2 PROJECT DESCRIPTION

2.1 Overview of the Proposed Project

2.1.1 The Proposed Project will underground a 3.5km section of the existing 400kV (and 132kV) OHL (referred to as the VIP subsection) within a cable tunnel from a location close to National Grid's existing Garth Sealing End Compound (SEC) on the western side of the Dwyryd Estuary to Cilfor on the eastern side of the Dwyryd Estuary. Once constructed and operational, the relevant parts of the existing OHL and associated pylons will be removed. Construction compounds, laydown areas, and temporary access tracks will be required to facilitate construction activities. The Proposed Project will comprise the components listed below and shown on Figures 2.1 (Proposed Works Boundary During Construction and OHL Removal Phase During Construction, drawing numbers PDD-33494-TUN-030 to PDD-33494-TUN-036) and 2.2 (the Proposed Permanent Development, drawing numbers PDD-33494-TUN-037 to PDD-33494-TUN-042).

Table 2.1: The Proposed Project

Project Components
Western Side of the Dwyryd Estuary (Planning Jurisdiction of Gwynedd Council)
• Diversion of third-party assets, including the undergrounding of an OHL supported on wooden poles away from the construction area in accordance with operator requirements
• Reconfiguration of equipment at the existing Garth SEC (including removal of the gantry, there will therefore be no equipment greater than 10m high)
• A tunnel head house (containing a tunnel shaft), with a permanent access road close to National Grid's existing Garth SEC. The ground will need to be raised out of the flood zone level. A permanent power supply and site drainage will be required.
• Underground buried cable to connect into the SEC from the tunnel head house
• Removal of six lattice pylons and associated foundation to 1.5m below ground level
• Temporary access routes (with potential highways improvements or passing places) and laydown areas to facilitate construction activities
• A section of cable tunnel (total length across the Proposed Project 3.4km long, with an internal diameter of up to 4.4m, at varying depths below the ground)
• Landscape and visual mitigation mounding and planting
Eastern Side of the Dwyryd Estuary (Planning Jurisdiction Snowdonia National Park)
• Diversion of third-party assets including the diversion of a water pipeline and OHL supported on wooden poles away from the construction area in accordance with

Project Components
operator requirements
• A new SEC near Cilfor (required to connect the new underground cable to the remaining existing OHL)
• A tunnel head house (containing a tunnel shaft), with a permanent access road. The ground will be raised to create a working platform and will be regraded/ contoured. A permanent power supply and site drainage will be required.
• A section of cable tunnel
• Removal and reinstallation of one pylon (Pylon 4ZC027) adjacent to the new Cilfor SEC
• Removal of two lattice pylons and associated foundation to 1.5m below ground level
• Temporary access routes and laydown areas to facilitate construction activities
• Landscape and visual mitigation mounding and planting (at an appropriate maturity)
Dwyryd Estuary (Planning Jurisdiction of Natural Resources Wales)
• A section of cable tunnel
• Removal of Pylon 4ZC030R, National Grid will also aim to remove all pylon structures including the foundation piles and cofferdam sheet piles; alternatively, foundations will be removed to the maximum depth possible by an excavator located on the working area
• Partial removal of the foundations of the previously dismantled pylon 4ZC030
• Removal of Pylon 4ZC031 and partial removal of its foundations
• Temporary accesses associated with the removals noted above, as well as temporary access to enable the dismantling of Pylon 4ZC032 (although the pylon itself is within the terrestrial environment)

2.2 The Construction Phase

Construction Compounds

2.2.1 Construction compounds will be required at the western and eastern ends of the tunnel surrounding the tunnel head houses. These fenced areas will be used to construct shafts, tunnel head buildings and install cables, and on the west only will accommodate above ground activities associated with tunnelling.

2.2.2 Where present, topsoil will be stripped and stored during establishment of the construction compounds and reinstated once construction operations are completed. The construction compounds will be established as stoned ground over a geotextile membrane (potentially excluding those areas which will remain); or where in sensitive habitats trackways will be used for storage of material to reduce the amount of habitat

being temporarily removed (see Chapter 7 Ecology). Where appropriate, pre-construction field drainage will be installed. Existing third-party services will be located, marked and protected. Warning posts and bunting will be erected for overhead cables and underground services.

2.2.3 The construction compound will comprise a combination of temporary offices and storerooms, equipment, material and tunnel arising (west only) storage areas, workshops, waste storage areas, fuel storage facilities and welfare facilities. Materials and equipment required to construct the Proposed Project will be delivered to the construction compounds. The area required for each construction compound is shown on Figure 2.1.

2.2.4 Due to the nature of the works, security will be employed to prevent access to both construction compounds.

2.2.5 Lighting will be installed at the construction compounds to accommodate the construction and operational phases. Tunnelling activities (24 hour working) and winter working (due to the short-day lengths when lighting will be required at the beginning and end of the day) will require task-specific lighting. Lighting will be used only when required and will comprise lighting of work areas and access routes with low level directional lighting.

2.2.6 There will be no movement of excavated material offsite during weekends and no HGV deliveries outside of the core working hours defined below in para 2.2.89.

High Voltage System Undergrounding

Diversion of Third-Party Assets

2.2.7 A number of third-party assets fall within the immediate proximity, and within the construction area of the Proposed Project. These assets will need to be avoided, protected or diverted in accordance with operator requirements. Of note the following will need to be diverted:

- A water pipeline in proximity to Pylon 027 on the eastern side of the Dwyryd Estuary. This may need to be re-routed to give the required distance from intrusive construction. It is anticipated that the water pipeline will be routed within the proposed construction working area where intrusive works will not take place; although the operator (Welsh Water) will determine the proposed route of the diverted water pipeline.
- An OHL held on wooden poles on the western side of the Dwyryd Estuary which will need to be diverted from the proposed construction working area. SPEN have indicated that this will be relocated below ground in existing hard standing access tracks.
- An OHL held on wooden poles on the eastern side of the Dwyryd Estuary which may need to be diverted from the proposed construction working area.

2.2.8 In addition, a high-pressure gas pipeline exists to the north of the Proposed Project on the western side of the Dwyryd Estuary. This will be safe guarded from construction activities and an exclusion zone applied in accordance with operator (Wales and West Utilities) requirements.

Shaft Construction

2.2.9 In order to construct the tunnel, vertical shafts will need to be constructed at the start and end points of the tunnel. Expected shaft locations are shown on Figure 2.1.

2.2.10 In terms of tunnel shaft depth, one of the shafts will be deeper than the other; the actual depth will be determined during the detailed design stage by the design and build

contractor and a key consideration will be the requirement to maintain the top of the tunnel below -15m AOD over its full length. For the purpose of the Environmental Appraisal, two shaft depth scenarios are being considered as shown in Table 2.2. Shaft construction following site establishment is anticipated to take six months shallow side, and eight months on deep side.

Table 2.2: Shaft Parameters

Shaft Parameter	Western Side of the Dwyryd Estuary	Eastern Side of the Dwyryd Estuary
Location	Garth	Cilfor
Internal diameter	up to 15m	up to 12.5m
Average water inflows[1]	137 m^3/day over 34 days	268 m^3/day over 74 days
Shaft depth scenario 1: Deep shaft located on the west (Garth)	71m	39.5m
Shaft depth scenario 2: Deep shaft located on the east (Cilfor)	32m	73.5m
Approximate size of construction compound	36,255m^2	33,460m^2

2.2.11 A substantial construction compound will be required at each shaft location, and access will be required for bringing in plant and material, an approximate size is provided in Table 2.2 for each construction compound however the exact size of the construction compound will depend on a number of factors and subject to main contractor designed layout.

