Coolkeeragh 110kV Extension

Preliminary Preferred Options Report

Date: November 2022

Title	Version	Name	Signature	Date
Author	1	Sarah Foster		November 2022
Reviewer	1	Raymond Smyth	Approved by email	November 2022
Approver	1	Elin Ahlund	Approved by email	November 2022

Contents:

Figures:

Tables:

References:

SONI Coolkeeragh 110kV Substation Extension, Civil and Environmental Engineering Studies Summary, 14th November 2022

Summary

Coolkeeragh Power Station was initially developed as an oil-fired power station in 1959 to supply the city of Derry/Londonderry. The original oil-fired station included three oil tanks situated into deep oil containment bunds to the west of the 110kV substation. The oil-fired station was decommissioned in 2005 when the new CCGT station was developed. Demolition of the oil-fired station and oil tanks was complete in 2010. Building material from the demolished turbine hall and three chimneys were used to backfill the disused oil tank bunds bringing them up to ground level.

The Coolkeeragh 110kV double busbar switchboard was constructed in 1966. The 110kV double busbar switchboard was extended and refurbished between 2005 and 2010.

A number of issues have been identified, which require to be addressed:

- Thermal overload of the 275/110kV interbus transformers under single contingencies (n-1) during high wind conditions.
- Reduced resilience and an unacceptable risk to security of supply due to layout of the substation. The substation was originally developed with two busbar couplers, however one was removed to allow the connection of a capacitor bank. The second busbar coupler will have to be introduced.
- The fault level at the site is approaching 90% of the rating of the current transformers (CTs). The CTs along with some earth switches, disconnectors and concrete structures need to be replaced to 40kA.
- There is no space at the substation to extend for future system services or demand needs in the city of Derry/Londonderry.

Need Reports have been prepared highlighting the above issues with the substation.

There were five main options investigated and some of them included variations. The options in this report include:

- Option 0: Do nothing
- Option 1: Extension of AIS into the old bund area
    - a Treat all bund material offsite
    - b Treat bund 2/3 material offsite
    - c Treat and redistribute bund material onsite;
- Option 2: New GIS board on site of the upper bund;
    - Arrangement (a) - AIS/GIS cable links via existing OHL bays
        - Cable route (i) – cable from the terminal tower
        - Cable route (ii) – cable from the first tower back from the terminal tower
        - Cable route (iii) – cable from the second tower back from the terminal tower
    - Arrangement (b) - AIS/GIS cable links via double banking IBTX cables
- Option 3: New GIS at seafront;
    - Arrangement (a) – Breaking into the Springtown circuits
    - Arrangement (b) – Breaking in to the IBTX circuits
- Option 4: New North West 110kV switching station near Mobuoy.

The options were appraised on the basis of technical, environmental, deliverability, cost and lifecycle cost criteria. The above long list of options was reduced to a shortlist and a preliminary preferred option was selected from that shortlist.

The option comparison presented in this report includes an assessment completed by RPS[1] on environmental aspects of Options 1-3. This assessment has provided information to SONI in identifying the preliminary preferred option.

Additionally, SONI have sought feedback from NIEN on the project delivery and asset management aspects of the option comparison including on the civil works for Option 1 and cable routing for each of the options. Where relevant this feedback has been noted in this report.

Three options were shortlisted: Option 0, Option 1 and Option 3. Based on a multi-criteria analysis the preliminary preferred option has been identified as Option 1c involving an AIS extension with the treatment of material on site. Option 1c had significantly less cost compared with the other options. It would avoid the transport of the contaminated material over long distances and is expected to be faster to implement. This option, at £11.52m, is the solution which provides the best technical performance and least disruption to existing circuits, provides the best long-term environmental solution to the site and performed best on health and safety than any of the GIS options.

For the purposes of our stakeholder engagement and TNPP submission this is selected as preliminary preferred option.

[1] A summary version of this report is published along with this Options Report,

1. INTRODUCTION

1.1. Background

Coolkeeragh Power Station was initially developed as an oil-fired power station in 1959 to supply the city of Derry/Londonderry. The original oil-fired station included three oil tanks located into deep oil containment bunds to the west of the 110kV substation. The oil-fired station was decommissioned in 2005 when the new CCGT station was developed. Demolition of the oil-fired station and oil tanks was complete in 2010. Building material from the demolished turbine hall and three chimneys were used to backfill the disused oil tank bunds bringing them up to ground level. Works in this area, which is currently leased as part of the power station lands, would require remediation of the material.

The Coolkeeragh 110kV double busbar switchboard was constructed in 1966. The 110kV double busbar switchboard was extended and refurbished between 2005 and 2010. This substation accommodates the only 275kV connection into the area and is an important node for exporting renewables from the west to the east of Northern Ireland.

1.2. Environmental

The ESB Site Closure Plan indicates commitments to the Northern Ireland Environmental Agency (NIEA) for remediation of the material in the bunds when the power station is closed. While there is some uncertainty about what exactly this would consist of and how it would be carried out, there is a strong likelihood that long term remediation of the site would consist of excavation and treatment of the material and that the cost would be socialised.

