Red John Pumped Storage Scheme

Non-Technical Summary of Flood Risk and Breach Analysis

Introduction

The following summary has been provided as a non-technical description for the flood risk assessment (FRA) and breach analysis and is based on the information that is contained within the publically available EIA Report submitted to the Energy Consents Unit.

Background

As part of the EIA it is necessary to investigate the potential flow paths and effects of a breach to determine if the risk is acceptable and to allow adequate emergency planning to be implemented in the highly unlikely event of a breach.

An assessment of the likelihood and consequence of a breach has therefore been undertaken to define the potential areas at risk of flood inundation. The assessment has been undertaken in line with the methodology set out in the "*Guidance to risk assessment for reservoir safety management – Volume 2: methodology and supporting information Report – SC090001/R2- Department for Environment, Food and Rural Affairs*" (Ref 1). This study is reported fully within the main text of the FRA report (Appendix 9.1, Volume 5).

Information regarding the Development design has been used to set up the 2D flood model which has been used to simulate the impact of Embankment failure for areas lying downstream of the Headpond. This is shown within:

- EIA Report Chapter 9 Flood Risk;
- EIA Figure 9.3 Breach Locations;
- EIA Figures 9.9-9.13 Breach Extents; and
- EIA Technical Appendix 9.1 Flood Risk Assessment (FRA).

The study involves four stages:

- Data collection;
- Breach flow estimation;
- 2D modelling of breach flow along downstream valley; and
- Production of mapping outputs.

Hydrology and Embankment Breach Parameters

Data Collection

The proposed location of the Headpond lies at a high elevation on moorland and has no contributing catchment area or impounded stream, so is categorised as non-impounding.

The storage capacity of the Headpond provides the volume of water that could be released in the event of breach. It should be noted that this would not release the entire volume of water contained within the Headpond – water would remain within the Headpond where the Embankment is excavated beneath the existing ground level.

Breach Scenarios

Two scenarios, dry day and wet day, consider different types of failure. The dry day accounts for internal failures of the Embankment structure such as piping, slope stability or foundation failure, whereas the wet day accounts for failure resulting from overtopping of the top of the Embankment.

A third scenario investigated the maximum flood rise in the Headpond resulting from the probable maximum precipitation (PMP) event to assess the validity of the starting water level of 0.1 m above the top of the Embankment for the wet day scenario.

The Headpond is situated on the watershed between the catchment area of Loch Ness, and the catchment areas of Loch Ashie and Loch Duntelchaig. As the Headpond is fully impounded, failure at different locations around the Embankment would result in water being released in different directions – either west towards Loch Ness, or east or north-east towards Loch Duntelchaig or Loch Ashie (as shown on Figures 9.9 – 9.13). Two potential breach locations were therefore identified (as shown on Figure 9.3). These were where the Embankment height was greatest, for example where there is the greatest difference in top of the Embankment and the bottom

Inundation Modelling Results

Breach Location 1 – Dores

Breach 1 is located on the south-west of the Embankment with flows directed towards Loch Ness and Dores village.

Between the dry and PMP events the extents are virtually the same. The flooding extents are shown in Volume 3: Figure 9.9. The main flow direction is to the north-west directly towards Dores and Loch Ness. A smaller stream flows to the south-west and splits into two separate streams which both flow into Loch Ness further to the south-west.

Breach Location 2 – Loch Ashie

Breach 2 would release flow immediately from the north-east of the Embankment into Loch Ashie where it would spread across the loch surface. The potential for this to cause overtopping of Loch Ashie embankment and cause a cascade failure was assessed.

Any flow passing through Loch Asie or over the crest would continue down the hillside towards south Inverness and eventually enter the River Ness.

The extents of the Dry Day and PMP event are shown in Volume 3: Figure 9.10 and Figure 9.11.

Safety Design and Maintenance

An All Panel Reservoir Engineer under the Reservoir (Scotland) Act 2011 is required to sign off on the design and execution of the works before the Headpond is filled.