2.2.12 Areas of peat have been identified within the proposed construction compound on the eastern side of the Dwyryd Estuary. The excavation of peat will only take place within the tunnel head house compound construction area shown on Figure 2.1; remaining working areas will largely be used for storage and will not require the excavation of peat. Should there be the requirement for further peat excavation the measures outlined within the Peat Management Plan will be followed.

2.2.13 Shaft excavation will be taken through softer rock and harder rock will be encountered as depth progresses. This will result in changing construction methodology to suit. There are several methods possible. It is likely that the excavation through softer rock will be made using concrete piles to form a continuous circular wall or concrete rings pushed into the ground. The proposed piling method will be non-percussive and is likely to involve the use of a steel case piling system. Steel cased augers will be rotated and pushed into the ground, excavating material which will be brought up through the middle of the casing. After the steel casing is in place and all excavated material is removed, concrete will be piped in and the steel case removed leaving a complete pile in place. This process will be repeated until a continuous wall is in place around the circumference of the shaft.

[1] Water inflows in the shafts will be variable depending on the depth of the shaft but at this stage in the design, the estimated average water inflows are provided although this may be subject to changes as the design evolves. The average water inflows to the shafts are based on an assumed permeability of 1.0 x 10^{-6} m/s. Water inflows to the tunnel are in addition and outlined in 2.2.20.

2.2.14 Both methods (piles or concrete rings) will be toed into the harder rock then the centre of the shaft will be excavated either using mechanical excavation and /or drill and blast. The control of groundwater will be a key consideration and will be one of the most important health and safety considerations to ensure safe excavations are progressed and the excavation may be made safe using a mixture of grouting from the surface and/ or from within the shaft and sprayed concrete applied by nozzle direct to the harder material face (it should be noted that the final construction methodology will be determined by the cable tunnel design and build contractor once appointed).

2.2.15 Each shaft may need to be have a permanent lining. This lining will be made out of concrete and could be constructed in a number of different ways including continuous pouring of concrete from the base upwards to ground level and/ or sprayed concrete lining or concrete segments. The longer-term build-up of external water pressure will also be considered in the detailed design.

2.2.16 Groundwater will be encountered whilst constructing the shafts, necessitating the requirement to remove ground water from within the shafts during their construction and transfer to a surface water feature in line with National Resources Wales requirements (it should be noted that dewatering is only anticipated for a number of months and not for the full duration of construction activities). Control of groundwater may also be required.

2.2.17 Groundwater inflow during construction through the water table will be minimised by a groundwater exclusion method (secant piles) in soil and ground treatment in rock prior to excavation. This will likely include pre-grouting of rock fissures and joints to reduce its permeability thereby reducing water flows into the excavations.

2.2.18 It should be noted that it is currently unknown whether the water to be discharged will be fresh or saline due to the proximity to the Glaslyn and Dwyryd Estuary. Groundwater monitoring undertaken to date does not indicate saline waters, however this cannot be ruled out at this stage. A network of existing drainage ditches exists in close proximity to each of the shafts. Following a site visit, National Grid and their appointed hydrologist have identified potential discharge points which have been discussed with Natural Resources Wales. Should saline waters be encountered whilst dewatering, pipes will be used to contain the saline waters from the freshwater habitat until a point in the watercourse where brackish waters are encountered (as surface water features get closer to the estuary features). The identified surface waters/ potential discharge routes on the east is illustrated on Figure 2.1 if saline waters are encountered. Discharges on the west are anticipated to be to the drainage ditch adjacent to the tunnel head house. Should fresh water be encountered it is anticipated that water will be discharged to surface waters in closer proximity to the shaft; this will be discussed with Natural Resources Wales as part of an application for an environmental permit or transfer licence.

2.2.19 Water removed from the excavation via pumps which is too turbid for discharge will be diverted to settlement ponds to remove any silt or contaminants before being discharged into the local surface water system. A water storage attenuation system will likely be required at both shaft sites depending on the shaft construction method. These could be up to 85m x 65m, consisting of three linked ponds with varying degrees of water filtration to ensure water discharged to surface water is of sufficient quality.

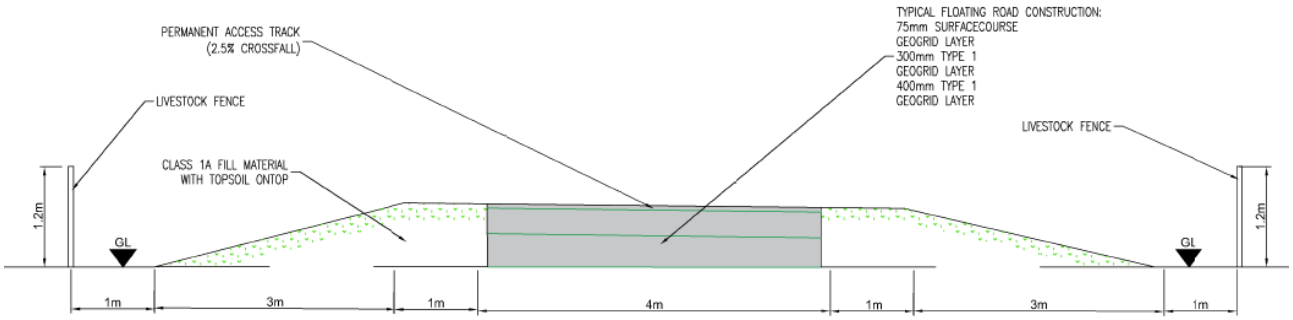
Tunnel Head Houses

2.2.20 Each tunnel shaft will require a permanent head house which will be constructed following tunnelling. The construction area is shown on Figure 2.1. A temporary enclosure may be required over the shaft during construction.

2.2.21 During the construction phase, the western tunnel head house will have up to two temporary access tracks (the location is shown on Figure 2.1).

2.2.22 Access and egress to the eastern tunnel head house during construction will utilise the same access track; this will also be retained during the operational phase. The location of the access track is shown on Figure 2.12 (drawing number PDD-33494-TUN-004F). The new access road will be constructed in an area of peat, which requires the construction of a floating road (or similar) where the peat is not removed from below the road. A typical design of a floating road is provided in Plate 2.1; however, this will be fully engineered and designed by the contractor to suit local conditions and may require placing and settling larger pieces of clean imported stone onto the peat and other areas. The benefits of a floating road over standard road construction are a reduced road thickness (subsequently less weight and compaction), a better distribution of pressure, the surface layer of the peat can remain in situ.

Plate 2.1: Typical Access Road Cross Section



Tunnel Construction

2.2.23 A tunnel with an internal diameter up to 4.4m, will be constructed between the two shafts (the tunnel alignment is shown on Figure 2.1). Tunnel construction is likely to take 17 months following shaft construction. The tunnelling method will use a tunnel boring machine (TBM) to bore through the ground. The tunnel would then be lined with precast concrete segments behind the TBM. The TBM will be launched from the west and received from the shaft at the eastern end of the tunnel. The TBM will be fitted with an effective dust-control system and controlled in a way to minimise noise and vibration. Initially a short section of tunnel (launch chamber (forward shunt) / back shunt) may be constructed using drill and blast or mechanical excavation to enable the TBM to be built below ground and improve the efficiency of the tunnelling process.