In July 2021 SONI commissioned RPS to complete a desktop environmental and civil engineering assessment of the options for Coolkeeragh 110kV extension[2]. The scope of work was confined to the current Coolkeeragh Power Station site and therefore only covered those options that are within the site.

RPS was asked to report on the method and costs of remediation of the demolition material in the bunds for an AIS option as well as any environmental considerations for the other options at the Coolkeeragh site. RPS made use of reports from other parties and these are referenced.

[2] Coolkeeragh ESB have previously carried out environmental assessments and have made that information available to SONI.

2. DESCRIPTION OF THE EXISTING 110KV COOLKEERAGH SUBSTATION

Figure 1 shows the SLD for the existing substation, which has 16 bays. Within the site boundary there is only space for one new bay. This bay has been reserved for a potential transmission customer with an accepted Connection Offer. Any further extension of the 110kV substation will require a renegotiation of the lease boundary between NIEN and ESB, remediation of the bunds and diversion of an access road.

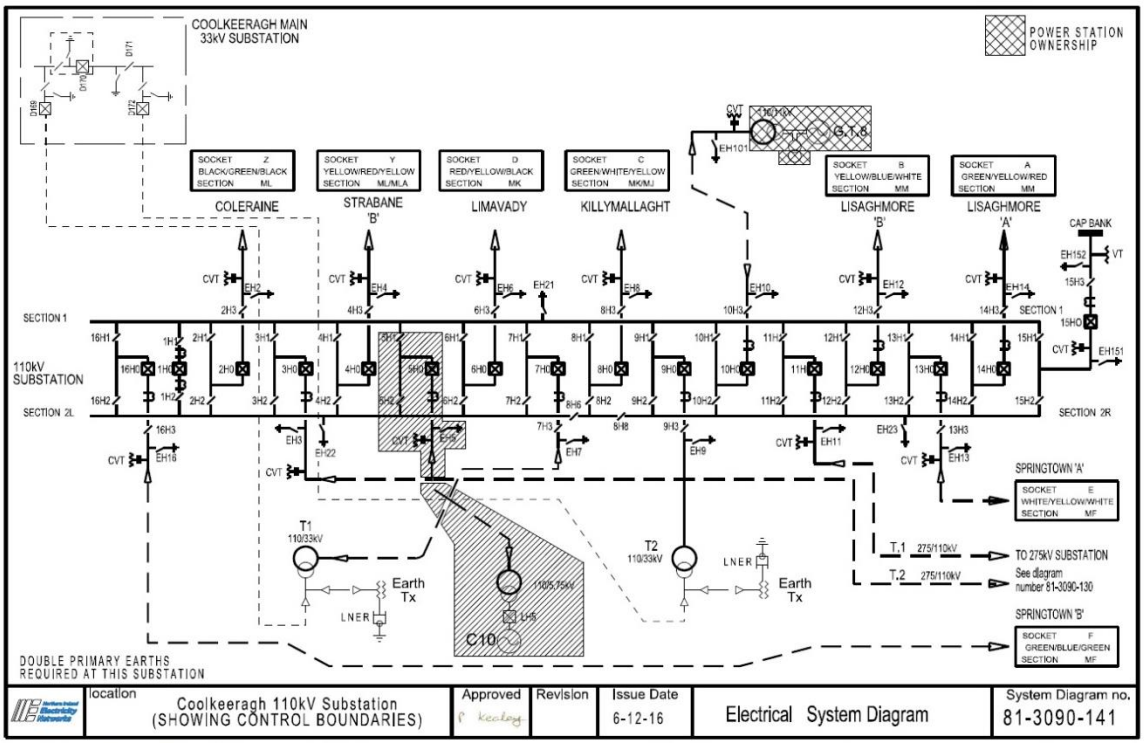

Figure 1 Coolkeeragh 110kV SLD

3. NEEDS

3.1. Capacity

A number of issues have been identified, which require to be addressed:

- Thermal overload of the 275/110kV interbus transformers under single contingencies (n-1) during high wind conditions.
- Reduced resilience and an unacceptable risk to security of supply due to layout of the substation. The substation was originally developed with two busbar couplers, however one was removed to allow the connection of a capacitor bank. The second busbar coupler will have to be introduced.
- There is no space at the substation to extend for future system services or demand needs in the city of Derry/Londonderry.

The need for the extension of the Coolkeeragh 110kV substation has been confirmed in the associated Needs Reports. There is presently no available space for new bays within the existing substation compound. There is a need to re-establish a second busbar coupler, provide a bay to connect a third interbus transformer in future and allow space for the connection of additional circuits and system services.

Where space is available, a switchboard is normally extended by building out the existing busbars at either end. However, the Coolkeeragh 110 kV substation cannot be extended to the west side due to the control building and 275kV substation. On the east side of the substation boundary fence, the land is currently leased by ESB and contains three infilled and disused oil containment bunds. After decommissioning of the older power station, the demolition material from the power station including the chimneys was filled into the bunds.

