

Cultural Heritage Heritage Impact Assessment

Cruachan 1
Unit 3 & Unit 4 Upgrade

January 2023

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Appendix 1: Designation Description, Cruachan Turbine Hall

1.0 INTRODUCTION

- 1.1 Barton Willmore, now Stantec (BWnS) has prepared this Heritage Impact Assessment, on behalf of Drax Pumped Storage Limited ('the Applicant') for the proposed Unit 3 and Unit 4 Upgrade at Cruachan Hydro Electric Power Station Turbine Hall (the 'Site'). This Assessment has been prepared to accompany the application for consent under section 36 of the Electricity Act 1989 (ECU Reference ECU00004537) and Listed Building Consent.
- 1.2 Historic Environment Policy for Scotland (HEPS), 2019 requires that decision making should be based on a robust understanding of the significance of the assets affected. That is the purpose of this statement.
- 1.3 The scope of this Heritage Impact Assessment appraises the cultural significance of the built structures. It does not consider the known or unknown archaeological potential of the Site.

The Site

- 1.4 Cruachan 1 is a pumped storage hydro-electric facility and one of four large-scale pumped storage facilities in the UK. It currently operates with a nominal maximum output of 440 MW in full generation mode with an average annual generation output of circa 300 GWh/year. The facility comprises the following main components:
- Cruachan Reservoir (upper head pond),
 - Energy storage in upper head pond,
 - Twin 4.6m diameter headrace tunnels that bifurcate to four steel lined unit penstocks,
 - Underground cavern power station housing 2x 100MW and 2x 120MW reversible Francis pump-turbines and motor-generators, and
 - Single 6.8m horseshoe shaped tailrace tunnel and inlet/outlet structure on the bank of Loch Awe.
- 1.5 The Site, for the purposes of this assessment is confined to the existing Cruachan 1 Turbine Hall and associated access tunnel.

Heritage Designations

- 1.6 Given the localised nature of the proposals and the fact that this element of the scheme will be below ground, the only heritage asset which will be impacted by the proposals is the Category A listed 'Ben Cruachan Hydro Electric Scheme, Turbine Hall.'

- 1.7 Listed buildings are afforded statutory protection through the Planning (Listed Buildings and Conservation Areas) Act 1997, together with any amendments set out in the Historic Environment Scotland Act 2014. Sections 14 and 59 of the Act, require local planning authorities to have special regard to the desirability of preserving a building or its setting or any features of special architectural or historic interest it possesses.

Methodology

- 1.8 This Statement will set out an assessment of significance in regard to Ben Cruachan Turbine Hall. It will then go on to consider the potential impacts of the proposed works within the legislative and policy context.
- 1.9 The assessment of significance follows the heritage interest led approach set out in HEPS, comprising aesthetic, historic, scientific, and social values. This has been guided by the definitions provided in the 'BURRA Charter: Charter for Places of Cultural Significance' (2013). The assessment of setting follows the staged approach set out in Historic Environment Scotland's guidance document 'Managing Change in the Historic Environment: Setting' (2016).

2.0 POLICY CONTEXT

National Planning Policy

- 2.1 Paragraph 3.30 of Scotland's Third National Planning Framework, 2014 (NPF3)ⁱ acknowledges that hydroelectric power is a "key asset in the north of Scotland" and that "...increasing the capacity of pumped storage hydroelectricity can complement our ambitions for more renewable energy capacity. Amongst the most advanced plans for this, and one which builds on an existing asset, are the proposals to increase capacity at Cruachan. We have identified new and expanded pumped storage facilities, including Cruachan, as a national development." Paragraph 4.6 notes that "The historic environment is an integral part of our well-being and cultural identity."
- 2.2 Revised Draft National Planning Framework 4 (NPF4)ⁱⁱ was laid before Scottish Parliament on 8th November 2022. Pumped Storage Hydro continues to be recognised as a National Development in Revised Draft NPF4 which will supersede NPF3 when approved by the Scottish Parliament and thereafter by Scottish Ministers. Cruachan is singled out as a "nationally important example of a pumped storage facility with significant potential for enhanced capacity".
- 2.3 Paragraphs 135-151 of the Scottish Planning Policy (SSP)ⁱⁱⁱ deals with conserving and enhancing the historic environment and sets out the Government planning policy. The guidance recognises the importance of preserving designated and non-designated assets and how they contribute to a "sense of place, cultural identity, social well-being and economic growth." It also notes that in order to enable positive change to heritage, this should be informed by a "...clear understanding of the importance of the heritage assets."