2.2.24 The type of TBM will be determined and fully specified by the appointed contractor, based upon the geology and hydrogeology to be expected. It is currently anticipated that the contractor will adopt the use of a Slurry TBM which works on the principle that the ground to be tunnelled through in front of the cutter head is supported by bentonite slurry. Bentonite is a naturally occurring clay mineral used extensively in the construction industry. The mineral is mixed with water at the surface in large tanks to form a slurry, which is supplied to the TBM by a delivery pipeline. The slurry is contained in the head of the TBM in a pressurised chamber that also contains the cutter head which is used to excavate the ground. The slurry is further utilised to remove excavated material in suspension. The slurry is mixed with the excavated material by the rotating cutter head and is then removed from the tunnel via a return pipeline in a closed piped network. At the surface, the excavated material is removed from the slurry by a treatment plant, which includes settlement tanks, cyclones and filter presses to allow the heavier particles of excavated rock to be separated from the lighter bentonite particles. The slurry is then reconditioned and topped-up as necessary with fresh bentonite before being returned to the TBM head through the supply pipes. It is possible that some of this equipment will need to be housed in an acoustic building.

2.2.25 The launch/ drive shaft is used for launching the TBM (on the western side of the tunnel), removing excavated material, supplying materials to the tunnel face and allowing personnel access for construction of the tunnel. The tunnel drive shaft needs to accommodate the plant required to support the tunnel construction such as ventilation ducting, power cables and cooling water pipes. The size of the reception shaft needs to be adequate to allow removal of the TBM on completion of the tunnel.

2.2.26 The tunnel would be constructed at varying depths depending on the final vertical alignment proposed by the contractor, the top of the tunnel will remain below -15m OD for the full tunnel drive. In areas of soft or poor ground, a number of additives may be required to condition the soil to facilitate tunnel construction. Once appointed, the contractor will supply details of all additives to Natural Resources Wales to confirm that they are acceptable for use.

2.2.27 It is currently anticipated that during tunnel construction, water inflows into the tunnel will be discharged through the western "drive" shaft. Volumes are likely to be variable but anticipated to be then between 0.001 and 4.67m^3/day[2] during tunnel construction over 280 days (increasing as the tunnel lengthens), not including occasional large water flows from fissures at the face.

Spoil

2.2.28 Shaft and tunnel construction will produce a large amount of spoil. It is currently estimated that the total volume of spoil excavated from shaft and tunnel construction will be in the region of 135,000m^3 of material (bulked factors applied), of which approximately 13,000m^3 will be soft alluvium and the remaining volume is anticipated to be rock[3].

2.2.29 Pyrite has been identified in cores taken from boreholes undertaken as part of the Ground Investigations to inform the design of the Proposed Project. The presence of pyrite and the wider potential for mineralisation has been further investigated to try and determine the implications for storage, reuse and waste and water disposal, further information is provided in Chapter 10 Geology, Soils and Contaminated Land.

2.2.30 The spoil, once removed, will need to be stockpiled temporarily on site. The western construction compound will be designed to hold seven days of excavated spoil temporarily in case of delays removing it from site. The Contractor will be responsible for managing and appropriately storing any waste. Disposal of spoil would be necessary, either on-site through creation of earth mounding, or off-site, necessitating numerous lorry movements.

2.2.31 Where possible waste shall be diverted from landfill. If it is not possible to divert waste from landfill, the excavated material shall be removed by licensed carriers to a licensed disposal site and handled in accordance with Waste Management Regulations.

2.2.32 The most commonly used method of removing spoil from a construction site is on road using Heavy Good Vehicles (HGVs). The initial routeing strategy is for the construction traffic to use the A487 and A497 to access the tunnel shafts, SEC and the pylon locations.

[2]The estimates for tunnel inflows assume BTS Specification Cat 3 water inflow rate, which gives between 0.001 and 4.67m^3/day based on a 4.4m diameter and 3376m long tunnel, not including flows from the face. This is in addition to the shaft water flows indicated in Table 2.2.

[3] Spoil volumes are based on Scenario 2 in Table 2.2 with a 32m deep, 15m internal diameter shaft at Garth (west), and a 73.5m deep and 12.5m internal diameter at Cilfor (east) and a 3376m long, 4.4m internal diameter connecting the two shafts.

2.2.33 The peak construction activity in terms of traffic generation is expected to relate to the excavation of rock and soil during tunnelling. Current forecasts indicate that tunnelling will generate in the order of 30 loads per day, (60 two-way HGV movements) undertaken by vehicles with a load carrying capacity of 15m^3. During this period, worst-case forecasts indicate that tunnelling activities could generate 160 two-way Light Goods Vehicles (LGV) movements spread across three shifts. Tunnelling works are expected to take place for approximately 17 months.

Cable Installation

2.2.34 Two High Voltage electrical systems shall be installed in the tunnel. One circuit shall be operated at 400kV and the other at 132kV. Installation of the High Voltage system within the tunnel will utilise the existing site compound and the shafts created to build the tunnel. The work to install the High Voltage System will largely be completed underground with some activities on the surface at each end to connect to the existing infrastructure.

2.2.35 A short section (approximately 100m) of cable will need to be buried to connect the High Voltage System in the tunnel to the existing cables at Garth SEC; it is likely that some sections of ducting will be installed so that cables can be inserted within the ducting following construction of electrical infrastructure. This would require a short construction corridor along the length of this cable route. This corridor will accommodate the cable trenches and the working area. Following completion of the cable ducting, the ground would be returned to its previous use. The cable circuit is shown on Figure 2.4 (drawing number PDD-33494-LAY-027). Hedgerows and other field boundaries would be reinstated. Trees felled would not be replanted over the buried cable but would be replaced locally elsewhere.

Sealing End Compounds

Western Side of the Dwyryd Estuary

2.2.36 On the western side of the Dwyryd Estuary the existing SEC at Garth will be retained although the existing gantries will be removed. The highest structure at Garth SEC will be up to 10m in height. The existing permanent access to Garth SEC will be utilised during its operation, however during construction access to Garth SEC will be along the section of cable connecting the tunnel head house to the existing SEC.

2.2.37 Highways improvements or traffic management will be required during the construction phase on the hair pin bend on to the A497 to access the western SEC (see Figure 2.1). A number of passing places will be required, indicative locations are shown on Figure 2.1.

Eastern Side of the Dwyryd Estuary

2.2.38 A new SEC is required on the eastern side of the estuary near Cilfor to achieve the transition from an underground connection to OHL. The SEC is likely to required piled foundations. The SEC is located as close to the existing OHL as possible, thus eliminating the requirement for, or minimising the extent of any new OHL required to connect with the existing OHL. The gantry is to be incorporated in to the tunnel head house building structure.

2.2.39 A terminal pylon will also be required; this forms the commencement of the 400kV OHL. The SEC will require the construction of a new permanent road access which will also service the Tunnel Head House adjacent.