Once commissioned there will be regular inspections to ensure the safety of the Headpond. Regular maintenance will likely include for examination of the critical safety features of the Headpond including Embankment structure, spillway, screens and scour arrangements, the condition of the major elements and the operating records.

Under the Reservoir (Scotland) Act 2011, the operator of a reservoir must appoint a Supervising Engineer from a ‘panel’ of engineers pre-approved by the Scottish Government. The Supervising Engineer will monitor the Headpond, supervise operations and conduct visual inspections annually. Inspection must also be conducted with a minimum frequency of every two years by an Inspecting Engineer who is an independent, panel engineer.

Conclusion

Although the likelihood of an Embankment breach occurring is extremely low, the consequences, however, are significant. It is therefore necessary to look at the potential flow paths and effects of a breach to determine if the risk is acceptable and to allow adequate emergency planning to be implemented in the future as mitigation in the unlikely event of a breach.

The analysis shows that in the unlikely event of a breach, a substantial area is at risk of inundation. Recognising that the likelihood of a breach event is extremely low, in line with the guidance set out in the guide to reservoir risk management, the risk is classed as being tolerable. This is based on undertaking the rigorous supervision and inspection regime based on the requirements of the Reservoir (Scotland) Act 2011 and that the general condition of the Headpond is classed as condition score 1, very good with no defects, within the guidance to risk assessment for reservoir safety management.The analysis has shown that the Development will not lead to an unacceptable increase in risk due to breach of the Embankment. The effect of the Headpond on flood risk will therefore be negligible based on the very low likelihood of occurrence.

References

Ref 1. Department of Environment, Food and Rural Affairs, Guide to risk assessment for reservoir safety management, 2013.

Ref 2. Reservoir inundation mapping methodology, SEPA 2011

Ref 3. Reservoirs (Scotland) Act 2011, Scottish Parliament, 2011

Red John Pumped Storage Scheme
Public and Local Community Council Meeting

Thank you for attending this public and local community council meeting, held in Dores on the 30th January 2019. The following table provide summary responses and post meeting notes to those delivered verbally at the meeting. These have been published in themes to assist and with the names redacted for privacy:

Theme	Question	Applicants Response
Engineering Design	Is there anything new and innovative about this particular PSH scheme?	Nothing new as such or that is specifically different on this project than any other in the UK. The extent of the headpond embankment is relatively rare for reservoirs but there are many examples worldwide. Within Europe, the projects which are of a comparable scale / nature to Red John are listed below. • Turlough Hill PSH – Ireland • Goldisthal PSH – Germany • Erzhausen PSH – Germany • Rönkhausen PSH – Germany Within Scotland, Scottish Water have 83 'large'[1] embankment dams, those which are the most comparable to Red John, in terms of scale, are listed below. • Meggat Dam • Upper Glendevon Reservoir • Backwater Dam • Daer Dam [1] – *A large embankment dam has been defined in line with the International Commission on Large Dams (ICOLD) definition which states a large dam is >15m in height or is between 5 and 15m in height with over 3Mm³ of storage.* SSE also have a number of reservoirs and dams within Scotland, these are not necessarily the same type of dams as that proposed for this project. However, similar to this Development, the dam built for the Glendoe is a rock fill embankment dam.

