Sellafield Ltd

Calder Hall Environmental Management Plan

Issue 15 – September 2022

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Introduction

Calder Hall ceased generating electricity in March 2003, after 46 years of operation. In accordance with Government policy, work has now begun to systematically remove (or decommission) the plant and buildings associated with electricity generation at the site. Prior to commencing this work, Sellafield Ltd, the licensee of the site, were legally required to seek consent from the Health and Safety Executive (HSE) to carry out the decommissioning project.

Application was made to the HSE (now Office For Nuclear Regulation (ONR)) for consent to carry out the decommissioning project at Calder Hall in August 2004. In support of this application, an Environmental Statement was provided, which assessed the impacts of the project on the environment. Following extensive public consultation, the HSE granted consent to carry out the decommissioning project at Calder Hall in June 2005, subject to certain conditions.

Under the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (as amended) (EIADR99) the ONR requires that the Licensee prepare an Environmental Management Plan (EMP) which shall:

- List the mitigation measures that are already identified in the Environmental Statement and evidence submitted [to the HSE] to verify information in the Environmental Statement.
- List the options to implement work activities where mitigation measures may be required but where selection of an option will only be possible in the future; and
- List the work activities where mitigation may be required but where assessment to identify mitigation measures will only be possible in the future.

It is a requirement of the conditions attached to the consent to describe the effectiveness of the mitigation measures over time and review annually or at a suitable frequency agreed with the Office for Nuclear Regulation (ONR). Up until June 2015 the EMP was reissued annually, however due to very little changing operationally at the facility in 2016 and 2017 it was agreed that it was not necessary to reissue an EMP for those years. The last review was issued in September 2021. This review considers any changes at Calder Hall since September 2021 and considers the planned work for the Financial Year 2022/23.

Decommissioning Objectives at Calder Hall

i) Manage the existing hazard at the Calder Hall site.
ii) Manage the progressive reduction in hazard potential on the Calder Hall site.
iii) Continue defueling of the reactors in line with Magnox Operating Plan requirements.
iv) Progress items on the critical path to Care and Maintenance.
v) Minimise ongoing maintenance costs by "Backing Out" of plant and buildings by discontinuing usage and removing services
vi) Remove other plant and buildings as resources permit.

Works Completed and in Progress up to Financial Year 2021/22

Current Status

The Calder Hall site currently comprises four reactors and associated facilities, including two turbine halls, sixteen heat exchangers, the control rod mortuary, and a series of other ancillary buildings. The majority of the facilities are redundant.

Turbine Hall A and a number of adjacent buildings are in an area of land that has been identified for redevelopment as part of the SiXEP Contingency Project (SCP). As such demolition and ground remediation is required in this area by 2023 to support this significant site priority. These works form the Calder Land Clearance Project (CLC).