The existing Coolkeeragh 110kV busbars and switchgear are of a relatively young age. Whilst there is a need for fault level reasons to replace all the current transformers and an earth switch for fault levels reasons there is no need for a wider replacement on the basis of asset condition within the foreseeable future.

3.2. Fault Rating

All the equipment in the substation, including main busbars, is rated at 40kA except for the following:

- All current transformers (CTs) - rated at 31.5kA
- Circuit breaker 15H0 in capacitor bank bay - rated at 31.5kA
- Disconnector 15H3 in the capacitor enclosure - rated at 35.3kA
- Earth switches EH151 and EH152 associated with the capacitor, rated at 33.1 kA
- Earth switch EH101 at the GT8 compound, rated at 15.3kA[3]

The fault level is currently 89% of the 31.5kA rating of the CTs. Replacement of the CTs is included in all the options. It should be noted that one set of CTs is owned by ESB (Bay 5 for the steam turbine) which would be replaced by ESB through a Modification Notification.

The need includes replacement of all the switchgear in the present capacitor bay to re-establish a bus coupler. Replacement of the earth switch EH101 at the GT8 site is also included in scope for all the options.

There are three concrete support structures within the 110kV substation that were not replaced during the previous refurbishment. NIE Networks have assessed similar concrete structures within 275kV substations and have found the fault rating to be lower than previously thought. While no assessment has been made specifically of the structures in the Coolkeeragh110kV substation, the same issues are believed to exist for these three concrete support structures. SONI have agreed with NIE Networks that the replacement of the three structures are required. This scope has been included for each option.

[3] Double primary portable earths are currently required at the substation.

A Needs Report has been prepared to describe the issues with the fault rating of the 110kV substation.

4. SONI TRANSMISSION DEVELOPMENT PLAN NORTHERN IRELAND (TDPNI)

The Draft TDPNI 2021 includes the Coolkeeragh 110kV Extension. The reinstatement of the second bus coupler as well as the diversion of the capacitor and CT upgrade is part of the scope of that project.

The potential overload of one of the two 275/110kV transformers under n-1 conditions was not identified in the Tomorrows Energy Scenarios System Needs Assessment (TES SNA). Provision for a third interbus transformer is therefore not yet included as a separate project in the TDPNI. However, this issue was identified in separate analysis and its omission will be re-examined and corrected in future TES SNA. The latest analysis, as documented in the Needs Report does confirm that one of the two transformers could be loaded to 130% under high wind n-1 conditions.

The TDPNI also includes for the upgrade of the 110kV circuits from Coolkeeragh to Strabane and Coolkeeragh – Killymallaght - Strabane. The options assessment for the upgrade of these circuits will include the option of splitting the existing Coolkeeragh – Strabane double circuit tower line into two separate circuits. An additional bay at Coolkeeragh would be required to facilitate that.

5. LONG LIST OF OPTIONS

We have identified five options in total ranging from “Do Nothing”, an extension of the existing compound to allow space to establish the necessary upgrades, several GIS options and an offsite switching station that would allow a rationalising of the circuits into Coolkeeragh.

The options, see Figure 2 and Figure 3, investigated in this section are as follows:

- Option 0: Do nothing

- Option 1: Extension of AIS into old HFO bund
    - a Treatment of all bund material offsite
    - b Treatment of bund 2/3 material only
    - c Treatment and redistribution of bund material onsite;

- Option 2: New GIS board on site of the upper bund;
    - Arrangement (a) - AIS/GIS cable links via existing OHL bays
        - Cable route (i) – cable from the terminal tower
        - Cable route (ii) – cable from the first tower back from the terminal tower
        - Cable route (iii) – cable from the second tower back from the terminal tower
    - Arrangement (b) - AIS/GIS cable links via double banking IBTX cables

- Option 3: New GIS at northwest corner of the site;
    - Arrangement (a) – Breaking into the Springtown circuits
    - Arrangement (b) – Breaking in to the IBTX circuits

- Option 4: New North West 110kV switching station near Mobuoy.

The full estimated costs are in Appendix 2.