2.2.40 The terminal pylon (Pylon 4ZC027R (replacement of Pylon 4ZC027) is located adjacent to the current OHL Pylon and the new Tunnel Head House building) is likely to have piled foundations. The construction working area around the terminal pylon would occupy an area on the ground of approximately 60m x 60m. Construction activities

would include piling for the pylon foundations, excavation works, pylon assembly and erection, installation of earthing tape (for lightning protection), and downlead erection from 4ZC027R to the Tunnel Head House. The terminal pylon will be 53.6m high the top of the structure will sit at 67m AOD.

2.2.41 The new terminal pylon will be constructed prior to the SEC and will be used to connect the existing OHL to the new SEC.

2.2.42 Pylon erection will be by either a Mobile Hydraulic Crane, or with a derrick to erect the pylon in small sections. Pylon erection will require a large laydown and assembly area for laying out and assembling the steelwork into the lifting sections. Steelwork will be delivered to site on trucks and assembled in sections around the pylon base. A tractor with a light crane or tele-handler may assist in the moving of and erecting steelwork on the ground. The first panel will be lifted by the crane and manoeuvred into position over the foundation stubs and fixed into place by locating the connecting bolts.

2.2.43 Once in place the panel will be stayed to hold its position. Subsequent sections will be assembled using a controlled lift and staying sequence with each panel or boxed section bolted in turn to the previous erected panel until the pylon is complete and secured.

2.2.44 Access will be required to Pylons 4ZC026 to 4ZC023, and the land in between in order to install earthing dressing, backstays (a backstay is to stabilise the pylon when one side is de-loaded backstays will be used to brace the pylon when the conductors are pulling it in the opposite direction) and lower conductor to enable Pylon 4ZC027 to be replaced with terminal pylon 4ZC027R. This will include two areas for temporary backstays of around 20m x 20m.

2.2.45 A Public Right of Way is located adjacent to the new terminal pylon and with the construction area, measures to safely manage pedestrian access will be agreed with the local planning authority.

Removal of Existing Infrastructure (VIP subsection)

2.2.46 Removal of the existing infrastructure (the VIP subsection i.e. removal of the OHL from Pylon 4ZC027 to 4ZC037) will take place following installation and commission of the new underground cables.

Conductor and Pylon Removal

2.2.47 Prior to work commencing on the removal of the OHL fittings and conductor the system must be made safe to work on. After the circuits are de-energised and permits issued, it is necessary to earth the conductors to ensure any impressed voltage or a lightning strike is dissipated to ground. To work in the section 4ZC026 to 4ZC027 it would be normal to earth the conductors onto the pylon at 4ZC025. To earth the conductors at 4ZC025 access would be required for Quad Bikes to take in the equipment and a team of five to carry out the work. The earthing at 4ZC037 would be installed in the SEC.

2.2.48 Prior to removing the conductors from the redundant OHL, the existing conductors need to be lowered out of the way to allow the erection of the new terminal pylon, 4ZC027R.

Therefore, the conductors between pylons 4ZC026 and 4ZC028 will be lowered to the ground to allow them to be shortened and eventually reconnected at 4ZC027R.

When the tension is removed from the conductors on one side of the pylon, along the axis of the OHL, the tension from the conductors on the other side of the pylon causes a structural overload which could result the failure of the pylon. To overcome this issue the tension in span 4ZC028 to 4ZC029 will be reduced by adjusting the tension arrangement at 4ZC028. However, the tension in span 4ZC026 to 4ZC027 goes back to the next tension pylon, which is 4ZC023, therefore the conductors at 4ZC026 will require “catching off” which involves securing them to a solid object.

To “catch off” the conductors in span 4ZC026 to 4ZC027 a series of kentledge loaded sledges or ground anchors will be place in-between pylons 4ZC026 and 4ZC027 (this method may also be used for pylons in the marine environment). Running out blocks (pulleys) will be installed on the ends of the insulators at 4ZC026 to avoid damage to the conductor. Each bundle of conductors (i.e. each phase) will be lowered to the ground, one at a time, secured to the sledge and tensioned using a “Tirfor” until the tension is equal on both sides of the pylon.

Once all the conductors, all six phases and the earthwire, are “caught off” it will be possible to complete the erection of the new pylon, 4ZC027R.

Plate 2.2: Conductors caught off at a suspension pylon

2.2.49 Access to install the anchors will be from the access to 4ZC027/027R.

2.2.50 The OHL fittings, such as dampers and spacers will need to be removed from the conductor spans by installing Spacer Chairs on the conductors and travelling the spans to remove these items. The spacers and dampers will be collected and lowered down at the pylons.

2.2.51 The Conductors between pylons could be simply removed by lowering them to the ground and reeling them onto wooden transport drums, although simple and fast this method offers no protection to anything situated in the span such as roads, buildings, railways, walls, hedges, lower voltage power lines and the ground itself.

2.2.52 An alternative, and the preferred approach to conductor removal is using continuous tension stringing whereby the conductor is replaced under tension by a light bond which is used to reel the conductor onto drums for removal from site. The light bond will be lowered to the ground and reeled in at the receiving Pylon. This method will have minimal impact on anything at ground level.

2.2.53 To keep the road A496 open during conductor removal, scaffolds and net will be erected over the A496. The same approach could be used for other road or rail crossings. The indicative location of scaffolding is shown on Figure 2.1. Construction of scaffolding may require partial road closures using traffic management and will require railway possessions when scaffolds are being built close to the railway line. Access to scaffold

locations for construction will generally utilise the road which the scaffolding is protecting.

Table 2.3: Access to Scaffold Locations

Scaffold Location	Access
A496- Span 4ZC027 - 4ZC028	The scaffold to the east side of the lane shall be accessed using the lane itself and the first section of the temporary access to Pylon 4ZC027. The scaffold to the west side of the lane shall be accessed off the lane using the access to Pylon 4ZC028.
Penrhyndeudraeth Bridge Approach Road and the Railway Line, Span 4ZC029 – 4ZC030	The three individual scaffolds to the east of the road shall be accessed using the access to Pylon 4ZC028. The scaffolds to the east of the road and both sides of the railway line shall be accessed from the road and lifted into place using a crane. This will necessitate a one way traffic management system during the construction of the scaffolds. The duration for all five scaffolds should not exceed two weeks. The scaffolds at both sides of the railway line shall require a line possession and the duration of these works should not exceed one week.
Railway Line, Span 4ZC032 – 4ZC033	The scaffold to the east of the railway shall be accessed using the access to Pylon 4ZC032 and then across the field from 4ZC032. The scaffold to the west of the railway line shall be accessed using the access to Pylon 4ZC033.
Lane, Span 4ZC034 – 4ZC035	This scaffold shall be accessed using the access to Pylon 4ZC034.
Scaffolds around the Roundabout at the A487 and A497, Span 4ZC034 – 4ZC035	These scaffolds shall be accessed from the A487, A497 and the surrounding roads. Some traffic management and partial road closures may be required for short periods of time.
Scaffold to the Lane, Span 4ZC035 – 4ZC036	The scaffolds to both sides of the lane shall be accessed using the lane off the A497.

2.2.54 There are opportunities at some of the lanes and minor roads to dispense with crossing protection and manage the conductor during removal by the use of sentries to stop the work as vehicles or pedestrians approach the area.