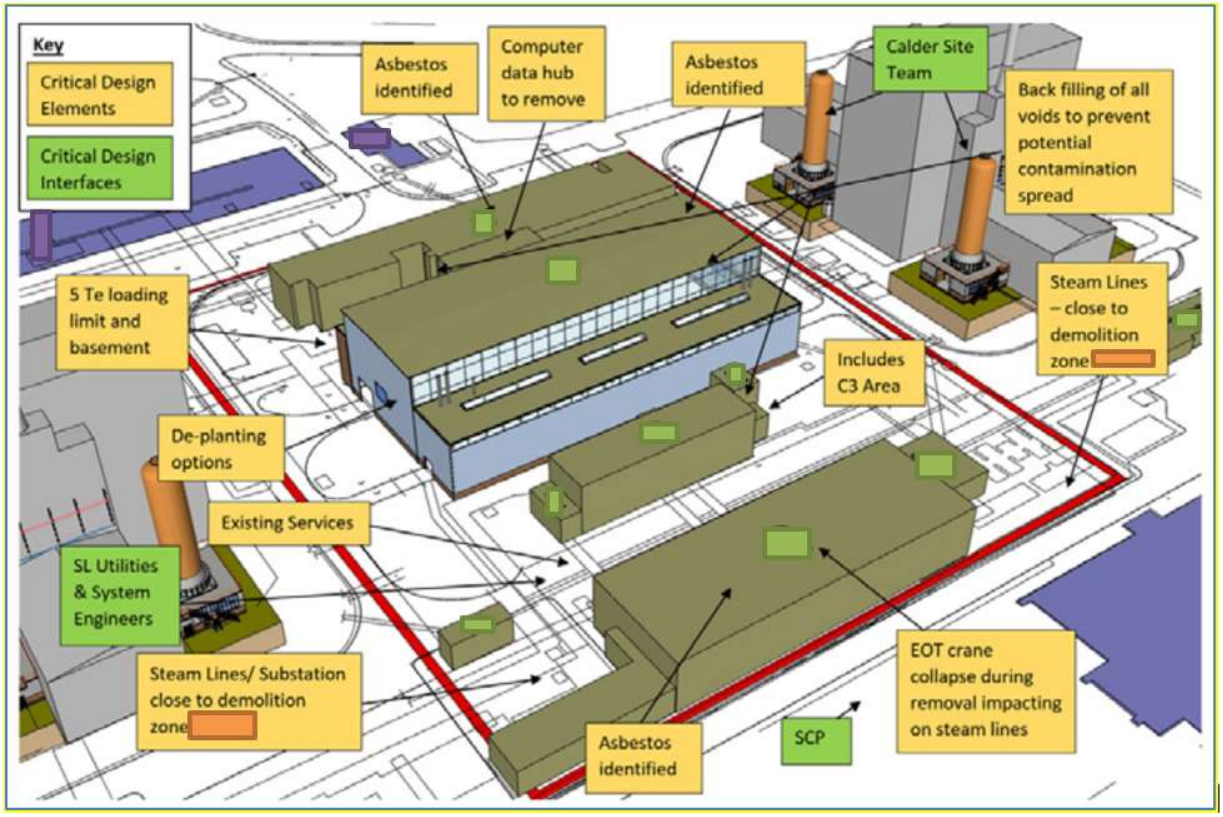

Figure 1: CLC Scope Image.

As part of the CLC project, a Finding Of No Significant Effect (FONSE) form has been prepared (TN/CLC/PROJ/00002/P1). This can be provided upon request.

There is also a general deterioration of the aging facilities on the Calder Hall site, with some buildings such as the turbine halls being in a poor condition. Substantial asset care interventions will be required on buildings if they are not demolished promptly due to increased asset care and maintenance costs.

Asbestos Removal and Other Minor Decommissioning Activities

Over the last few years work has been ongoing to improve the conventional safety in the area through commencement of minor decommissioning activities such as asbestos removal, removal of high voltage electricity cables, service strip out, waste removal and building cladding enhancement.

During 2021/22, a significant amount of asbestos has been removed from the following areas.

Reactor 2 Long Blower House Snake Pits (Circuits 5 & 6) – 2 x Licensed works.

Reactor 3 Long Blower House Snake Pits (Circuits 3 & 4) – 2 x Licensed works.

Reactor 1 all 4 Cyclone Filter Houses (Circuits 1, 2, 3 &4) – 4 x Licensed works.

Reactor 2 Cyclone Filter Houses (South: Circuits 5 & 8) – 2 x Licensed works.

As part of Calder Land Clearance Project domestic water isolations and disconnections have been carried out during 2022 under Plant Modification Proposal (PMP).

Removal of redundant equipment

All four reactors were declared fuel free by August 2019, which is consistent with the MAGNOX Operating Plan. Since defueling was completed in August 2019, the redundant Reactor Pile Cap Fuel route equipment (including Discharge and Charge Machines) have all been removed and disposed of on Reactors 1, 3 and 4. On Reactor 2 the remaining redundant Reactor Pile Cap Fuel route equipment will be removed during 2022/23 and disposed of.

Figure 2: Before and after removal of redundant Reactor Pile Cap Fuel route equipment.

Most of the Reactor 1 compound (and Reactor 2 front area) have had their radiological categorisation downgraded to C1R0 and the fenced areas around the compounds have been significantly reduced enable future Heat Exchanger de-planting tasks to be carried out.

Figure 3: Reactor Compound fence removal after radiological categorisation downgraded to C1R0.

To prepare sufficient space for creation of an area to temporarily locate the HXs, once removed, the Reactor 1 Gallows hoist installation has been demolished and disposed of via the SL waste routes.

Figure 4: Reactor 1 Gallows hoist before removal.

Miscellaneous Demolition

Calder Hall has now reached the end of its life and decommissioning has commenced. A PMP to support preparation work required to ensure the safe deconstruction of the Control Rod Mechanism Workshop In order to safely deconstruct the building to ground level (which will be covered under a separate PMP) the building is required to meet C0 radiological classification.

Overview:

The building was used as a processing area for the decontamination of items from the Reactors to support maintenance. There is a controlled area within the building. This consists of redundant steam/water baths, it should be noted that there was no acid involved in the process.

In terms of the radiological conditions in the building the majority of which is designated R2C2 with a small room (the Cell) designated R2C3. Gamma dose rates are typically background with a few items of active plant and waste displaying slightly elevated dose rates on contact or very local to the items. A few elevated dose rate items are present in the building Cell where contamination has accumulated, including solvent containers, work benches, and pipework connected to the decontamination baths. These items form very local hot spots which have up to 10k cps by DP6R probe and have contact gamma dose rates of up to ~100uSv/h. In general there are relatively low levels of loose and fixed contamination present in the Building including the Cell. It is likely that the majority of the deplant and decontamination work could be done under the C2 designation without the risk of generating significant airborne contamination. However, there is the potential for unknowns in terms of the contamination within some of the plant and in drainage gullies, etc that we won't be able to properly access until we are well into the deplant work. While there is no indication that it will differ significantly from what we currently see, given this uncertainty it is considered prudent to conduct the initial work under a Temporary C3 designation.

