SHELTERING

The distance across which it is justifiable to recommend shelter as a protective action has been calculated as ~950m from the centre point of each site based on the lower emergency reference level for an infant, identified as the most vulnerable group.

Whist this distance is shorter than that of stable iodine, it is recommended that the two protective actions be deployed together and therefore it would be reasonable to extend shelter as a protective action to the same distance as that of stable iodine. This follows public protection guidelines set out by Public Heath England in report PHE-CRCE-049.

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 of the site based on the lower emergency reference level for an infant, identified as the most vulnerable group.

This area is largely contained within the site fence in most places and contains no permanent residents. 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 can reduce a significant proportion of the dose an individual could receive. Therefore advice should be issued to restrict consumption of appropriate food stuffs 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 he 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 2000m for individuals for whom it is not possible to offer appropriate shelter in solidly built buildings and stable iodine tablets. This may include transient populations such as users of local recreational facilities.

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 and stable iodine. 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 that detailed planning is justified at Torness power station within at least 2000m and the urgent protective actions of administration of stable iodine and implementation of sheltering are justified within a maximum distance of 2000m from the site for protection of the public. 2000m 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. Consideration should be given to the pre-distribution of stable iodine tablets within the area likely to be affected. Stable iodine can be administered up to 5-8 hours following exposure as averting iodine inhalation dose of ~ 50% is still possible. 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