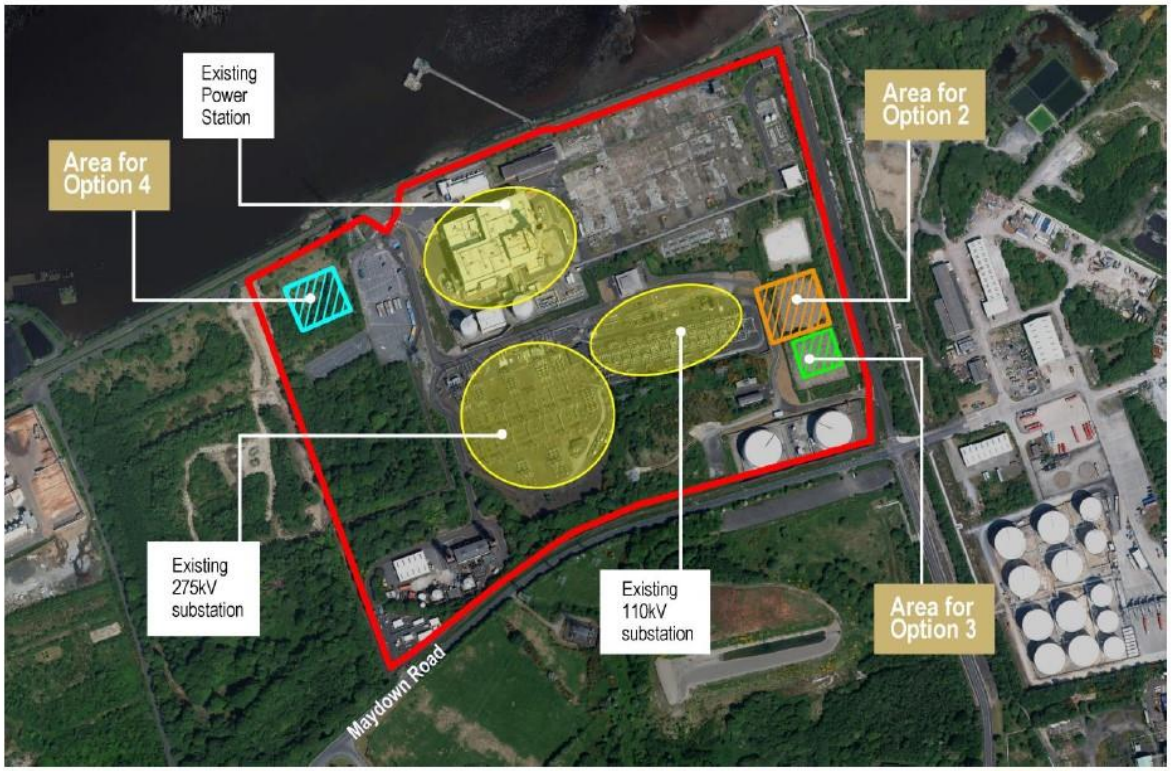

Figure 2 Location of the Coolkeeragh options

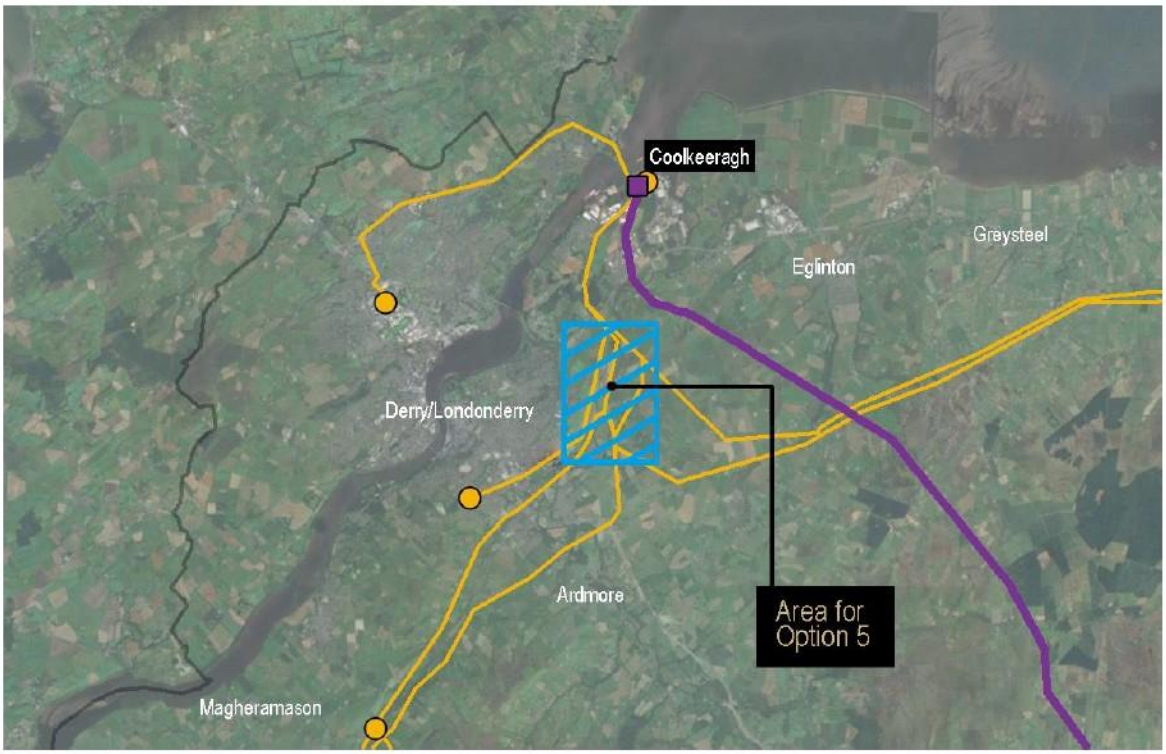

Figure 3 Location of the Coolkeeragh options

5.1. Option 0 – Do Nothing

This option would result in the substation remaining as is with no ability to connect a second bus coupler, a third 275/110kV interbus transformer and also no space in the substation for any future network projects, generation/demand or system services connections.