Local Planning Policy

- 2.4 The Development Plan Framework for Argyll and Bute comprises the Local Development Plan^{iv}. Those policies relevant to the built heritage assessment are:
- Policy LDP 3 – Supporting the Protection, Conservation and Enhancement of our Environment.
 - SG LDP ENV 16(a) Development Impact on Listed Buildings.
- 2.5 The emerging Argyll and Bute Proposed Local Development Plan 2^v is also a material consideration in decision-making. Policies 15-21 are relevant to this assessment.

Legislative Context

Planning (Listed Buildings and Conservation Areas) Act 1997^{vi}

- 2.6 Listed Buildings are afforded statutory protection under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. Sections 14 and 59 require that local planning authorities have special regard to the desirability of preserving the heritage significance of listed buildings and their setting when determining listed building consent and planning applications, respectively.

Best Practice Guidance

- 2.7 Historic Environment Policy for Scotland (HEPS)^{vii}, 2019 is a material consideration in the planning process. That document sets out the considerations that need to be taken into account when proposals affect the historic environment. HEPS “sets out a series of principles and policies for the recognition, care and sustainable management of the historic environment.”
- 2.8 Historic Environment Scotland has published a series of guidance documents which are intended to guide changes to the historic environment including:
- Managing Change in the Historic Environment: Engineering Structures (2020)^{viii}
 - Managing Change in the Historic Environment: Use and Adaptation of Listed Buildings (2020)^{ix}
 - Managing Change in the Historic Environment: Interiors (2016)^x

3.0 STATEMENT OF SIGNIFICANCE

Scoping

3.1 Given the nature and scale of the proposals, the only historic asset considered to be affected by the development is:

- Ben Cruachan Hydro Electric Scheme, Turbine Hall – Category A listed building

Statement of Significance

3.2 The assessment of significance follows the heritage interest-led approach set out in the Historic Environment Policy for Scotland (HEPS), comprising aesthetic, historic, scientific, and social values. This has been guided by the definitions provided in the 'BURRA Charter: Charter for Places of Cultural Significance' (2013). The assessment of the contribution made by the setting of the heritage assets follows the staged assessment approach set out in Historic Environment Scotland's guidance document 'Managing Change in the Historic Environment: Setting' (2016).

Ben Cruachan Hydro Electric Scheme, Turbine Hall

3.3 As a Category A listed building, the heritage significance of the Turbine Hall as a receptor is derived primarily from its aesthetic and scientific value, arising from its innovative technological engineered design. The designation describes the receptor as:

"...a monumental engineering achievement and an integral part of one of Britain's most innovative hydro-electric power schemes and the first example of the use of reversible turbine pumped storage technology."

3.4 The Turbine Hall is of high historic cultural significance for the role it played in the technological development of hydroelectric power and the post-war energy programme of Scotland. In 1965, when construction was completed, the asset was the first example of a reversible turbine pumped storage plant in Britain. This development was significant for British power generation as it improved energy efficiency; with the power station being able to store otherwise wasted energy produced in off-peak hours to instead be used when it was most needed. The construction of a power station of this scale, underground, and utilising pumped storage was 'pioneering' and paved the way for similar schemes elsewhere in the world. The hall was designed by James Williamson and Partners and is

noted in the listing as being 'typical of their approach' which was defined as being innovative and forward thinking. Williamson and Partners became synonymous with the North of Scotland Hydro Electric Board (NoSHEB).

