Nomination of Land adjacent to Oldbury Nuclear Power Station

Supplementary Information D1

Further information on flood risk, storm surge and tsunami

Supplementary information Ref D1

Further information on Flood Risk, Storm Surge and Tsunami required by criterion D1

1. Introduction

This supplementary information contains further information required to support question D1 of the nomination of land adjacent to the existing nuclear power station at Oldbury. It considers the current vulnerability of the Oldbury site to flooding, storm surge and tsunami. Additional information regarding flood defence options, approaches to external impact mitigation and the potential to pass the Sequential Test are also included.

In setting out the SSA criteria the Government has confirmed that assessment of the potential risks from flooding, storm surge and tsunami should be undertaken for nominated sites. Updated guidance on the application of SSA criteria confirms that the three issues should be grouped together as a single discretionary criterion.

The SSA process will consider flooding issues from two perspectives. First, the possible threats to the safety of a new nuclear power station in an area exposed to flood risk. Secondly, the wider impacts of flood protection countermeasures on areas surrounding potential new nuclear power station sites.

Whilst Government recognises that mitigation measures to minimise the risk from flooding, storm surge and tsunami are likely to be feasible, information is sought through the nomination to indicate the practical feasibility of likely protection and associated mitigation measures.

Additionally, all new developments in England, including infrastructure such as new nuclear power stations, must take due account of the policies set out in Planning Policy Statement 25 (PPS25). PPS25 outlines how flood risk should be considered in making planning decisions. The policy's aim is to make development safe without increasing flood risk elsewhere and, where possible, to reduce flood risk overall. Whilst Government does not propose to apply the PPS25 tests at strategic level in the SSA (insufficient site-specific information is available), some information is required to show that it is reasonable to conclude that one part of this test, the Sequential Test is likely to be passed.

2. Criterion

To address the flood risk, storm surge and tsunami criterion, the nomination must identify potential water-related risks incorporating allowances for the effects of climate change over the planned lifetime of the development. Consideration must be given to practical options for risk minimisation and any necessary impact mitigation in order to demonstrate why it is reasonable to conclude that, at a strategic level, it should be possible to reduce any residual risk to an acceptable level.

The lifetime of the station needs to include for the safe and secure storage of all the spent fuel and intermediate level waste produced through operation and from eventual decommissioning for several decades until it can be sent for disposal in a geological disposal facility.

The criterion requires in particular:

- the measures believed appropriate to protect the site against flooding;
- a view on whether the protection measures would affect other designated areas;

- the assumptions that have been made about off-site flood protection and water management and, in particular, the reliance on flood protection measures which are in the control of other parties, such as neighbouring landowners or government bodies;
- the potential for flooding to impede access to the site in respect of both normal operations and emergency services;
- a view on whether the development of a new nuclear station on the site (including any likely mitigation measures) is likely to increase flood risk elsewhere.

Keeping in mind the latest predictions of climate change and the long potential lifetime of a new nuclear station, a holistic view is sought on the risk of flooding to the nominated site recognising that flooding can come from rivers and the sea (including storm surges), directly from rainfall on the ground surface and from rising groundwater, overwhelmed sewers and drainage systems and other sources – and that such sources may occur in parallel (requiring consideration of the combined effect).

3. Addressing the Criterion

S M Foster Associates Limited, a hydrological and hydrogeological consultancy experienced in carrying out flood risk assessment, was appointed to provide a desktop based review of the flood hazard and its implications for the proposed Oldbury-on-Severn site.

For the Oldbury nomination this criterion has been addressed by S M Foster Associates through site visits, desk studies and the implementation of a high level strategic flood risk review incorporating semi-quantitative assessment of flood, storm surge and tsunami defence options and potential approaches to external impact mitigation. Reference has also been made to Section 17 of the Environmental Statement for decommissioning of the existing power station at Oldbury. The review has been undertaken in accordance with the general approach set out in PPS25. Consideration has also been given to consultation on the Severn Tidal Power Feasibility Study which was open at the time of preparing the nomination.

S.M. Foster has confirmed that the information contained within this supplementary section provides a true and factual summary of the work undertaken by them, of the key findings, and has been undertaken in accordance with industry best practice.

4. Key Findings

4.1 Flood zone designation and standard of protection

The site and surrounding area is designated as Flood Zone 3 on published Environment Agency flood zone maps. The area is therefore considered to be at high risk of flooding with a statistical flood risk of greater than or equal to 1% for fluvial flooding and/or 0.5% for coastal and tidal flooding.