SONI have a Licence obligation to make an offer of terms to customers seeking to connect to the transmission network. The present arrangement at Coolkeeragh makes it not possible to make an offer to any party wishing to connect at this node.

Consistent with project appraisal policy in Northern Ireland this option is shortlisted and considered in the CBA.

5.2. Option 1 – Extension of AIS

This option is to extend the existing 110kV AIS compound partly into the bunded area, shaded in green in Figure 2. This option would make available seven spare bays, replace the appropriate number of CTs, divert the existing capacitor to a new bay and re-establish the second busbar coupler in the existing capacitor bay.

See Appendix 1 for SLD and general layout drawings for this option. An indicative layout is provided in Appendix 1 for this option which shows seven new bays[4]. The scope of electrical works includes the following:

- Compound extended to make space for seven spare bays;
- Either the capacitor would be cabled to one of the new bays, or, in the event of the need for dynamic reactive compensation for an increase in demand, the capacitor would be replaced with a STATCOM or SVC;
- Bus coupler would be reinstated in the current capacitor bank bay;
- Diversion of Strabane B circuits to spare bay;
- Installation of bus section disconnectors at former Strabane B bay;
- Replacement of all CTs
- Replace three concrete structures with steel equivalents
- Extension of control building

The deferred cost of any additional future bays, such as the 3rd interbus transformer, that could be provided by this option are not included in the upfront costs but will be factored into the lifecycle costs later.

5.2.1. Civil and Environmental

To extend the compound it is necessary to remediate the material in the bunds and re-align the access road to the distillate tanks. The scope of environmental and civil works (including environmental sub-options) is as follows:

[4] The exact number of new bays would be confirmed after detailed design.

- Remediate all material in bunds to offsite facility (Sub-option 1a), remediate material in bunds 2/3 only to offsite facility (Sub-option 1b) (not taken forward[5]), or treat all material onsite (Sub-option 1c);
- Divert access road to make room to extent substation compound;
- Extend substation compound including all civil works.

Option 1a Treat bund material offsite

The material would be removed and transported to a treatment facility in Belfast. This process would have to be phased because the annual capacity of local treatment facilities is limited. Suitable backfill would be used to re-grade the site. For Option 1a the environmental and civil construction costs are estimated at £10.77m.

Option 1c Treat bund material onsite

This option is based on treatment[6] of the material onsite. The feasibility of this option will be after the completion of lab testing. For the duration of the works (and potentially a short duration thereafter) a dedicated water treatment plant would be used for the treatment of the leachate. For Option 1c the environmental and civil construction costs are estimated at £5.21m.

Total construction costs for these options including environmental works, civil, plant and cabling are as follows:

Option 1a £17.63m

Option 1c £11.52m

It can be seen that the onsite treatment of the material, if demonstrated to be feasible through a treatability study is significantly cheaper than offsite removal.

For a breakdown of this cost estimate see Appendix 2.

5.3. Option 2 - New GIS board on site of the upper bund

This option is based on establishing a new GIS switchboard on the site of the upper bund, its integration into the network and the diversion of circuits to allow spare bays to be made available. The environmental works for all electrical variants of this option are based on the excavation of material in bund 3 and retaining this material onsite for re-use within bunds 1 and 2 (known as Option 2b in the environmental report). In the environmental report there is a sub-option that considered treatment offsite of material in all three bunds, however this is

[5] RPS indicated that remediation of all the material will be required in the long term due to commitments in the Site Closure Plan and therefore is more efficient to treat all infilled material at the same time.

[6] Stabilisation/solidification treatment of the infilled bund material to reduce the mobility of the contaminants prior to its re-distribution as infill within the upper and lower bunds.

not taken forward and no longer referred to in this report. The scope of Option 2 is as follows:

- establish a new GIS board on the site of the upper bund which would be connected to the existing 110kV board[7];
- Divert feeders including capacitor from the AIS to the GIS to allow for second coupler and bus mid-section switches on the AIS[8];
- Replace all CTs on the existing switchboard
- Replace three concrete structures on existing switchboard
- Upgrade of the membrane on three bunds.

Option 2 has the following electrical sub-options:

Option 2(a) Connection with three interconnecting cables and various cable routes i), ii) and iii)

Option 2(b) Connection by double banking two cables onto existing 275/110kV transformer incomers.

5.3.1. Option 2a New GIS at upper bund with three cables

For this option the overhead tower line circuits are diverted into the GIS switchboard via underground cables, and those bays on the AIS board are used for the cables linking to the GIS board, as seen in Figure 4. Three potential cables routes for this arrangement are considered in the next section.