All works involved PMP will be carried out in line with a Safe System of Work (SSoW) which will compromise of a detailed Risk Assessment and Method Statement. A quality plan detailing the rollback/declassification process will also be produced ensuring each activity has been completed and approved prior to commencing with the next.

Another PMP supports work required to ensure the safe deconstruction of the Maintenance Workshop and comprises of separate workshop areas and has an overhead crane running the length of the main building.

A third PMP also supports the requirement to safely deconstruct the Welding and Fabrication Workshop and comprises of a workshop area, a grinding bay and a small, segregated section at the building entrance. Subsequent to this work there is also a requirement to remove the Dry Airline Pipebridge adjacent to this workshop, It has been confirmed that these have been isolated and are not in use. The pipes include four (4) lines (Dry Air system, Low Pressure Demineralised Water, CO^2 and Back up Feed Water). Confirmation that these pipes have been isolate is required prior to the deconstruction works. They will then be cut into sections and removed - All works associated with this PMP have been assessed as C0 classification.

Removal of redundant filter pots and supporting steelwork/jib cranes on Calder Reactors 3 & 4 took place was completed in 2021.

Figure 5: Removal of filter pots, Summer 2021.

Removal of legacy effluent

The sampling, analysis & subsequent disposal of legacy IBC's of effluent continued throughout 2021/22. (Of the 54 IBC's 30 were safely discharged 2021/22 with 24 left to discharge FY2022/23).

Figure 6: Legacy IBC's of effluent pending disposal.

Use of Chemical Disposal Hub at Calder Hall

Disposals of legacy chemicals from across the enterprise continued being packed and disposed of from the new chemical disposal hub during 2021/22.

Figure 7: The Chemical Disposal Hub at Calder in 2022.

Project related activities:

- SEAP (Site Emergency Assembly Point)

  A building (Building 'X') at Calder Hall currently acts as the Site Emergency Assembly Point.

  There is a legal requirement for Site Emergency Assembly Point (SEAP) provision (Nuclear Site Licence Condition (NSLC) 11). There are currently 3 Calder SEAPs. Building 'X' is due to be demolished as part of Calder Land Clearance (CLC) to provide land for SIXEP Waste Management (SWM).

  As such, a site has been identified immediately South of the redundant laboratory building for a replacement facility. In 2021/22, this area was cleared of vegetation to allow construction activities to begin.

Figure 8: Land identified for location of new SEAP.

A Heat Exchanger removal Project has been initiated to look into the removal of the 6 Heat Exchangers that need to be lowered to ground to support the SiXEP Contingency Project (SCP).