- 3.5 The scale of the Turbine Hall and its functional character allows for an appreciation of the technological achievement of its construction. The structure comprises the main Turbine Hall and access tunnel, at the point where the access tunnel meets the Turbine Hall, there are several secondary tunnels, adits, and shafts, including the 'viewing gallery, transformer hall and surge shaft.' Through discussions with HES and the Argyll and Bute Council, it has been agreed that the designation includes the main access tunnel.
- 3.6 The Turbine Hall is large in scale and is barrel vaulted with areas lined with concrete . A large industrial gantry runs west to east along the hall and 1960s rectangular lighting hangs from the ceiling. The south side of the hall has exposed bedrock walls and the four generators sit at the centre of the hall which has a later tiled floor.
- 3.7 The receptor holds high architectural significance for its distinctive 1960s interior design, featuring a timber mural by the artist Elizabeth Falconer. The Turbine Hall is 36m high by 90m long and features several design features dating from the 1960s, including the timber mural, lighting and use of timber and concrete throughout. The designation (**Appendix 1**) notes the following features specifically:
- Viewing gallery to NE corner,
 - Concrete lined vaulted roof,
 - Supported track and gantry cranes,
 - Tiled Floor
 - Timber mural by Elizabeth Falconer,
 - Timber panels and acoustic baffling panels of concrete, geometric shapes,
 - Projecting window to control room,
 - Large overhead lighting panels.
- 3.8 The south wall of the hall has the highest architectural and artistic cultural significance, with a multitude of 1960s period design features. Wooden panelling and geometric concrete baffling panels line the face of the south wall. A timber and glass control room projects over the four generators on the upper level. Along the lower level, are the control panels which date to the 1980s with the internal workings having been replaced over time. Elizabeth Falconer's wooden mural sits on the south wall near the west end. The mural depicts the local legend *Cailleach Bheur* (the Old Hag of The Ridges), and references

the construction of the dam (with the fifteen shrouded figures referencing the fifteen lives lost in construction). These features contribute to create an attractive and significant interior with strong mid-20th century designs and imaginative uses of materials.

Setting

- 3.9 The asset is located c.400m below ground level at Cruachan Dam and is accessed by a 1km long tunnel located on the northern shoreline of Loch Awe, this setting makes a positive contribution to the asset's significance. Access to the Turbine Hall is through the main access tunnel, which then opens up to the monumental interior of the Turbine Hall. The length of the tunnel and the contrast in scale between it and the Turbine Hall amplifies the scale of the asset. The fact that asset is set underground enhances the experience, allowing for an appreciation of the engineering achievement accomplished in its construction.
- 3.10 The wider setting of the asset is within the hillside of Ben Cruachan, to the north and west of *Loch Awe*. As most of the asset is underground its landscape setting makes a limited contribution to its heritage interest. To the north of the asset is the reservoir and dam associated with the power plant. These are intimately connected with the function of the asset and contribute positively to its significance. To the east and west, are the mountain slopes of Ben Cruachan, which create an attractive natural setting to the listed building. To the south is the A85 and Loch Awe. These features all form part of the wider setting of the asset; however, they make a limited contribution to its heritage interest.

4.0 HERITAGE IMPACT ASSESSMENT

Proposals

- 4.1 The proposals are set out in detail within the accompanying plans. In summary the proposals seek to replace Units 3 and 4 within the Turbine Hall. These Units are coming to the end of their working life and require replacement to increase efficiency within the power station.

Consultation

- 4.2 Consultation has been undertaken informally with Argyll and Bute Council and Historic Environment Scotland in relation to the proposals. Officers advised that they considered that the works require Section 36 consent and that a Listed Building Consent application would be required.