[7] Best practice for the installation of GIS switchboards is to install the required number of spare bays along with the main board. This is because the extension of a GIS switchboard can be problematic if a) the OEM has gone out of production, b) legislation changes require wider components that no longer fit within the space provided etc. Any spare future bays will be included in the upfront capital costs for this option. These spare bays would be allocated to individual system or customer projects in future as the need arises, however they could not be charged to those future projects.

[8] As with Option 1, a bus coupler arrangement would be installed on the AIS in Bay 15, the current capacitor bank bay, with the existing equipment recovered. The switchgear within the capacitor enclosure would be replaced to provide an equal fault rating as the 110kV switchboard. The capacitor would be cabled into the GIS board. Mid-section disconnectors would also be established in the Killymallaght bay which is the centre point and the Killymallaght circuit is diverted to the GIS.

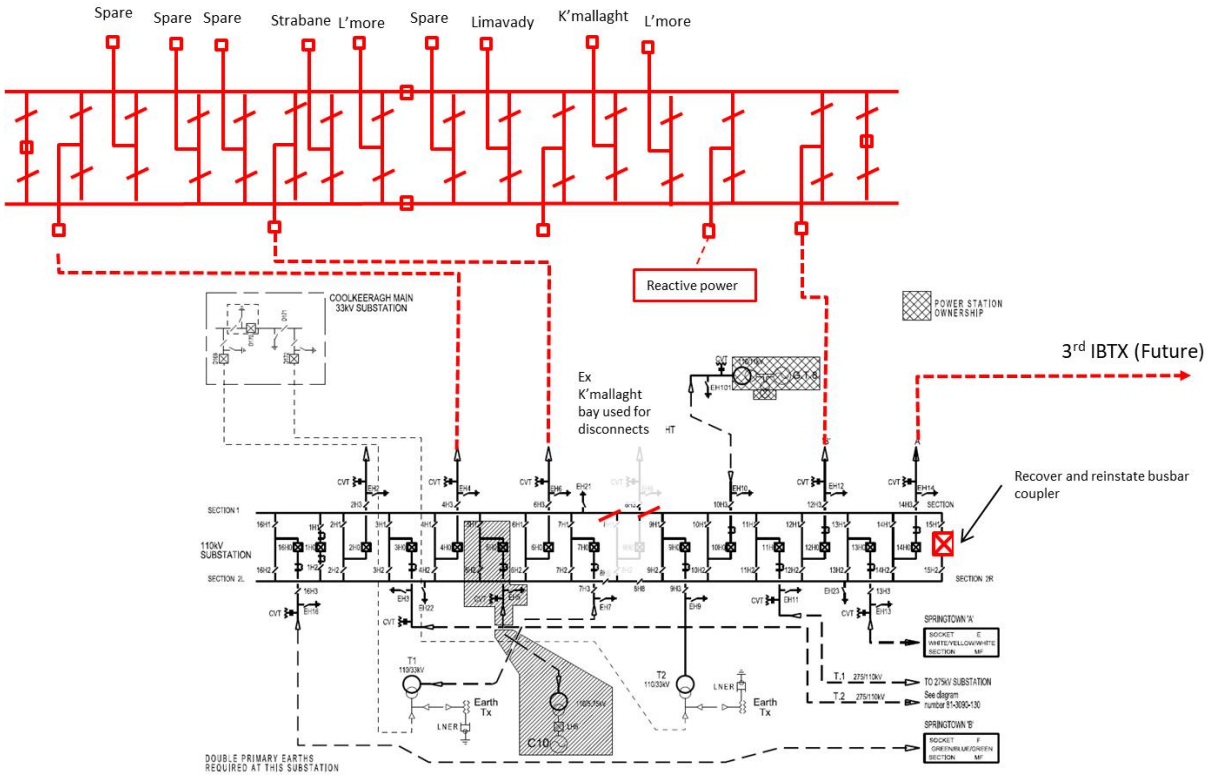

Figure 4 Option 2(a) SLD

5.3.2. Cable routing arrangements for Option 2a

The option is based on three linking cables between the AIS and GIS, using the existing Limavady, Killymallaght and Lisaghmore B bays. Those circuit are diverted into the new GIS. Strabane B and the capacitor are also diverted to the GIS to allow the second bus coupler and bus section switches to be established on the AIS board.

Cable routes for the three AIS/GIS links would have to run along the internal road which is used to access the back of the 110kV substation, crossing the outer access road at the east side of the substation and connecting into the GIS switch house. The distance for each of the three cables ranges from 120 to 180m.

For the cables to divert the Lisaghmore B, Strabane B, Killymallaght and Limavady lines into the GIS, there are a number of possible arrangements with the variations being which overhead tower line the cable is terminated at, as described below:

Option 2a(i) Cable from the terminal tower (where the overhead drops down to the substation).

Option 2a(ii) Cable from the next tower back from the terminal tower.

Option 2a(iii) Cable from two towers back from the terminal tower.

5.3.3. Option 2b New GIS at upper bund double banked to interbus txs

This variant of Option 2 is to double bank the connections onto the existing 275/110kV transformer incomers, as seen in Figure 5.