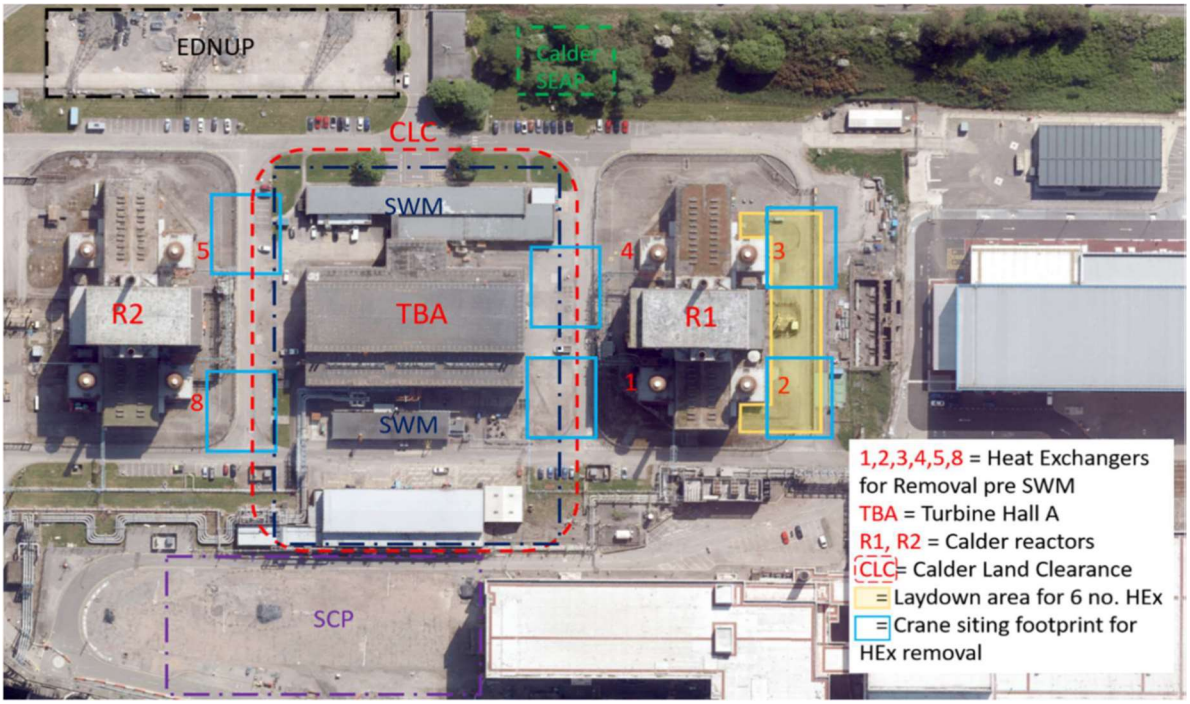

Figure 9: Location of CLC Demolition scope surrounding Turbine Hall A.

This project is split into several packages of work, including Reactor 1 elbows and bellows removal. Figure 10 provides an overview of the key sections that need to be removed.

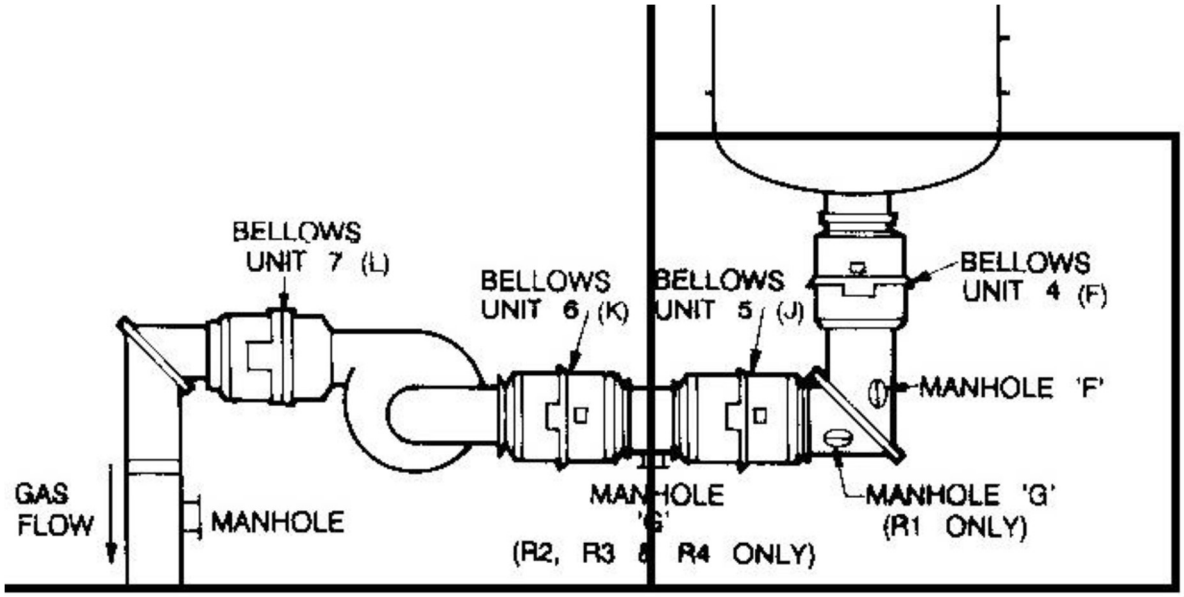

Figure 10: Image showing bellows/elbow section to be removed.

Impact on EIADR

The progress described above is not considered to be a change or extension to the decommissioning project, therefore Regulation 13 of EIADR does not apply, and a Finding Of No Significant Effect (FONSE) form is not required.

Works Planned for Financial Year 2022/23

Decommissioning of Turbine Halls

Turbine Hall B is significantly degraded with water ingress in the building and a corroding structure. On balance of risk the Remediation priority area for decommissioning would be Turbine Hall B. However, it is recognised that the short-term land requirements for Turbine Hall A underpin an As Low As Reasonably Practicable (ALARP) case to prioritise this area, with physical work expected to start in late 2022 / early 2023.

Calder Land Clearance (CLC) and Heat Exchanger Decommissioning

In the short term (2022), the focus will be on commencing early decommissioning to support Calder Land Clearance project (CLC), i.e., asbestos removal, service diversion, and kit removal. Upon completion of the CLC project, it is expected that a construction project will commence on that area of land.