Impact Assessment

- 4.3 The works will involve the removal of the internal working machinery that makes up Units 3 and 4. The elements of the turbines to be replaced are not visible within the Turbine Hall and are housed, primarily below ground level within large metal casings.
- 4.4 HES Guidance on Managing Change to Engineering Structures, whilst more focussed on physical structures such as bridges, piers, etc, does provide some useful principles which can be applied at Cruachan. The guidance is clear that *"Alterations and repairs to historic engineering structures must protect their character and special interest."* It goes on to acknowledge that that replacement of parts within structures is often necessary, and that it is *"...equally important to achieve continuation of use..."*
- 4.5 It is not considered that the listed building designation was intended to stifle the ongoing maintenance of the turbines and it is acknowledged in guidance that proposals which keep buildings in active use is preferable to buildings becoming redundant. HES Managing Change: Use and Adaptation of Listed Buildings states:

For a building to stay in use over the long term, change will be necessary. This reflects changes over time in how we use our buildings and what we expect of them. This should always be considered carefully and avoid harming the building's special interest. A building's long-term future is at risk when it

becomes hard to alter and adapt it when needed. Proposals that keep buildings in use, or bring them back into use, should be supported as long as they do the least possible harm.

- 4.6 The replacement of the two Units at Cruachan is necessary to ensure the continuation of use and to increase production of the power station. The works to replace Units 3 and 4 will not result in any noticeable visual change to the appearance of the Category A listed Turbine Hall, nor will it result in any loss or damage to other historic features within the structure, such as the control panels or mural.
- 4.7 The special interest of the Turbine Hall is derived from its aesthetic and scientific value, arising from its innovative technological engineered design. The replacement Units will occupy the same space as the existing, with the majority of the structures located below ground level. The external housing which currently surrounds the above ground elements, will be reinstated on a like for like basis. As such, it is considered that the proposals would preserve the special interest of the listed building and would not result in harm to its cultural significance as a monumental feat of engineering.
- 4.8 During discussions with Argyll and Bute Council, it was suggested that due to the historic nature of the turbines being removed, a recording condition was likely to be necessary in order to record the significance of the existing machinery prior to removal. This has been agreed by the Applicant and the report will be deposited in the public archive. It is suggested that a Level 1: Standing Building Recording would be proportionate
- 4.9 HES guidance on interiors states that where removal of interior fixtures is appropriate then it may be that they would be of interest to museums. The Cruachan Visitor Centre is located to the southwest of the Site and discussions have been held with Argyll and Bute Council and HES in relation to whether a part of an old Unit could be displayed with interpretation. Given the scale of the plant being removed, it is considered that this may not be feasible, or practical. However, it may be more appropriate to secure additional interpretation within the Visitor Centre or Viewing Gallery in relation to the turbines and the work being undertaken.

5.0 CONCLUSION

- 5.1 This assessment has been prepared to assess the likely effects of the development in respect to built heritage, based on an assessment of the sensitivity of the Cruachan Turbine Hall.
- 5.2 Whilst each application must be considered on its own merits, it should be noted that a similar application for replacement of internal machinery and plant within the Category A listed 'Grampian Hydro Electric Scheme, Tummel Power Station' was granted in 2020. The proposals and justification were similar to those set out above, and the proposals were found acceptable to secure the long-term viability of the listed building.

Conclusion

- 5.3 When considering proposals affecting listed buildings, there is a presumption in favour of their retention. Policy SG LDP ENV16(a): Development Impact on Listed Buildings guides that development should preserve listed buildings and that development should be of the highest quality, respecting the original structure in terms of scale, design, and materials. It also notes that development will be supported where it is *"...essential to securing the best viable use of the listed building without undermining its architectural or historic character..."*
- 5.4 As set out in Section 4 of this report, the works to replace the existing Units 3 and 4 are necessary to secure the long-term viability of the Cruachan Hydro Power Station. The existing turbines are coming to the end of their working life and will no longer be fit for purpose. The proposals will not result in any visual change to the character or appearance of the listed building, with all visible elements being replaced on a like-for-like basis. The replacement turbines will ensure that the optimum viable use of the structure as a hydro electric power station is retained, and the special interest of the building is preserved.
- 5.5 In conclusion, it is considered that the proposed works would preserve the special interest of the Category A listed Cruachan Hydro Electric Power Station, Turbine Hall and would not result in harm to its cultural significance. The proposals are therefore in accordance with both the legislative tests at sections 14 and 59 of the 1997 Act and local and national planning policy.