2.2.55 Pylon dismantling and removal can be carried out using a variety of methods depending on the pylon type, location and access. Potential methods include:

- Crane: Pylons can be dismantled using a large mobile hydraulic crane which is positioned on a crane pad at the pylon location. The crane pad will be approximately 20m x 20m (subject to crane size/site constraints) constructed from imported stone and plastic or metal panelling. It will take approximately three days to dismantle a pylon using a crane (following advanced site preparation i.e. installation of the crane pad and progressing of advanced works on the pylon prior to commencement of works with the crane). The sections of the pylon will be cut/ broken up as they are lowered to the ground using a steelwork breaker/ mechanical shears fitted to an excavator. The cut sections of the pylon are then placed into waste skips (which could be located within the crane pad or on temporary track way joining the crane platform) and removed from site for reuse or recycling.
- Winch and Derrick: This method requires two small mobile winches and a derrick (lifting device) to be taken to the site. The derrick will be raised up to the top of the pylon such that approximately one third of the derrick is above the top of the pylon. Four stay wires will be required (for support) at right angles from the top of the derrick down to backstays which are positioned at least one and a half times the maximum height of the derrick away. The pylon will act as a scaffold and dismantled from the inside in small sections which will be individually lowered to the ground using the winch and derrick.

2.2.56 It is currently anticipated that the following methods will be used at each pylon:

Table 2.4: Pylon Dismantling Method

Pylon	Anticipated Dismantling Method
4ZC027	Crane
4ZC028	Crane
4ZC029	Crane
4ZC030R	Crane
4ZC031	Derrick
4ZC032	Derrick
4ZC033	Crane
4ZC034	Crane
4ZC035	Crane
4ZC036	Crane
4ZC037	Crane
Garth Gantry	Crane

2.2.57 As each pylon is dismantled and laid down in sections a hydraulic shearer mounted on a 360-degree excavator or gas torches will be used to break up the pylon into small sections and load into skips for disposal, reuse or recycling. The land take required for OHL removal is shown on Figure 2.1.

Foundation Removal

2.2.58 The foundations to Pylons 4ZC027 to 4ZC037 consist of either a Pyramid Foundation or Pile Clusters with a Pile Cap. In the case of 4ZC030R (the replacement pylon built in

2013) a driven steel tube pile for each leg with the leg stub cast into the top of the pile. The foundation removal method for those pylons within the terrestrial environment is listed in Table 2.5 below.

Table 2.5: Pylon Foundation Removal in the Terrestrial Environment

Foundation Type	Pylon	Removal Method
Concrete Frustum and Chimney	4ZC027, 4ZC032, 4ZC033, 4ZC034, 4ZC035, 4ZC036 and 4ZC037	Soil will be excavated from around the foundation to a depth of approximately 1.5m and stored for backfilling. The reinforced concrete foundation will be broken out using a hydraulic breaker mounted on an excavator. The broken concrete will be removed from site as waste. The void in the ground will be backfilled with a non-cohesive fill from a local source, overlain by the soil previously set aside.
Piled Foundation	4ZC028 and 4ZC029	Soil will be excavated from around the foundation to a depth of approximately 1.5m and stored for backfilling. The reinforced concrete foundation will be broken out using a hydraulic breaker mounted on an excavator. The broken concrete will be removed from site as a waste. It is anticipated that the base of the pile cap is likely to be slightly above or around 1.5m below ground level. However, if the base of the pile cap is deeper than 1.5m below ground level then the pile cap will be removed entirely leaving only the piles in the ground. The void will be backfilled with a non-cohesive fill using a mixture of the soil previously set aside and soil imported from a local source, overlain by the soil previously set aside.

Marine Works

2.2.59 The foundation removal method for pylons located within the marine environment which have been discussed and agreed with Natural Resource Wales is listed below.

4ZC030 (Redundant Foundations)

2.2.60 The Pylon at 4ZC030 was installed in the 1960's, it was taken down in 2013 after scour compromised the stability of the foundations and made it become unsafe. The redundant pylon foundations are still in-situ and sit beyond the shoreline. There are occasions when the water level is low enough to access the foundations, however tidal action has scoured the sand away from the immediate area around each pile cap leaving a margin of deep water between the exposed sand and the pile cap.

2.2.61 The foundation to each pylon leg consists of eighteen pre-cast concrete piles driven to an unknown depth (the piles are nominally 600mm in diameter, each made up of a number of short sections of pile pushed down on top of each other (i.e. not a continuous

pile)). The piles are tied together with a pile cap 7.02 x 4.57 x 1.28m (one independent pile cap for each pylon leg). The pile caps each have an extended chimney 0.9m x 0.9m x 1.5m. The pile caps and chimneys are currently visible in the sea.

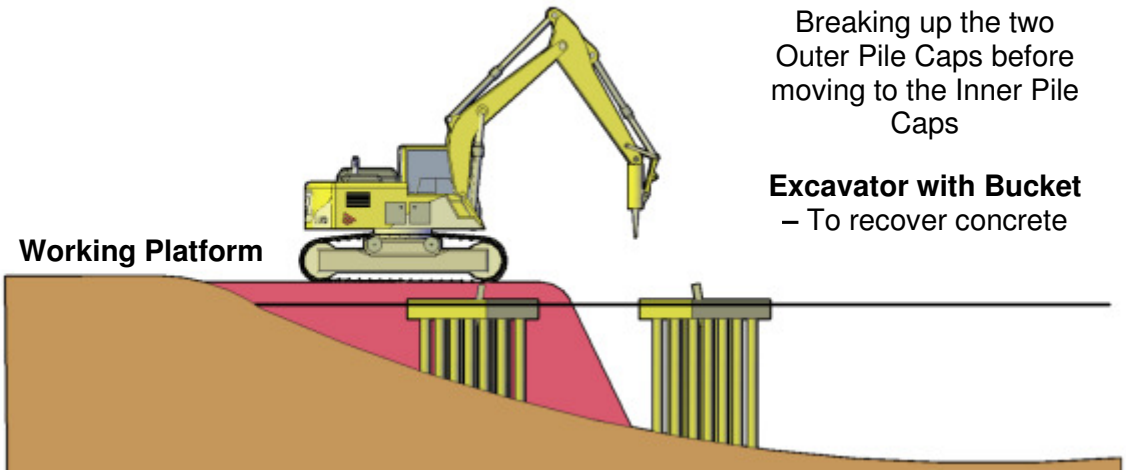
2.2.62 The method of removing the foundations addresses the pile caps and the pre-cast concrete piles down to below the seabed level. The works will be suspended at high tide and the equipment removed to place above the anticipated water level.

2.2.63 Although design details are available of the pile caps there are no detailed records of the actual piles. The pre-cast concrete piles are in sections which may be connected by steel reinforcement and concrete. Therefore, it would not be possible to withdraw the piles from the sand by any method other than to excavate them out as far as is safe and reasonably practicable.

Plate 2.3: 4ZC030 foundations in the estuary (2019)

2.2.64 The proposed method of foundation removal involves building a working platform so that an excavator with a hydraulic breaker can be located close to the pylon foundations.