With regard to flood risk, the standard of protection required for general industrial development is typically 1 in 100 (1% probability) years for fluvial flooding and 1 in 200 (0.5% probability) years for tidal flooding. For nuclear installations the industry standard is to design in relation to the 1 in 10,000 years (0.01% probability) standard of flood protection. It is understood that when considering flood risk in relation to future nuclear facilities the Health & Safety Executive (HSE) may apply a safety factor of 1.4 to the 1 in 10,000 year flood level which is interpreted as being equivalent to a 1 in 14,000 year flood level.

4.2 Identification of flooding, storm surge and tsunami hazards

The site is not located in the fluvial flood zone of any major surface watercourse other than the River Severn/Severn Estuary. Water levels in the Severn Estuary adjacent to the site are controlled by tidal variation rather than by fluvial flood levels in the river channel upstream. Figure 1 shows the area affected by 1 in 200 year return flood levels predicted by the Environment Agency.

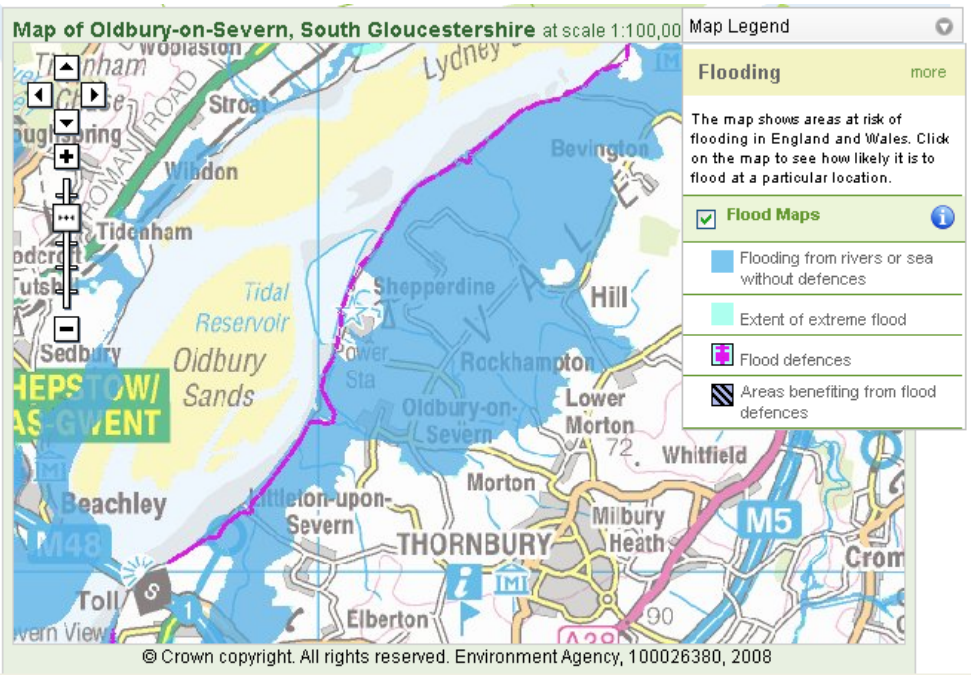

Figure 1. 1:10,000 scale flood map for Oldbury-on-Severn and the surrounding area, Crown copyright 2009.

Detailed consideration of the potential flooding mechanisms is therefore focused on the potential for tidal flooding from the Severn Estuary. Flooding could occur in response to (i) extreme high tide levels, (ii) tidal surge or wave action, or (iii) structural failure in the integrity of flood defences. The Environment Agency has confirmed that the design standard of protection of the existing defences is a 1 in 200 year flood event.

In response to predicted sea level rise, the standard of protection provided by existing defences would progressively reduce to being able to withstand around a 1 in 100 year flood event by 2025. By 2055 the existing defences will cease to provide any significant protection from tidal flooding in the Oldbury area. It can be concluded that, including allowance for tidal surge/wave action there is potential for overtopping of the existing defences in response to an extreme tidal event from 2010 onwards.

A breach in flood defences could occur during an extreme tidal flood event with a magnitude up to and including the 1 in 10,000 year event. In contrast to flood defence overtopping where there is potential for flood levels to equalise with peak tide levels for small tidal flood plain areas, the implication of a defence breach is related to the magnitude and duration of the breach and the depth of floodwater that subsequently accumulates. Provisional assessment indicates that the consequences of a major flood defence breach in the Oldbury area would be flood plain inundation to an average depth of up to 1.6m.

In recent times, two separate Tsunami modelling studies relating to the United Kingdom's coastline have been undertaken which draw specific conclusions regarding the risk in the Bristol Channel.

The most relevant recent study is that produced by Richardson (2006) for DEFRA Flood Management Division. The study indicates that a tsunami approaching the south west coastline would dissipate over

a period of three hours and as it progresses up the Bristol Channel the tsunami wave height would not exceed 0.1m above normal sea level.