Theme	Question	Applicants Response
	Could you not dig further sown to avoid visual intrusion and risk?	Digging down would mean that there was a significant excess of excavated material on site. This would require offsite disposal which would add many thousands of lorry trips to local roads during the construction phase. It would also reduce the generating capacity of the project which needs as much height difference between the Headpond and Loch Ness as possible.
	Consideration of problems with construction, risk and climate change in designing dams (referring 2015 quote in National Geographic from AECOM)	These comments (from the AECOM representative in the USA) are very generalised and probably international in context. However, they relate primarily to earthfill dams which may only be subject to periodic, or little, monitoring. The embankment proposed for this Development is very different. The Red John headpond will have a rigorous inspection regime, as required in the UK under the Reservoirs Act. In addition, as the pumped storage facility will be a staffed and operational facility to which there will be good access, it will be monitored much more frequently than a remote or unstaffed reservoir. . Furthermore, the Headpond will be emptied regularly allowing both the inside and outside faces of the embankment to be inspected frequently. Further assurance is that the headpond will be designed to be drawn down quickly (that being the essence of pumped storage) through a tunnel (the high pressure tunnel and low pressure tunnels) specifically designed for that purpose. The Development Headpond is not, for comparison, a water supply reservoir where (typically) water is stored at reservoir full. Furthermore, this Development has no natural catchment (other than rainwater) so flood flows – which can cause problems if insufficient spillway capacity is provided (which is what Mr France is talking about) – are not a relevant consideration.
	Why have you chosen Option B for the headpond? This seems the most risky as you're building on a natural fault line.	There are a number of geological faults in the area. These are to be avoided if possible but any possible effects can be mitigated during the design of the embankment. The fault line in question is classed as an 'inferred fault' by the British Geological Survey (BGS), this means the exact location of it is unknown. The Great Glen Fault, which runs along Loch Ness, has an impact on the surrounding bedrock for many kilometres and it is this fault line that has created the potential varying rock quality across the Development and at both of the Headpond options that were considered. Given the short distance between the locations of Option A and Option B, it is unlikely that there are considerable differences in the rock quality which would result in one of the options being considered as more or less risky than the other. Detailed ground investigation work will be undertaken as part of the final design phase.

Theme	Question	Applicants Response
	Why does this scheme need a headpond if Scotland is already very hilly?	ILI have looked at multiple locations for such a facility and a combination of factors contributed to the selection of this one. All pumped storage facilities need a Headpond although it is more usual for a valley to be dammed.
	What steps have been taken to minimise night lighting from the PSH scheme site?	No lighting is proposed at the Headpond, other than if this is stipulated on the diversion of the C1064. At the Inlet / Outlet structure on Loch Ness, there will be no lighting required on this structure and we will be installing infra-red cameras for security during hours of darkness due to comments from the Ness Fisheries about illegal salmon poaching.
Flood Risk	Is there a risk (*of headpond failure*)?	A dam breach assessment is a statutory requirement for all new dams and reservoirs. The acceptability criteria are set out by the Health and Safety Executive (HSE) and the Department for Environment, Flood and Rural Affairs (DEFRA) through the latest Reservoir risk assessment guidance. The assessment is based on the risk of failure of the embankment and includes factors relating both to the consequences and to the probability of the failure. In the case of the Red John embankment, the outcome of this assessment placed the risk in the “Broadly Acceptable” category. This term is further explained below. Dam safety procedures in Scotland are written into the law via the Reservoirs (Scotland) Act 2011. This stipulates that every reservoir over a certain size has to be inspected every year by a Reservoirs Panel Engineer. A different Reservoirs Panel Engineer must also certify that the design and construction of the reservoir is appropriate for its purpose. The Act makes reservoir owners, operators and managers legally responsible for the safety of their reservoirs. They are required to employ suitably qualified civil engineers to make regular checks on safety in between the Panel Engineers' inspections. This system of supervision, which was introduced into the UK after a failure in Wales in 1925, has eliminated the failure of dams which are covered by the Act. In practical terms, this means that any problems are spotted early by monitoring and inspection and the water level in the reservoir is lowered so that the dam can be further inspected and, if necessary, repaired. Whilst the risk of failure is minuscule, an assessment was carried out as required by, and based on, the method stipulated by SEPA for assessing the extent of flood inundation from a breach (Chapter 9: Flood Risk and Water Resources of the EIA). Such assessments are used to inform The Highland Council emergency planners in the same