Plate 2.4: Foundation Recovery – Outer Pile Caps



2.2.65 The working platform will be created by placing boulders in the sea or alternately textile bags filled with granular material. If textile bags are used a capping layer of granular material will be required laid over the top of the bags. The outer pile caps (furthest away

from the shore) will be broken up and removed before reducing the size of the working platform and moving to the inner pile caps (closest to the shore). Although the pre-cast concrete piles cannot be totally recovered it will be possible to remove sections of pile within the reach of the excavator which is anticipated to be 6- 7m below the level of the working platform (the working platform is anticipated to be approximately 1m above low tide level). A realistic best case for foundation removal is anticipated to be 3.75m below ground level (assumed to be the saltmarsh level at 2.5m above ODN). It is anticipated that it will take 21 days to setting up and removal the working area and a further seven days for excavation of the foundations.

4ZC030R

2.2.66 4ZC030R (replacement pylon for 4ZC030 on the salt marsh installed in 2013 as an emergency replacement pylon) has single steel tube pile leg foundations (762mm in diameter) which have been driven to suitable load bearing strata and are approximately 18m deep. These tubes are driven into the soft ground and the centre of the tube contains the original ground material. This design feature allows the weight of material inside the tube to contribute to the downforce required to combat uplift forces.

Plate 2.5: 4ZC030R pylon's concrete collars exposed at ground level

2.2.67 The top 2m of the steel tube pile has been cleaned out to accept the pylon stubs which are set into the top of the tube with a concrete plug. The tube has then been surrounded with a concrete collar approximately 1.80m x 1.80m x 1.20m and is visible at ground level.

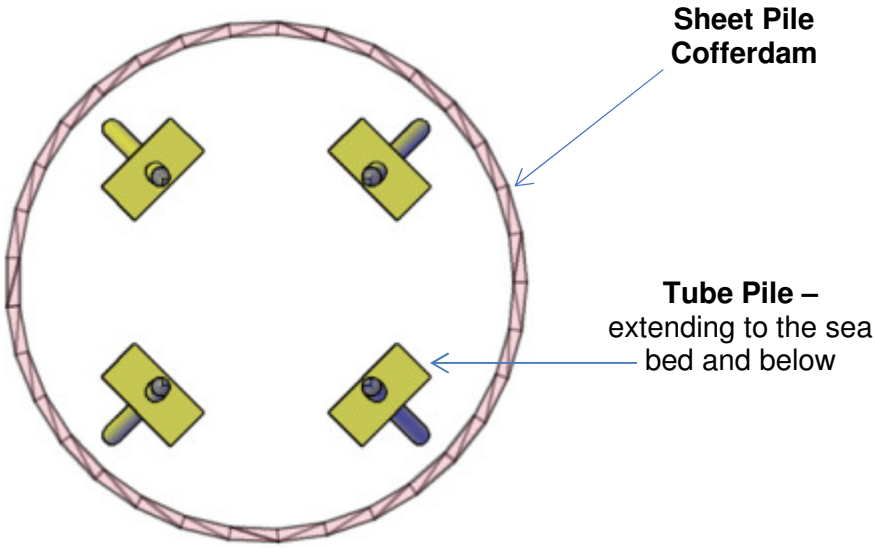
2.2.68 At the time of writing this document two of the concrete collars around the foundation legs are below the surface sediments, whilst two remain above ground level within the cofferdam.

2.2.69 The foundations are surrounded by a 12m deep cofferdam which consists of 69 pairs of steel sheet piles to protect the foundations from tidal action.

Plate 2.6: 4ZC030R Foundations and cofferdam at the edge of the estuary channel (2019)

2.2.70 A cross section through the foundation arrangement is shown in Plate 2.7 below.

Plate 2.7 - Plan View of 4ZC030R Foundations



2.2.71 National Grid will aim to remove all pylon structures, including the foundation piles and cofferdam sheet piles at 4ZC030R. However, it will not be known if this will be possible for certain until the contractors are on site and removal has been attempted.

2.2.72 The foundation collars shall be removed by hydraulic breaker. The preferred approach to removing the steel tube piles is to use a Leader Pile Rig which will grip the pile and remove it vertically with a vibrating action. It is anticipated that the piles will be removed with the concrete plug intact. The cofferdam ring beam shall be removed by using the same Leader Piling Rig which would simultaneously vibrate and lift the metal sheets. The sheets would be cut into manageable sizes and lifted out using a crane.

Plate 2.8: Removal of cofferdam sheet piles using leader pile rig

2.2.73 It is anticipated that five days will be required for the removal of the pylon foundations. However, if full removal of the foundations and cofferdam is successful it is anticipated to require seven days (timescales are weather dependant).

2.2.74 If the piles have fused / bonded they may not come out through vibration and pulling as planned (or should safety considerations deem this not to be possible), in which case the foundations will be removed to the maximum depth possible by an excavator located on the working area formed of plastic or aluminium panels. The sand around the tube piles will need to be removed to a depth of around 2m (inside the cofferdam). Even though the foundations are inside the cofferdam, water will continue to enter the excavation even at low tide so continuous pumping will be required.

2.2.75 If full removal does not work, excavation of the foundations is estimated to be 17 days in total (three days to attempt full removal and a further 14 days to undertake partial removal) (timescales are weather dependant).

2.2.76 As this area is tidal the void in the ground will fill naturally with local material by tidal action.

2.2.77 The reinforced concrete shall be disposed of and the redundant steelwork removed for recycling.

4ZC031

2.2.78 Pylon 4ZC031 was installed in the 1960's and consists of four foundations each with 18 piled legs beneath a concrete pile cap which in turn is below a concrete chimney and muff.

Plate 2.9: Pylon 4ZC031 Chimney and Muff

2.2.79 Pylon 4ZC031 is at a level and location on the saltmarsh where inundation by tides is infrequent. 4ZC031 will be removed using the Piled Foundation method outlined below.

- Place temporary trackway across the saltmarsh. Trackway approximately 4.5m wide, constructed of plastic or aluminium panels laid two side by side and a third centrally positioned over the top.
- Excavate soil from around the foundations to a depth of 3.75m and set aside for backfilling. Removal of the pile cap and concrete piles to 3.75m below ground level.
- Backfill with soil set aside and a non-cohesive fill imported from local source to maintain the topography.

Plate 2.10: 4ZC031 Pylon on saltmarsh (2019)

2.2.80 It is anticipated that once the access to the pylon has been installed, 10 days will be required for pylon removal, and a further four days for excavation of foundation (timescales are weather dependant).

Temporary Access and Laydown

2.2.81 Pylons 4ZC027 to 4ZC037 will require temporary access to carry out the dismantling works. In general preference will be given to using plastic or aluminium road panels to construct temporary roads.

2.2.82 A number of temporary culverts or clear span bridges will be required to facilitate construction access across linear infrastructure and watercourses (the proposed locations of clear span bridges are shown on Figure 2.1). The watercourses requiring bridge access are mainly within the saltmarsh and shall affect access to pylons 4ZC030 and 4ZC031. A preference shall be given to using a temporary bridge than a temporary culvert and this form of crossing can be installed and removed very quickly.

2.2.83 Where laydown areas are located next to pylons for the removal of conductors the temporary working area known as the Equipotential Zone (EPZ) shall be constructed from aluminium roadway panels.

2.2.84 Where the works involve using a crane or a piling rig, a level crane pad or piling mat to site machinery will be constructed. Where the ground conditions and terrain permit the crane pad or pile mat can be constructed from roadway panels, however if the ground is of poor bearing quality or uneven the pad will be constructed from crushed stone.