During 2018/19 plans were drawn up for a pilot to remove one heat exchanger. That Pilot did not go ahead in 2019/20. Calder Hall has 16 heat exchangers adjacent to each reactor building that are within the Remediation baseline to remove and laydown. Due to SIXEP Waste Management (SWM) land requirements post Calder Land Clearance (CLC) there is an enterprise programme need for Remediation to remove and laydown 6 number heat

exchangers adjacent to Turbine Hall A, post CLC and prior to SWM build. There are currently no business schedule drivers to remove the subsequent 10 heat exchangers.

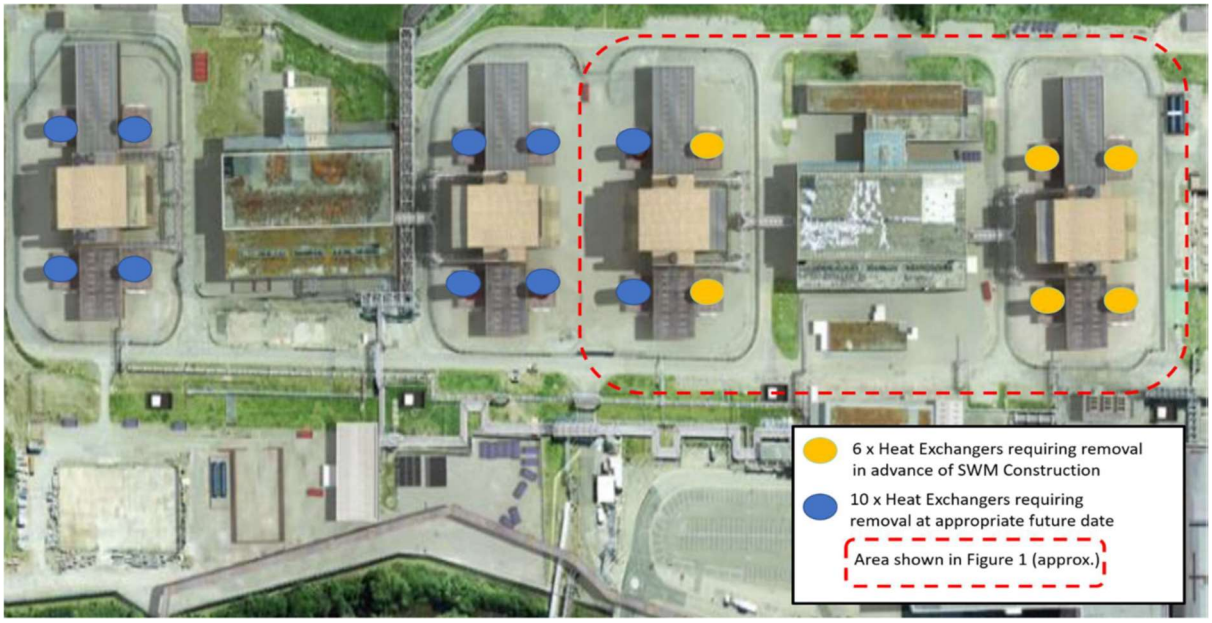

Figure 11: Calder Site overview presenting upcoming work and interactions. Please note, all areas approximate.

The land which currently contains Calder Hall Turbine Hall A and surrounding structures, is to be used as the footprint for the new SWM Facility with construction scheduled to commence in 2024. CLC project has therefore been initiated to demolish Turbine Hall A and its associated facilities by the end of 2023 (Figure 11 above).

Figure 12: Turbine Hall A.

As part of the project to remove the 6 heat exchangers non-destructive testing which involved the use of a Mobile Elevated Work Platform (MEWP) was carried out to ascertain the condition of the steel.

Figure 13: Work on the Reactor 1 heat exchangers.

The PMP for removal of Reactor 1 heat exchanger bottom elbows, Bellows 4 and Bellows 5 was signed in March 2021 and these will be separated and removed during 2022/23. Work is expected to continue of the Heat Exchanger Removal Project during 2022/23 to identify preferred approaches with respect to lowering of the aforementioned six (6) heat exchangers to ground.

Preparation works continue to enable the separation of all the Heat Exchangers on Reactor 1 and heat exchanger circuits 5 & 8 on Reactor 2. During 2023, the Bottom Elbows and the Bellows will be disconnected, blanked off and removed from each Pumphouse. This will allow the future heat exchanger removals to be carried out. Figure 13 below shows how the Bottom Elbows and Bellows will be removed using rails.