Theme	Question	Applicants Response
		way that they are informed about flood risk from rivers and lochs. All other data is classed as sensitive information and is therefore held confidential by SEPA. This approach is the same for all new and existing reservoirs within the UK. The EIA reported that the level of risk was determined to be "Broadly Acceptable". This is based on research into societal risk acceptance which is defined in extracts from the *Guide to Risk Assessment for Reservoirs Safety Management* (DEFRA) and the *Reducing Risk, Protecting People* (HSE). The *Guide to Risk Assessment for Reservoirs Safety Management* refers to "Broadly Acceptable" as follows: *"Risk compared with those that people live with every day, and that they regard as insignificant and not worth worrying about (for example, health risk associated with using mobile phones)" (Section 9.3.1, page 160).* The HSE document "*Reducing Risk, Protecting People"* defines the Broadly Acceptable region as being the tolerable region and defines the risk in this region as *insignificant or trivial in their daily lives* (Section 123, Page 43). It should also be noted that SEPA, the competent authority responsible for ensuring compliance with the Reservoirs (Scotland) Act 2011, said the following in their consultee response (attached) on Flood Risk: ***"7. Flood risk*** *7.1 The owner/operator/applicant of a reservoir has a legal responsibility to comply with the requirements of the Reservoirs (Scotland) Act 2011. Our Assessment of Potential Application of the Reservoir Inundation Maps for Land Use Planning Purposes Position Statement indicates that the probability of failure of a reservoir structure managed under the 2011 Act is considered to be so low that it is beyond the scope of likely probabilities considered within the Scottish Planning Flood Risk Framework. As a result, we have not considered the reservoir breach analysis when providing you with advice on flood risk."*
	Why are you constructing this scheme if it's not environmentally friendly and has a flood risk?	The EIA Report has objectively outlined the potential for environmental adverse effects as a result of the construction, operation and decommissioning of this Development. A range of environmental factors have been assessed as agreed within the Scoping Report and the Scoping Opinion which was received from Energy Consents Unit. The Highland Council and ultimately Scottish Ministers will determine whether, on balance, the Developments potential

Theme	Question	Applicants Response
		effects will, on balance, be acceptable. A range of mitigation measures have been recommended and will be implemented via the Section 36 consent or Section 75 provisions. These are summarised in the Mitigation Register which is contained in Appendix 17.1 (Volume 5) of the EIA Report. Response regarding flood risk is covered above.
	What would the fatality risk be?	Refer to the answer above on risk assessment.
	There must be a risk if there is sensitive material in the confidential appendices and terrorists could potentially target this area as a result.	The statutory guidance does not differentiate between dams of different sizes so all design information relating to dams is classified as “Official Sensitive”. There is nothing about the Development that makes it any more or less sensitive or vulnerable than any other dam.
Impacts of Flood Risk on Properties	Have you discussed house valuation, insurance and compensation? Will insurance increase due to this scheme?	During the meeting, ILI took the action to speak to their insurance company. This insurance company has advised the following: *We wouldn’t be able to issue a letter commenting on what action a third parties home insurer will take in respect to the dam being built as we have no authority to comment on their underwriting strategy.* Therefore we have contacted a local resident who in turn has spoken to their insurance company and the policy underwriters. The insurance company has confirmed that property rates would not increase due to the presence of a dam, and that there would need to be precedent for rates to be adjusted.
	Would ILI be prepared to offset any Increases in house insurance premiums?	Due to the negligible risk factor and advice from a local residents insurance company, we are assured that house premiums will not be affected.
Availability of Information	Why can’t we see the confidential appendices?	See answer above. The statutory guidance referred to is: the National Protocol for the Handling, Transmission and Storage of Reservoir Information and Flood Maps, UK Reservoir Safety Liasion Group, Version 2.4.5 – June 2018
Transport	Transport plan for Red John is very poor, no consideration of local schools, no mention of speed restrictions, bad experience with	The Framework Construction Traffic Management Plan (CTMP) provided in the EIA Report (Appendix 15.1, Volume 5) provides the basis from which a finalised CTMP will be developed post-consent. This will be significantly more detailed and will include information relating to