On the basis of currently reported research it can be provisionally concluded that the potential duration and magnitude of tsunami impact at Oldbury is likely to be low. It is apparent that the proposed flood defence design standard of 1:14,000 years provides a high degree of coastal flood protection that under the majority of tidal conditions far exceeds that required to protect the site against the effects of tsunami hazard.

4.3 Flood protection measures

The analysis of potential flooding mechanisms in the vicinity of the Oldbury site indicates that at present the site is at risk of tidal flooding from tidal events of greater magnitude than the 1 in 200 year event and that by 2025 this will have been reduced to events greater in magnitude than the 1 in 100 year event. Additional flood defence measures would be required to provide the appropriate standard of flood protection and a basis for compliance with PPS25 and other relevant planning regulation.

Full protection against future sea level rise and tidal flooding, including the additional effects of tidal surge and wave action, could be achieved by development of flood defences that act to isolate the site from the effects of flooding. The existing flood defences along the coastal boundary could be raised to a minimum elevation of 11.7mAOD; an average increase in height of 1.5m. Flood defence improvement may need to extend to a minimum distance, i.e. 500m, in both directions along the coastline to ensure that the development would not be at risk from tidal overtopping at the site boundary. The consideration of flood risk has focused on the risk to the site over the period of the next one hundred years, as the construction, operation and decommissioning of the station is most likely to be completed within this timeframe. Ancillary buildings, such as the fuel store, may need to be on site after the reactor and other equipment have been removed, which means that defences for some of the site may need to be maintained for a greater duration, but at this stage it is felt sufficient to note that this could be achieved, if required, through further modification to the defences at a later date.

Although protected from direct tidal flooding, the development would be at risk of indirect flooding from defence overtopping beyond the upgraded defence line or as a consequence of a breach in defences. Failure of the flood protection defences via overtopping or breach could result in a flood plain water level of up to 1.6m. Therefore, flood defence measures in addition to the estuary boundary defence walls may be required which would need to be designed to achieve protection against a 1.6m depth of flood water plus an appropriate additional freeboard to account for uncertainty. Secondary flood defence measures with a minimum height of around 2.0m above the flood plain height would probably be required. With existing ground levels at the site averaging approximately 6.5mAOD and on the basis of current levels of predictive uncertainty it would be appropriate to consider ground raising for the station site to a level of 8.5mAOD.

4.4 Implications for protection measures on other designated areas and for the flood risk in others areas in regard to development of a new nuclear station

On the basis of current understanding it is not considered that raising flood defences adjacent to the site would result in any increased risk of tidal flooding or other negative hydrological impact anywhere else along the estuary coastline. Future detailed studies and civil design would be needed, incorporating consultation with local and national stakeholders in order to provide a more detailed evaluation of risks.

Ground raising works and the construction of new landward side flood defences both result in removal of an area of land from the flood plain. At the Oldbury site this is relevant to consideration of flooding impacts resulting from remote overtopping of defences or a breach of defences.

However, even using a conservative basis that all of the nominated land would be used for development the result would only be a negligible reduction in available flood plain storage. It is recognised that in considering the requirement for compensatory storage the Environment Agency, with reference to PPS25, typically adopts the view that compensatory measures should normally be required to prevent incremental loss of flood plain by progressive development of an area. PPS25 Practice Guide Companion published by the Department for Communities and Local Government in February 2007 states that,

Unless the development is located in an area that is subject to tidal flooding and which serves no conveyance function, land raising must be accompanied by compensatory provision of flood storage either on or off-site.

It has been ascertained that the proposed development site is subject to tidal flooding and that in its location adjacent to existing coastal defences it serves no flood conveyance role.

When considering the requirement for impact mitigation it is important to recognise that the benefit delivered to the local area from improvement works to the existing flood defences is likely to be significantly greater than the impact of a small loss in flood plain storage resulting from the proposed development.

4.5 Assumptions about off site flood protection and water management, including reliance on flood protection measures which are in the control of other parties

PPS25 requires that when undertaking site specific flood risk assessments consideration is given to the potential risk of flooding from a range of sources. At the Oldbury site there is an absence of any extensive stormwater/sewerage drainage system and therefore no flooding mechanism related to that source. The site is not considered to be at significant risk of flooding from overland flow from adjacent areas as there is no significant topographic variation and the area is extensively drained. The site is generally underlain by low permeability geological formations that do not typically form aquifers. The site is therefore not expected to be at risk from groundwater flooding or direct rainfall. Refer also to section 4.2 in section D2.

4.6 Potential for flooding to impede operational and emergency access to site

The operator of new nuclear power stations at the Oldbury site would need to develop operational and emergency plans. In developing the plans, the failure of flood protection and any coastal erosion would need careful consideration. The current Magnox power station operating at Oldbury-on-Severn has detailed plans and emergency procedures in place to ensure its operational safety; the station is due to enter decommissioning in the near future, which will entail maintaining access to the site for the next 125 years.