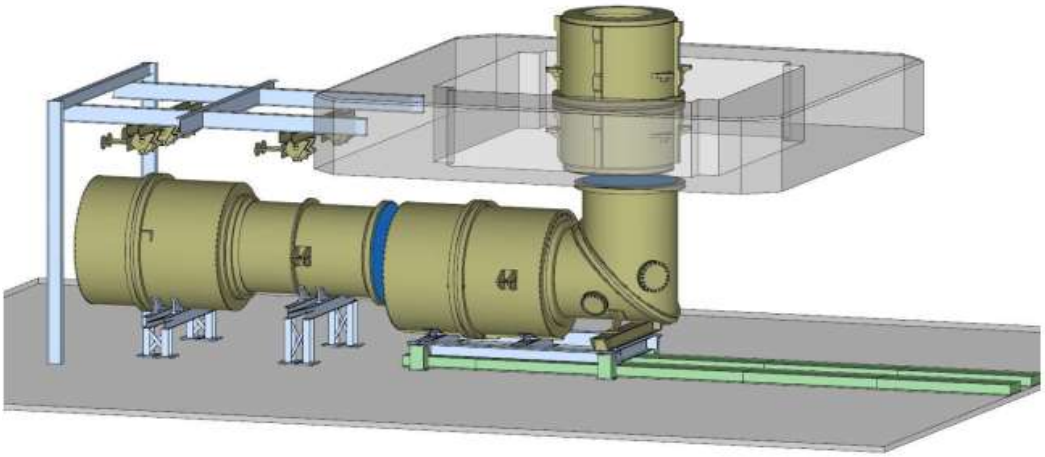

Figure 14: Image showing bellows/elbow section to be removed.

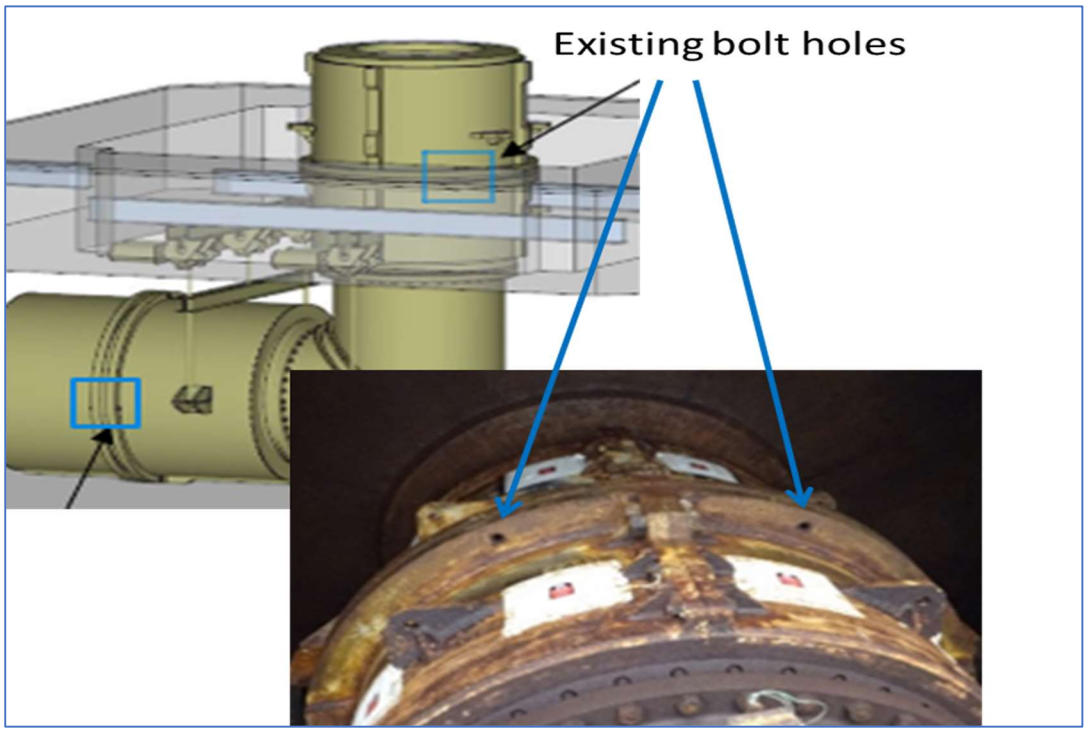

Figure 15: Image of section of elbows & bellows from Heat Exchanger

To further support the Calder Land Clearance project (CLC) during 2021/22, work commenced on installing 10 Groundwater Monitoring Wells, to a nominal depth of 10 metres below ground for eight locations, and 20 metres below ground for the remaining two locations. In addition, up to 10 Vapour Monitoring Wells will be installed adjacent to the groundwater monitoring wells at each location. The vapour monitoring wells were drilled to a target depth of 3m below ground level, using sonic drilling techniques using the same methodology as the groundwater wells. The vapour monitoring wells have been be installed, to a maximum depth of 3m below ground level as described in BS8576:2013 ‘Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs).

These wells will add to the existing groundwater monitoring infrastructure to support the management of land quality at Sellafield (it is anticipated that four of the ten locations will be retained, and the remaining six locations will be decommissioned; (up to ten of the vapour locations will be backfilled) after the completion of the Project. The Hydrogeologist will decide on the actual number of wells required based on the sub-surface ground condition.