This option means the GIS board would not remain connected for an N-2 event so the maximum demand that could be directly connected to the GIS would be 100MW as per the TSSPS. While this would allow connection of some future demand, it would limit further demand connection to this board. Option 2b is not considered further.

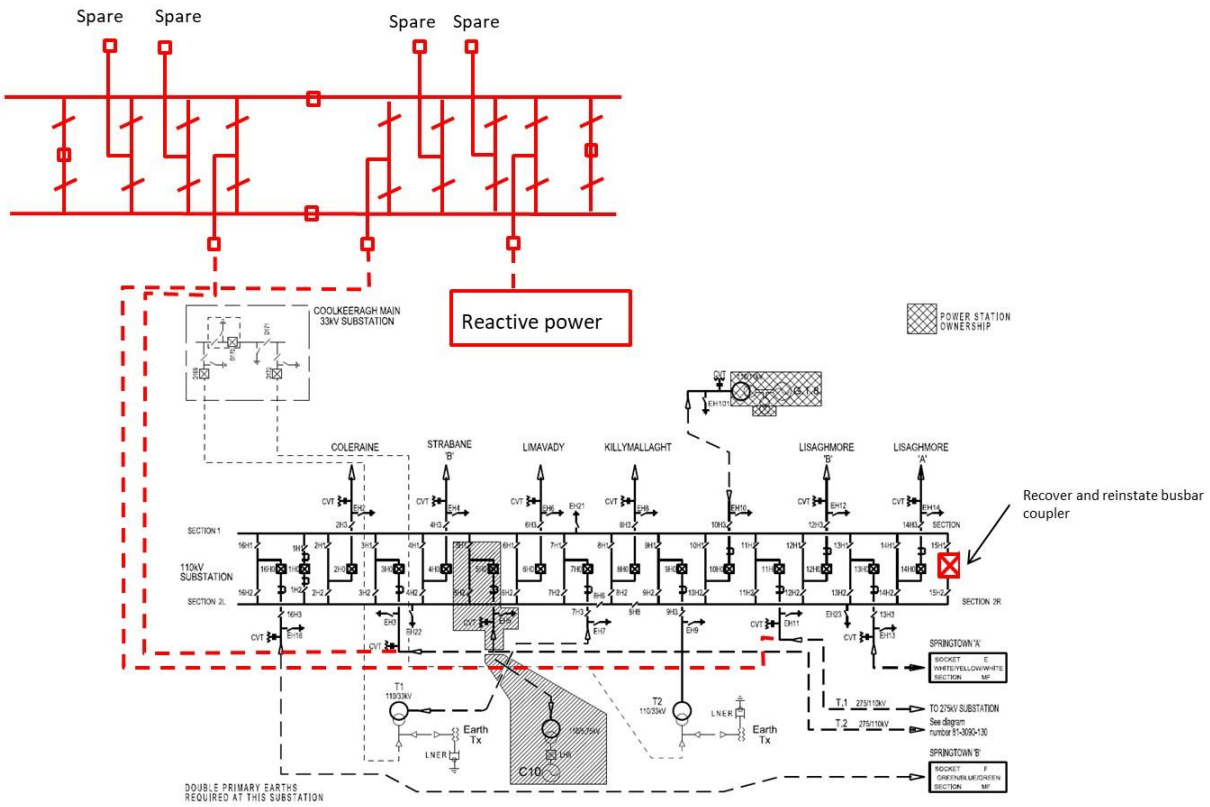

Figure 5 Option 2(b) SLD

5.3.4. Civil and environmental

Applicable for all the Option 2 variants.

Based on engagement with RPS, with this option, all the material in the upper bund would be redistributed to the middle and lower bunds and inert material used to backfill the upper bund.

The material would be moved because RPS have advised that the upper bund is below the water table and is ruptured at the base, consequently ground water penetrates the bund thus affecting the pH discharge. RPS have proposed that the material needs to be removed from this bund to manage the pH levels.

The other bunds are not below the water table and RPS have recommended that by capping those bunds and removing the continued inflow of groundwater from the upper bund it will substantially reduce the volume of high pH effluent to be managed and that this smaller volume of effluent could be successfully infiltrated into underlying soil strata without adverse impact on groundwater quality.

Option 2a(i) has the least cable length associated with it, while Option 2a(iii) has the most. Total construction costs for each option are as follows:

Option 2a(i)	£20.50m
Option 2a(ii)	£20.78m
Option 2a(iii)	£22.86m

For a breakdown of these cost estimates see Appendix 2.

5.4. Option 3 - Establish new GIS option at the northwest corner

This option is based on establishing a new GIS switchboard on the land bank lands to the west of the car park[9], see blue shaded area in Figure 2, its integration into the network and the diversion of circuits to allow spare bays. This includes provision for the integration of a third interbus and second coupler on the AIS board.

Best practice with GIS technology that the required future bays are installed along with the main board and therefore included in the upfront capital costs. These spare bays would be allocated to individual system or customer projects in future as the need arises.