It is anticipated that the new stations would work in cooperation with emergency procedures at the present station and would consider updating and renewing those procedures as time develops. Examples of the types of countermeasures which can be considered would include, raising the site level for the new power station and access roads to the site and protecting them using common civil engineering solutions. Further mitigation measures are possible and commonly used at other sites and it is therefore envisaged that these would be considered at a later date.

4.7 PPS25 Compliance

Suitability for development in respective flood zones is addressed in PPS25 by the development of flood vulnerability classifications and flood zone compatibility guidance. Under this classification a nuclear power station is considered as 'essential infrastructure' which has the highest flood vulnerability. In order to comply with PPS25 it is necessary to pass both the Sequential Test and the Exception Test. As stated in section 1, the SSA requires some strategic level assessment of the Sequential Test. The Sequential Test requires justification for the site selection in comparison to other sites that may be available in areas at lower flood risk.

The Sequential Test is primarily a planning test informed by Government planning policy and local authority planning priorities. In order to pass the test it is necessary to demonstrate that there are '*no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed'*. In reality, the availability of sites which meet the necessary technical, environmental, planning, regulatory and operational requirements for a new nuclear power station is likely to be limited to a small number of strategically suitable locations. At a national scale, the majority of coastal locations around the UK will become increasingly at risk of flooding or coastal erosion in response to the effects of climate change. In relation to other UK coastal locations the total predicted sea level rise is lowest in South West England. At a regional scale, the majority of the Severn Estuary shoreline is designated at the same level of potential flood risk as the Oldbury site. In this context it is considered that there are unlikely to be appropriate alternative sites with a lower probability of flooding.

Provisional flood studies have indicated that flood mitigation measures required to support development at Oldbury would need to include some form of land raising to bring ground levels above predicted flood level. The construction of an elevated platform would ensure that the site would have a lower probability of flooding than the surrounding area. The location of the site at the edge of a relatively undeveloped and extensive floodplain will ensure that the impact of development on flood risk in the surrounding area is likely to be low in comparison to alternative locations.

Due to the probable lack of suitable alternative sites at lower risk of flooding and the reduction in flood risk that would result from flood mitigation measures associated with a new nuclear power station at this location it is considered reasonable to conclude that the Oldbury site would pass the Sequential Test.

Compliance with PPS25 also requires demonstration that properly maintained defences would provide an acceptable standard of safety taking into account climate change. The flood risk review indicates that it should be technically feasible to construct defences that provide an acceptable standard of safety including climate change allowance. On this basis it can be concluded that at a strategic level there appear to be potentially feasible approaches to flood protection that meet the requirements of PPS25.

4.8 The Severn Barrage

At the time of submitting this nomination the Government is undertaking consultation on the Severn Tidal Power Feasibility Study. Some of the options would incorporate the construction of new structures, i.e. barrage, reef, fence, etc., across the Severn Estuary at locations downstream of Oldbury. On the basis of currently available information it is understood that the potential impact of such schemes would be to reduce the upstream tidal range whilst providing a degree of protection against tidal storm surges. Although development of new structures across the estuary is unlikely to

have any beneficial impact on flood risk related to extreme climatic events such as the 1 in 10,000 year design flood applicable to nuclear installations, there is currently no evidence to indicate that there would be any adverse impact on tidal flood risk at Oldbury.

5. Conclusions

A review of flood, storm surge and tsunami risks associated with potential development of a new nuclear power station at Oldbury-on-Severn has been undertaken to provide a basis for evaluation of flood defence options and planning issues related to PPS25 Development and Flood Risk.

On the basis of current knowledge, and at a strategic level, typical civil engineering methods would be appropriate for protecting the site from flooding, storm surge and tsunami risks that also meet the requirements of PPS25 and protection standards for nuclear installations. These methods include the enhancement and extension of flood defences (wall structures) as well as site raising and appropriate drainage.

Improvements in the flood protection measures such as increasing the height of the estuary flood protection walls will also increase the protection to the local area and should be considered a positive benefit.

Modification of local flood defences owned by others will be required, but the improvements brought about by the modifications are likely to be of a net benefit to the areas affected.

As the site is located in an area at risk of tidal flooding and as the proposed development will not have any impact on flood flow conveyance, it is unlikely that the provision of compensatory flood storage capacity would deliver any flood risk benefit.

Consideration of the size of the flood plain and the impacts of removing the station area suggests an almost negligible impact.

Access to the site can be maintained through appropriate civil engineering solutions, but additionally through emergency planning and procedures which would need to be developed at a later stage.