Theme	Question	Applicants Response
	construction workers previously as they didn't keep to speed limits and were not experienced driving on country roads, the EIA did not mention exact location of new roads. The community want better traffic management plan-AECOM haven't made the effort to speak to the surrounding community councils. Disappointed with lack of communication	local road improvements, traffic restrictions for site vehicles, safety measures etc. The restrictions and measures listed in the Framework CTMP serve as the legal minimum from which more detailed, stricter and informed measures and/or restrictions will be based on. Input and feedback from local communities relating to road improvements, enforcement measures and restrictions will be sought - as stated in the EIA chapter - for inclusion in the finalised CTMP post-consent. Any road improvements or restrictions will be in agreement with the Highland Council and would focus on the areas/issues identified in the South Loch Ness Road Improvement Strategy in addition to any widening or visibility improvements required for construction traffic. Farr Primary School has been directly mentioned in the Framework CTMP and restrictions have been proposed during school opening and closing hours to maintain safety. Aldourie Primary School is likely to only be impacted by abnormal loads which would be transported during off-peak hours (evening/night time) and be escorted therefore safety would be maintained. The exact location and nature of road improvements cannot be specified until the Construction Contractor has been appointed and finalised designs have been submitted and approved by the Highland Council.
Consultation Responses	Would you give us more cooperation with our community councils in terms of planning and flexibility with response dates?	We can confirm that we have spoken to the ECU and they will confirm the extension to your response deadline until the end of the month, to allow for further meetings to be undertaken.
	No extension from ECU-unhappy with this and would like collaboration with ILI, AECOM and the community councils to sort out issues.	
Communication and Liaison	Spoke about bad experience with Tullich homes building contractor not knowing about local roads and access etc. Would be good to have a community liaison with this project.	We would very much welcome the opportunity to have local community involvement in the proposed Project Liaison Group, which is outlined in the CEMP, and see representatives from local community councils as being some of the core representatives. The CEMP will be amended to add more detail on the roles and responsibilities which this Group would have, how regularly it would meet and any feedback mechanism which can be implemented via the dedicated Environment Manager and / or Liaison Officer.
Demand Trends	Can you clarify how electric cars will effect PSH	It is likely that modern pump storage hydro will work differently from previous projects

Theme	Question	Applicants Response
	due to their increased use and the effect of night time pumping?	because the nature of the generation mix on the grid and the patterns of demand (such as electric cars) are changing. Previously PSH was used as “arbitrage” to even out the peaks in electricity demand (in the morning and evening) with the generally steady electricity output of coal and nuclear power stations. In the future it is likely that PSH will be used to balance the more intermittent power output from wind, solar and conventional hydro.
Next Steps	If the scheme gets consent but there is no buyer, what happens?	The project will not be built until a buyer is in place. The consent is valid for 5 years from point of approval.
	Could you explain your investment in benefiting out community and our households? I’m concerned about ILI building and leaving the liability of the project with the community.	We have offered community ownership which we are having positive ongoing discussions. This is in addition to community benefit, again where discussions are ongoing. This could be for the next 100 years and beyond.
	How is this scheme going to be financed?	This will be a project of national significance and the buyer will be a significant investment / development operator.
Construction Phase	How will the PSH scheme actually affect me in terms of what I see, hear etc.?	The Non-Technical Summary of the EIA Report provides a summarised version of the full assessment. Detailed photomontages from key viewpoints are available in Volume 4 and there is a comprehensive summary of mitigation to be implemented contained within the Mitigation Register in Appendix 17.1 (Volume 5). There will be the intake structure on the shore of Loch Ness and there will be the headpond at the top of the hill. The latter will be visible initially until the landscaping and native broadleaved woodland matures. This is explained in much more detail in the EIA Report and within the visualisations. There are no emissions or noise anticipated from the Development in operation.
	Why is there not a workers compound in place to reduce traffic issues?	It is anticipated that most of the workforce will be provided by the Inverness area and surroundings given the skills and knowledge base within the locality from projects such as Glen Doe and Foyers, plus in Inverness. It is envisaged that some on site accommodation will be provided within Compound 1 for those workers required for critical path activities.