2.2.85 The removal of pylons (including the foundations) of 4ZC030, 4ZC030R, 4ZC031 and 4ZC032 will require a temporary access across saltmarsh habitat in the marine environment. The temporary access will make use of trackway (or similar); however, upgrades may be required by placing a temporary stone access road/ surface across an existing access track. From this existing access an area will need to be created to allow for vehicles to safely turn into and out of the saltmarsh to achieve the appropriate turning circle; a ramp will be required due to the difference in ground level.

Plate 2.11: Photograph of ramp constructed for previous works on Pylon 4ZC030R

2.2.86 Due to turning vehicles a stone ramp area will be required (plastic trackway would be used once on the saltmarsh). There is a drainage channel adjacent to the track which would need to be culverted to allow for access across the watercourse. The ramp would be created using sandbags (or similar permeable fill) around an appropriately sized culvert to accommodate flows, a layer of geotextile would be laid onto of the fill material and stone used to create a surface (vegetation will be left in situ). All material will be removed at the end of construction activities.

Plate 2.12: Photograph of trackway for previous works on Pylon 4ZC030R

2.2.87 Stone will be used for the crane pad construction for the foundation removal of 4ZC030. Access to 4ZC030 and 4ZC030R will partly use an existing stone track which leads to a sewage works and partly cross the saltmarsh using a temporary constructed track along the same route used during the installation of pylon 4ZC030R in 2013.

Construction Workforce

2.2.88 Temporary works required for the Proposed Project would include: new access onto public highways; equipment laydown areas; temporary storage of materials and spoil, welfare facilities, office accommodation and parking, the erection of temporary scaffolding for crossings whilst cable sealing end and/or OHL works are undertaken.

2.2.89 It is anticipated that a labour peak of up to 100 personnel on-site will occur during the busiest period including all contractors and sub-contractors. The peak plant usage could be up to 20 plant items and would include wheeled and tracked excavators, tractors, trailers, mobile cranes, bulldozers, and specialist plant such as concrete silos, generators, compressors, cable installation equipment, OHL installation plant, augering and drilling machines.

Local Economic Benefits

2.2.90 The labour force required to construct the Proposed Project will consist of a mix of highly specialised workers, semi-skilled staff and contractors/ service providers. These personnel will include engineers, construction specialists, plant operators, inspectors

and supervisors, and management staff. Although a large percentage of the staff employed by National Grid and their appointed Contractor will be drawn from the permanent staff of those organisations, it is expected that a proportion of staff will be recruited locally. Typically, local employment opportunities could cover preparation of the working areas, haulage, fencing, drainage and security, together with unskilled support across all other disciplines. There will also be an opportunity to use local suppliers of construction plant, fencing, re-instatement materials, fuel, consumables, aggregates, seed mixes, timber, portaloos, skip hire, office equipment etc. There will also be small economic benefits arising from expenditure by the workforce on accommodation, subsistence and consumables.

2.2.91 Local quarries will be used, and the contractor will be encouraged to engaged with local construction/ developers to see if rock and stone from tunnelling could be used by them locally.

Working Hours

2.2.92 The core working hours for general construction work (including but not limited to, site establishment, shaft construction, headhouse and sealing end compound construction and reinstatement) be limited to between 0800 and 1800 Monday to Friday, 0800 and 1300 Saturday, and no working on a Sunday or bank holidays, unless otherwise approved by the relevant planning authority. Piling will be undertaken between 0900 and 1700 during weekdays.

2.2.93 The following operations may take place outside the core working hours referred to above (exempt activities):

- Tunnelling, including associated above ground plant and equipment required to enable this activity. This activity can be 24 hours 7 days per week;
- completion of operations commenced during the core working hours which cannot safely be stopped;
- any highway works requested by the highway authority or requested by third parties such as network rail, police escorts etc;
- security monitoring;
- the completion of works delayed or held up by severe weather conditions which disrupted or interrupted normal construction activities;
- Getting workers to and from the site, and activities such as briefings, setting to work, maintenance of equipment and machinery (excludes running engines) etc.;
- Any surveys (such as continuous baseline monitoring or ecology surveys) which are required to take place at night.;

2.2.94 In all instances, there will be no movement of excavated material offsite during weekends and no HGV deliveries outside of the core working hours.

2.2.95 For appraisal purposes it has been estimated that three shift change overs will be required during tunnelling activities with less people working on site over the evening / night-time shift pattern.

2.2.96 National Grid are currently exploring the potential of using a minibus to transport construction workers to the site at shift changes; this vehicle is likely to be over 3.5 tonne and therefore considered to be a HGV. Should this mode of transport for construction workers prove viable, National Grid would request that this vehicle is excluded from any restriction on HGV movement so that traffic movements to/ from the site can be reduced.

Programme of Works

2.2.97 The current indicative programme is that, assuming planning consent, on site works would commence in 2021 and take approximately 5-6 years to complete.

2.2.98 First site access will be taken at the western tunnel drive site near Garth, this is currently expected to take place in early 2021 and is subject to gaining all necessary approvals.

2.2.99 Site establishment near Cilfor will begin later and will be started at a time to allow completion of the shaft prior to the arrival of the TBM. Site establishment at Cilfor will involve building the floating access road (which will permanently remain in situ), a construction compound and any associated groundworks.

2.2.100 The shaft, tunnel head house, SEC will be constructed at Cilfor. Once the outage is in place, the erection of the new pylon will be completed, as well as the removal of the current 4ZC027 pylon. Once these, and the tunnel are complete, and the new conductors energised the OHL removal will take place. All tunnel, tunnel head house and sealing end compound construction work is expected to be complete by the end of 2025.

2.2.101 OHL removal work (including the Proposed Marine Works) is expected to take place in 2026. The Proposed Marine Works will take place between 01 April and the end of October.

2.3 The Operational Phase

High Voltage System Undergrounding

2.3.1 Following completion of the tunnel and installation of the High Voltage System, the construction compounds will be as far as possible restored to their previous condition although permanent tunnel head houses, SEC and permanent access roads (with appropriate drainage) will remain. A permanent electricity and water supply will be required.

2.3.2 The tunnel would be cleared regularly (as required) of excess water using sump pumps therefore a permanent operational discharge of water will be required. It is currently anticipated that this will be discharged from the lowest point from one of the shafts (not both); the discharge point will be determined by the design and build contractor once detailed design has taken place.

Sealing End Compound and Tunnel Head House

2.3.3 The purpose of the tunnel head house is to allow controlled safe and secure access into the shafts, provides enclosure for ventilation fans and equipment to regulate the temperature in the tunnel and to locate mechanical and electrical equipment and to house control equipment for the cable circuits. Tunnel head houses will accommodate:

- Ventilation plant for the tunnel, shaft and dedicated access staircase;
- Accommodation for operational services such as a control room;
- Conductor transition structures;
- Shaft access;
- Uninterrupted Power Supplies (UPS); and,
- Limited Welfare facilities.

2.3.4 The overall scope of the VIP Project is to mitigate the visual impact of existing electrical infrastructure in nationally protected landscapes, therefore tunnel related above ground structures have been designed to minimise their visual impact. The tunnel head houses

have been sized to accommodate only the required equipment for the operation of the tunnel. Each has been designed in a way to fit in with the environment and surroundings.