These boreholes will be used to determine the ground conditions directly underneath the CLC Footprint prior to any excavations to support the SiXEP Contingency Project (SCP) in identifying any areas of radiological or chemotoxic contamination.

Figure 16: Image of borehole being monitored at Calder Hall

SWM LP Boreholes

In December 2020, ADAPT were authorised by Sellafield Ltd to conduct an intrusive investigation within the Calder Hall site (situated to the east of the River Calder), in an area known as the Cube. There are a series of ongoing engineering projects being conducted in the lead up to decommissioning and demolition within this area; these will be followed by the construction of new facilities that will support long term operations at site.

Based on the understanding of historical operations (detailed within a Phase 1 Desk Study from 2018) and groundwater results from locations near to the Cube (to the West, in the vicinity

of the SIXEP Contingency Plant site, SCP), it was suspected that subsurface contamination was likely to be present within the subject area.

The main chemicals of concern were chlorinated solvents. The purpose of the ADAPT works was to commence characterisation of the chemical conditions within the subsurface, and to evaluate possible sources of contamination. In addition, ADAPT were to consider how these contaminants could move through the ground, and begin to assess the potential for risk (to human health or the environment) associated with them. The drilling conducted was the first major intrusive investigation

within the Cube area (with only one borehole existing in the area prior to this project), with results likely to be used by Sellafield during engagement with environmental regulators, and stakeholders associated with decommissioning, demolition, and construction projects within the Cube.

The project commenced in December 2020, with the siteworks starting in February 2021, and the main phase concluded with the first groundwater (and vapour) monitoring round in July 2021. During this period there was significant time spent managing the presence of asbestos in the shallow soils, as well as waste management, site compound management, and the consignment of samples for issue to offsite laboratories. Tasks associated with drilling of the eight groundwater wells (and eight adjacent vapour wells), on site data collection, soil/groundwater/vapour sampling, and surveying tasks were completed comparatively quickly. Also reported herein are additional assessments conducted during July to September 2021 that build on the characterisation. These included a small soil sampling
exercise inside the Control Rod Mechanism Workshop, and a large sub slab soil vapour survey in the vicinity of building the Maintenance Workshop (intended to improve the understanding of the lateral distribution of contamination and identify sources if possible). Repeat groundwater and vapour monitoring rounds (rounds two and three) have also been conducted (these were intended to improve understanding conditions over time). Radiological analysis has also been conducted on soil and groundwater samples.

Based on samples taken to date, the major findings regarding contamination presence, as detailed in the SWMLP Sampling and Characterisation Ground
Investigation Report, are as follows:

- Analysis of soil and groundwater samples did not return substantial radiological impact, although it should be noted that not all areas of the Cube were due to be characterised in this particular investigation.
- Soil vapour results indicate chlorinated solvents contamination in the three vapour wells located inside the Maintenance Workshop, with the most elevated impact towards the northern end of the building. Groundwater, which was measured at approximately four metres below ground level across the Cube site, also contained chlorinated solvents inside the three groundwater wells situated inside the building. Based on samples to date, no significant evidence of soil contamination has been found for the chlorinated solvents (with only trace detections reported), although not detecting this type of contamination in soil, but finding it in vapour and groundwater, is possible on some sites.
- Significant impact of this type of contamination was not reported in soils, soil vapour, or groundwater to the east of the Maintenance Workshop (five locations are spread across this remaining area, surrounding buildings Turbine Hall A and the main Administration Building). To the west of the Maintenance Workshop (down gradient, and towards the River Calder), on the south western edge of the SCP construction site, evidence of chlorinated solvents continues to be reported from samples taken from the single remaining groundwater well in this area.