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- ⁱ Scottish Government, National Planning Framework 3 (NPF3), 2014 [National Planning Framework 3 - gov.scot \(www.gov.scot\)](https://www.gov.scot/publications/national-planning-framework-3/pages/1-3-introduction.aspx)
- ⁱⁱ Scottish Government, Draft National Planning Framework 4 [Revised Draft NPF4 | Transforming Planning](https://www.gov.scot/publications/draft-national-planning-framework-4/pages/1-3-introduction.aspx)
- ⁱⁱⁱ Scottish Government, Scottish Planning Policy, (SSP), 2022 [Scottish Planning Policy - gov.scot \(www.gov.scot\)](https://www.gov.scot/publications/scottish-planning-policy/pages/1-3-introduction.aspx)
- ^{iv} Argyll & Bute Council. Local Development Plan, 2015 [Local Development Plan \(argyll-bute.gov.uk\)](https://www.argyll-bute.gov.uk/development-planning/local-development-plan)
- ^v Argyll & Bute Council. Draft Local Development Plan 2 [Local Development Plan 2 \(argyll-bute.gov.uk\)](https://www.argyll-bute.gov.uk/development-planning/local-development-plan-2)
- ^{vi} Planning (Listed Buildings and Conservation Areas) Act 1990.
<http://www.legislation.gov.uk/ukpga/1990/9/contents>
- ^{vii} Historic Environment Scotland Policy (HEPS), 2019 [Historic Environment Policy for Scotland | Hist Env Scotland](https://www.historicenvironment.scot/policy)
- ^{viii} Historic Environment Scotland: Managing Change in the Historic Environment: Engineering Structures (2020)
- ^{ix} Historic Environment Scotland: Managing Change in the Historic Environment: Use and Adaptation of Listed Buildings (2020)
- ^x Historic Environment Scotland: Managing Change in the Historic Environment: Interiors (2016)

APPENDIX 1 - Designation Description, Cruachan Turbine Hall

Summary

Category	A
Date Added	11/02/2011
Local Authority	Argyll And Bute
Planning Authority	Argyll And Bute
Parish	Ardchattan And Muckairn
NGR	NN 07990 26720
Coordinates	207990, 726720

Description

James Williamson and Partners; George Rennie (resident engineer for North of Scotland hydro Electric Board technical panel); J B Armstrong (architect); 1959-65. Monumental underground barrel vaulted chamber forming turbine hall hollowed out from solid bedrock with long sloping vaulted access tunnel; additional chambers housing transformers and tunnels, one forming access roadway to machine hall. Large turbine hall 36 metres high, 90 metres long with viewing gallery to NE corner at upper level and concrete lined vaulted roof. Regularly spaced columns to N supporting track for overhead gantry cranes. Tiled floor. Control panels to S wall with large inlaid timber mural by Elizabeth Faulkner above to SE. Alternating timber panels and acoustic baffling panels of concrete consisting of regular geometric shapes to remainder of S wall. Offices to S including control room at upper level with projecting faceted timber and plate glass window overlooking turbine hall floor; transformer room and surge shaft to far S. Large overhead lighting panels with lights contained by panelled timber wings cantilevered from large central beam. Matt grey square ceramic tiles to entrance and replacement tiles to turbine hall.

ACCESS TUNNEL: vaulted vehicular access tunnel running for 1 kilometre from tunnel entrance. Terminating in round arched entrance to turbine hall lined with rectangular slate tiles. Pedestrian entrance to offices directly adjacent to left (E) with split slate tiles forming apron around doorway.