2.3.5 There is a requirement for both the western and eastern tunnel head houses to be contained within a 2.4m welded mesh security fence with an additional 1m electric fence. The colour of the fencing will be agreed with the relevant planning authority and will be in-keeping to the tunnel head house building and the surrounding environment.

2.3.6 The finished surfacing of the tunnel head houses/ SEC will either be reinforced grass or crushed stone. MOT type 1 is a crushed stone to provide a stable sub-base for road surfaces and pathways. The mixture of solids and fines ensures minimal voids in the sub-base material when compacted, giving a strong load bearing layer with a suitably flat surface. The crushed stone/ reinforced grass layer would be built on layers of MOT type 1 and 2, with additional reinforcement in the form of geotextiles/geogrids. The spec of surfacing in substations and SECs is minimum of 300mm MOT Type 1.

2.3.7 Permanent accesses surfacing would be designed by the contractor in such a way to reflect the vehicle use and loading type to be reasonably expected.

2.3.8 Parking spaces are currently anticipated to be 'reinforced grass', as the traffic volume will be low, maintenance in the form of cutting the grass will be needed. The bellmouth (public road/ access road interface) is likely to need a hard-wearing surface course, to deal with vehicles turning in sharply. This surfacing is likely to be impermeable. Outside of the bellmouth surfacing can be less durable, e.g. reinforced grass/permeable tarmac.

Western Compound

2.3.9 The dimensions of the operational Garth SEC will be 22.5m x 50m and 10m high. Permeant access to Garth SEC will utilise the existing access to the operation site. The proposed elevations of Garth SEC are shown on Figure 2.3 (drawing number PDD-33494-LAY-024).

2.3.10 The proposed Tunnel Head House will be situated approximately 100m to the west of the existing Garth SEC.

2.3.11 In accordance with the objectives of the VIP Project, the design of the tunnel head house aims to keeping the size of the tunnel head house building and the associated infrastructure to a minimum. The dimensions of the tunnel head house are 15.2m x 12.7m x 5.9m high. A site plan of the Tunnel Head House is provided in Figure 2.5 (drawing number PDD-33494-ARC-206), Elevation Plans are shown in Figures 2.6 (drawing number PDD-33494-ARC-221) and 2.7 (drawing number PDD-33494-ARC-220).

2.3.12 As shown on Figure 2.6 ground level will be raised to 3m AOD. The top of the shaft will be at 3.2m AOD. An architectural roof plan is provided in Figure 2.8 (drawing number PDD-33494-ARC-211).

2.3.13 One access will be utilised for access and egress from the tunnel head house. HGVs will reverse into the tunnel head house; this will be an infrequent operation and cars, and vans would be able to turn around within the site.

2.3.14 Small ventilation fans will be installed in the tunnel head house to provide air to the sealed staircase. These will be used only when the tunnel is accessed for maintenance.

Eastern Compound

2.3.15 Figure 2.13 provides layout information relating to the proposed Cilfor SEC (drawing number PDD-33494-LAY-021).

2.3.16 The dimensions of the operational tunnel head house are 44.8m x 18.5m x 12.7m high. A site plan of the Tunnel Head House (incorporating SEC) is provided in Figure 2.9

drawing number PDD-33494-ARC-106), Elevation Plans are shown in Figures 2.10 (drawing number PDD-33494-ARC-121) and 2.11 (drawing number PDD-33494-ARC-120). As shown on elevation plans the proposed ground level is at 6m AOD. An architectural roof plan is provided in Figure 2.15 (drawing number PDD-33494-ARC-112).

2.3.17 Two or three fans will be installed in the tunnel head house, with fans in operation and standby modes (note the noise and vibration appraisal assumes the operation of one fan and the remaining fans will be on standby). The fans will be used to cool and ventilate the tunnel and are fundamentally important to ensure the cables can perform correctly and carry the electrical loads.

2.3.18 Acoustic louvres and acoustic doors have been assumed to be required as part of the Environmental Appraisal.

2.3.19 The terminal pylon would occupy an area on the ground of around 15m x 15m with the arms extending a further 7.5m either side. The height of the terminal pylon is 50.5m (in the proposed location it would site at 60.0m AOD).

2.3.20 For appraisal purposes Redwood Conductors on the terminal span between the terminal pylon and SEC have been assumed.

Maintenance

2.3.21 Maintenance of the Proposed Project will be required during its operational lifetime. Typical maintenance procedures are summarised in Table 2.6.

Table 2.6 - Typical Maintenance Works during Operational Lifetime

Project Element	Typical Maintenance works	Frequency
Headhouse/above ground structures	Maintenance checks at regular intervals of the Tunnel Head Houses would be undertaken and would cover elements including the fans, lighting, pumps and gas detection. Where access to the shaft or tunnel is not required, the THH building would be inspected and maintained as per any National Grid Electricity Transmission System building.	Weekly and Monthly
Below ground infrastructure	• Civil inspection of shaft and tunnel lining, base slab, cover slabs etc (outside lower doors), crane or davit arm required. • The cables would be subjected to maintenance inspections over the length of the tunnel comprising at least one annual inspection. The inspection would report on any defects or changes, identifying any additional requirements such as repairs/replacements • Mechanical and electrical equipment and structure of,	3 Yearly Annually

Project Element	Typical Maintenance works	Frequency
	pressurised stairwell, including sump pump (not outside lower doors)	6 Monthly
Pre-inspection checks	• Prep for monthly & Routine; check training and safety inspections up-to-date and all equipment available and within inspection dates.	6 Monthly (issued 2 months prior)
Terminal Pylons	Infrequent visits for replacement of pylon fittings/ anti climbing devices (ACDs), pylon steelwork / bracing. Vans would be used to carry workers in and out of site and trucks would be used to bring new materials and equipment to site and remove old equipment (using permanent SEC access road). Painting pylon steelwork.	As required Every 10-17 years

2.4 The Decommissioning Phase

2.4.1 Decommissioning activities include removal of the Proposed Project, i.e. transmission medium from the tunnel, SEC and terminal pylon, tunnel head houses, tunnel and permanent access.

2.4.2 The tunnel and shaft will have a design life of 120 years and the tunnel head house will have a design life of 50 years (design life is defined as the mean time before major maintenance). Cables have a life expectancy of approximately 40-60 years (although it is expected equipment will last longer than this from National Grids experience of their existing assets). After this time, they could require replacing, assuming the connection is still required. If the connection is no longer required, the circuits would be decommissioned. Unless there was a compelling need for removal of the underground sections, buried sections of cable would remain buried in the ground, it is likely that cables in the tunnel would be removed.

2.4.3 The lifespan of a SEC is approximately 40 years (or maintained to extend its useful life). When the SECs useful life has expired the materials would be removed and taken for recycling. Unless there is a compelling need for removal of the foundations, these would be removed to approximately 1m deep and subsoil and topsoil reinstated. If the foundations were to be removed, similar methods and access would be required as outlined for installation.

2.4.4 Should there be a need to decommission the tunnel head houses they can be demolished, and the constituent materials taken away for recycling. The foundations would be removed up to 1m below ground level.

2.4.5 A considerable sum of resources would have been expended to construct the tunnel and shafts; therefore, a highly compelling reason would need to be found for decommissioning. However, if it is decided to decommission then the shafts and tunnel can be either capped off at the top of the shafts and flooded with water or filled with foamed concrete, depending on the situation at that time.