1. What the CC wants to know in order to assess the risk issue is what constituted the fatality rates classed as being within a 'Broadly Acceptable' number as presented in your EIA? For the avoidance of doubt we would like this number no matter how unlikely the event.

The rates were calculated as part of a dam breach assessment which is a statutory requirement for all new dams and reservoirs. The acceptability criteria are set out by the Health and Safety Executive (HSE) and the Department for Environment, Flood and Rural Affairs (DEFRA) through the latest Reservoir risk assessment guidance. The assessment is based on the risk of failure of the embankment and includes factors relating both to the consequences and to the probability of the failure. In the case of the Red John embankment the outcome of this assessment placed the risk in the "Broadly Acceptable" category. This term is further explained below.

Dam safety procedures in the Scotland are written into the law via the Reservoirs (Scotland) Act 2011. This stipulates that every reservoir over a certain size has to be inspected every year by a Reservoirs Panel Engineer. A different Reservoirs Panel Engineer must also certify that the design and construction of the reservoir is appropriate for its purpose. The Act makes reservoir owners, operators and managers legally responsible for the safety of their reservoirs. They are required to employ suitably qualified civil engineers to make regular checks on safety in between the Panel Engineers' inspections.

This system of supervision, which was introduced into the UK after a failure in Wales in 1925, has eliminated the failure of dams which are covered by the Act. In practical terms this means that any problems are spotted early by monitoring and inspection and the water level in the reservoir is lowered so that the dam can be further inspected and, if necessary, repaired.

Whilst the risk of failure is miniscule (refer above) an assessment was carried out as required by, and based on, the method stipulated by SEPA for assessing the extent of flood inundation from a breach (Chapter 9: Flood Risk and Water Resources of the EIA).

Such assessments are used to inform The Highland Council emergency planners in the same way that they are informed about flood risk from rivers and lochs. All other data is classed as sensitive information and is therefore held confidential by SEPA. This approach is the same for all new and existing reservoirs within the UK.

The EIA reported that the level of risk was determined to be "Broadly Acceptable". This is based on research into societal risk acceptance which is defined in extracts from the *Guide to Risk Assessment for Reservoirs Safety Management* (DEFRA) and the *Reducing Risk, Protecting People* (HSE).The *Guide to Risk Assessment for Reservoirs Safety Management* refers to "Broadly Acceptable" as follows:

"Risk compared with those that people live with every day, and that they regard as insignificant and not worth worrying about (for example, health risk associated with using mobile phones)" (Section 9.3.1, page 160).

The HSE document "*Reducing Risk, Protecting People"* defines the Broadly Acceptable region as being the tolerable region and defines the risk in this region as *insignificant or trivial in their daily lives* (Section 123, Page 43).

2. Could you explain your position on why option A was abandoned? No need to go into too much detail, just the main points.

   Option A was not taken further after consultation was undertaken with local communities and regulators, and the Scoping Opinion was received from the Energy Consents Unit. The vast majority of consultation responses identified Option B as the most favourable option. The only exception was the Forestry Commission, due to the impact on tree felling from Option B.

   The main issues raised for Option A were.

   - Ecology – Presence of Red Throated Divers
   - Archaeology – Proximity to remains of Caisteal an Dunriachaidh
   - Water Quality – Proximity and interaction with Loch Duntelchaig and proposed drainage of the lochs in to Loch Duntelchaig to enable construction of the Headpond
   - Water Resource – Increased loss of catchment of Loch Duntelchaig

   This is covered in Volume 2, Chapter 3: Alternatives of the EIA Report in greater detail.

3. Was any form of breach analysis carried out on Option A, no matter how draft?

   No breach analysis was undertaken for Option A.