Statement of Special Interest

Ben Cruachan Turbine hall forms and A-group with Ben Cruachan Dam (see separate listing). Ben Cruachan turbine hall is a monumental engineering achievement and an integral part of one Britain's most innovative hydro electric power schemes and the first example of the use of reversible turbine pumped storage technology. The 3240 cubic metre turbine hall was hollowed out entirely from solid bedrock and is set deep within the side of the Ben Cruachan ridge. The turbine hall is accessed by a 1 kilometre long vehicular access tunnel. The lower end of the tunnel terminates in 'the crossroads' where secondary tunnels give access to visitors viewing gallery, transformer hall and surge shaft. The housing of a power station of this scale wholly underground in addition to secondary features such as transformers and pressure tunnels was pioneering and allowed for the development of a power station large enough to play a nationally significant role in energy supply in an area renowned for scenic beauty with very limited visual impact. The station exhibits a number of period design features dating from the 1960s including the timber artwork panel by Elizabeth Faulkner and careful attention to detail in lighting and acoustic design, all with imaginative uses of timber and concrete.

Cruachan was groundbreaking in its use of pumped storage when it was opened by the Queen in 1965, and still provides vital peak load capacity today. During periods of cheap electricity the turbines are run in reverse to pump water from Loch Awe back up into the

reservoir, a process which provides 90% of the water used for generation by the station. Prior to the design of Cruachan pumped storage facilities had required separate pumps and a separate pipe network to pump water back into reservoirs, making them much more expensive to build than conventional hydro systems. The use of reversible turbines at Cruachan was highly innovative and removed the costly requirement for separate pumping infrastructure. The reversible technology was first developed in the 1930s, but Cruachan was one of the first large-scale applications in Europe. The Lünenseewerk station of 1958 in Austria pre-dates Cruachan, but has a smaller capacity of 232 MW. The technology became more widely used, in Britain and worldwide, from the later 1960s onwards with further schemes in Wales at Ffestiniog in 1963 with a 360MW station

The turbine hall houses four turbines capable of a combined capacity of 440MW with 2 sets generating at 120 MW and the original 2 at 100MW. Each set uses approximately 110MW of power to pump water back up to the dam (see separate listing). The station can move from standstill to full generating output in under 2 minutes, compared to a time of several hours for a thermal power station. The station fulfils a key strategic requirement for the UK with the capability to produce enough power to re-start essential services nationwide (a so called 'Black Start').

Cruachan was the penultimate of the major post-war hydro electric developments by the North of Scotland Hydro electric Board (NoSHEB). The scheme played a key role in the realisation of the social agenda of NoSHEB by generating electricity which could be easily exported to the grid (via a connection at Windyhill on the fringe of Glasgow) and sold to Scotland's central belt. Revenue from the sale of the power subsidised the provision of electricity to remote north Highland communities on loss making schemes and stimulated economic regeneration. Under the leadership of eminent chairman Sir Tom Johnston the board undertook developments throughout Highland Scotland. This commitment saw the development of schemes in locations such as Loch Dubh near Ullapool and Storr Lochs on Skye. Johnstone's social aspirations ensured these schemes remained a key part of the NoSHEB development plan.

The design is typical of Williamson and Partners approach. James Williamson had completed a large number of innovative designs on behalf of NoSHEB, including developing the buttress dam which he first used at Loch Sloy (see separate listing) before his death in 1953. The scale and degree of innovation behind the plans for Cruachan is characteristic of the skill of the firm and their long experience with hydro power and commitment to developing Scotland's resources. Williamson had specialised in the design of dams following his work on the Galloway Hydro Electric scheme (see separate listings) in the 1930s. He acted as one of the chief engineering advisors to NoSHEB and was the lead engineer for a number of schemes before his death in 1953. After this date the company of James Williamson and Partners continued to be closely involved in the work of NoSHEB and were the lead team of engineers on a number of schemes, including Cruachan.

(Listed 2011 as part of Hydro Electric Power Thematic Survey)

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The Hydro Boys, (2002), p178-79; J Miller, The Dam Builders: Power from the Glens, 2002, p230-40; F A Walker, The Buildings of Scotland: Argyll and Bute (2000) p375.