- In late 2020 groundwater wells within the SCP construction site itself also detected chlorinated solvents (these wells were decommissioned at that time).
- A sub slab soil vapour survey at the Maintenance Workshop was conducted towards the end of the siteworks phase of this project. A total of 66 interior locations (as well as 5 exterior) near surface locations were advanced. Elevated levels of organic contamination (predominantly chlorinated solvents, as well as suspected petroleum hydrocarbons) were identified within the Maintenance Workshop. The most elevated impact was at the northern end of the main workshop, as well as immediately to the north (within the northern extension).
- With regards to lateral delineation of chlorinated solvents, it should be noted that prior to the investigation starting, a potential source area for chlorinated solvents was considered to be a former drying room at the northern end of the Maintenance Workshop. Findings of the sub slab vapour survey lend further support to this. With regards to groundwater, unfortunately, due to access constraints it was not possible to access the northern end of the Maintenance Workshop (or immediately to the north west of the Maintenance Workshop) with a drilling rig for the purpose of groundwater well installations. If this area is the source of the chlorinated solvents identified in groundwater, there is potential that more elevated concentrations (i.e., higher than found in this investigation) are present in groundwater at the northern end of the building; higher impact in soil and soil vapour is also possible.
- In terms of vertical delineation of the contamination, it is noted that the drilling scope target depth was a maximum of 20 metres below ground. Due to the dense nature of chlorinated solvents, contamination could (at least in theory) be more elevated at greater depths. Based on the appraisal of all of the soil, groundwater, and vapour data obtained during the investigation, including chlorinated solvents, the key findings with regards to risk are as follows:
- Human Health (i): Potential risks to Human Health have been identified. The risk is associated with the presence of asbestos in shallow soils, which was found within the made ground in the majority of test pits. Each pit contained either chrysotile, amosite, or both of these asbestos types; this asbestos requires management.
- Human Health (ii): Regarding chlorinated solvents assessed in the earlier phase of the project, although impact was reported in shallow groundwater vapour and generic screening suggested a possible risk, a more detailed risk assessment indicated that measured concentrations did not pose a significant risk to commercial/industrial users of the area. However, in the subsequent Maintenance Workshop sub slab soil vapour survey, a greater distribution of contamination was found. More intrusive works are required to fully characterise the northern end of the building, and northern extension. This could result in more elevated levels of contamination being found, thus potentially increasing the risk profile.
- Controlled Waters (i): Potential risks to Controlled Waters from the recorded impact are detailed in the SWMLP Sampling and Characterisation Ground Investigation Report. The main risks are associated with chlorinated solvents, with concentrations above environmental screening criteria at locations within the Maintenance Workshop and also the well to the south west of the SCP site (located 40-45m from the River Calder, the surface water receptor). It should be noted that risk assessment conducted to date, for waters, is generic risk assessment only, and that a more detailed risk will ascertain as to whether identified risks are of concern (i.e., would drive the requirement for a detailed management strategy and/or remediation).

Given the pending demolition works in the area, Sellafield recommended that six of the new groundwater wells were retained for long term monitoring. Two new wells (and two installations at an existing old well) have been decommissioned.

Decommissioning of Reactor Buildings and related activities

Several items have been identified for removal from various parts of the four reactor buildings during 2021/22, including asbestos that was installed throughout.

During 2021/22 the removal of the remaining Reactor 3 redundant pile cap fuel route equipment, including discharge and charge machines was completed leaving only Reactor 2 redundant reactor pile cap fuel route equipment (including discharge and charge machines) to be removed and disposed of during 2022/23.

Repairs are required on the reactor building glazing, including spray coating being implemented on the high-level glazing.

Subject to funding and acceptance, the following work will be completed during 2022/23:

- Pilot project on one circuit in Reactor 1 blower house, 54” valve removal and permanent blanking off. This work will include removal of redundant lube oil equipment, section of shield wall and asbestos removal tasks in order to access the valve.

- Phase 3 of the electrical overlay will remove HH Reyrolle Switch Gear from service.

Figure 17: Reactors 2 and 3 at Calder Hall.

Impact on EIADR

From the scope of work described above it is not expected that any of the work will have a significant adverse effect on the environment, and therefore does not require further assessment under EIADR.

Environmental Performance and Mitigation Measures

It is a requirement of the conditions attached to the consent that this EMP reports on the effectiveness of the mitigation measures over time.

There are no significant changes to the mitigation measures that were submitted in the original Environmental Statement. However, there were continual improvements in traffic management due to changes in Sellafield Ltd's Transport Policy, up to the end of March 2020, when the Covid-19 Pandemic forced a change in strategy.

Prior to the Pandemic, employees and contractors were encouraged to share transport, (or use public transport) when travelling to or from the Sellafield Site. Shuttle bus routes and park and ride schemes were developed.

From the beginning of April 2020, these measures were suspended, and were under constant review up until April 2021, based on Government advice in response to the Covid-19 Pandemic.

Assessment of mitigation measures has concluded there is no potential for decommissioning work at Calder Hall planned for 2021/22 to cause any significant environmental effects, based on the following criteria (used in Calder Hall's Environmental Statement, submitted under EIADR 1999):

- Air quality and dust.
- Archaeology and cultural heritage.
- Ecology.
- Geology, hydrogeology and soils.
- Landscape and visual.
- Noise and vibration.
- Surface waters.
- Traffic and transport.

Conclusion

There have been no significant changes to environmental performance since Issue 14 of the EMP was written in September 2021.

There have been no significant changes or extensions to the Decommissioning Project since the Environmental Statement was written in 2004, up to 2021/22.

Decommissioning work that is planned for Financial Year 2022/23 is not expected to have a significant adverse effect on the environment, and therefore does not require further assessment under EIADR. Any other changes or minor impacts will be captured in a FONSE.