The scope of works is as follows:

- establish a new GIS board on the northwest corner of the site which would be connected to the existing 110kV board;
- Divert feeders including capacitor from the AIS to the GIS to allow for second coupler and bus mid-section switches on the AIS;
- Replace all CTs on the existing switchboard
- Replace three concrete structures on existing switchboard
- Upgrade of the membrane on three bunds[10].

[9] The 275 kV substation requires refurbishment and is being investigated as part of a separate project. As the 275 kV refurbishment may require a new site the area immediately to the west of the 275kV substation is reserved for that project.

[10] This is considered the minimum upgrade to managing the material in the bunds and is included in this option.

There are two possible arrangements for the connection of the GIS into the system, either diverting the Springtown circuits (Option 3a) or the IBTXs on the new board (Option 3b) as outlined below.

5.4.1. Option 3a GIS in northwest corner using Springtown circuits

The Springtown A and B bays would be used to establish to 200MVA cable connections to the new GIS. Three cable links are required between the AIS and GIS to future proof the new switchboard[11]. The third connection would use the bay already offered to a potential transmission customer and that customer would be connected into the GIS.

5.4.2. Option 3b GIS in northwest corner using IBTX circuits

The two existing IBTXs are diverted into the GIS. As for Option 3a above, this option proposes for the third link that the bay already offered to a potential transmission customer would provide the third and that customer would be connected into the GIS.

Option 3a option has an estimated cost of £24.44m and Option 3b has an estimated cost of £25.28m. For a breakdown of this cost estimate Appendix 2.

5.5. Option 4 - New North West 110kV switching station near Mobuoy

Option 4 is a new 110kV AIS switching station approximately 4km from Coolkeeragh at the point where the Limavady, Coleraine, Killymallaght, Strabane and Lisaghmore overhead tower lines start to diverge as they exit Coolkeeragh. At least two circuit are required to link the new switching station to Coolkeeragh 110kV which allows rationalisation and frees up bays (potentially up to four).

This option would create a maximum of four new bays at Coolkeeragh.

The scope is as follows:

- Purchase land at Mobuoy
- Establish new switching station at Mobuoy
- Free up bays at Coolkeeragh
- Divert capacitor to allow for second coupler and bus mid-section switches on the AIS;
- Replace all CTs on the existing AIS
- Replace three concrete structures on existing AIS
- Upgrade of the membrane on three bunds.

See Appendix 1 for an SLD of this option.

This option has an estimated cost of £36.77m. For a breakdown of this cost estimate Appendix 2.

[11] Any future customer connections would be connected into the GIS switchboard. In the event that the combined Springtown and possible future demand is greater than 100MW, re-supply is required for an N-2 event as per the TSSPS.

6. SHORTLISTING

The options in the long list are compared on technical and environmental performance, deliverability and estimated capital cost to produce a shortlist of options. It does not include longer term deferred costs. SONI considers these criteria as important in rationalising the long list of options.

Based on the multi criteria analysis Options 0, 1 and 3a are shortlisted for further assessments. Table 1 show the outcome of the shortlisting appraisal.

The sub sections below provide a narrative of the comparison for each criterion.

The assessments undertaken for each option are for comparative purposes between the options and are not absolute assessments of the individual options. The effect on each criterion parameter is qualitatively determined using expert judgement and experience. This is presented by means of colour coding, along a range from “more significant” / ”more difficult”/“more risk” to “less significant”/”less difficult”/“less risk”.

The following scale is used to illustrate the performance of each criterion:

Key:

Table 1 Comparison of options in long list

Option	Environmental	Technical	Deliverability	Cost (£m)[12]
0 Do nothing			N.A	N/A
1a AIS extension – offsite treatment				17.63
1c AIS extension – onsite treatment				11.52
2a GIS upper bund, cable route (i)				20.50
2a GIS upper bund, cable route (ii)				20.78
2a GIS upper bund, cable route (iii)				22.86
2b GIS upper bund				N/A
3a GIS northwest corner of the site, diverting Springtown				24.44
3b GIS northwest corner of the site, diverting IBTXs				25.28
4 New NW S/S				36.77

[12] Cost of option (£m) colour scale: less than £10m – yellow; between £10m and £15m – light green; between £15m and £20m – green; between £20m and £30m – blue; and greater than £30m – dark blue.

6.1. Cost

The estimated costs of each the options are set out in Table 2 and Figure 6 below. For a full breakdown see Appendix 2.

Table 2 Capital cost estimate for long list options

Option	Cost (£m)
Option 0 - Do nothing	-
Option 1a – AIS extension, removal of material offsite	17.63
Option 1c – AIS extension, onsite treatment and disposal of material in bunds	11.52
Option 2a GIS upper bund, cable route (i)	20.50
Option 2a GIS upper bund, cable route (ii)	20.78
Option 2a GIS upper bund, cable route (iii)	22.86
Option 3a GIS northwest corner of the site, diverting Springtown circuits	24.44
Option 3b GIS northwest corner of the site, diverting IBTXs	25.28
Option 4 NW switching station Mobuoy	36.77

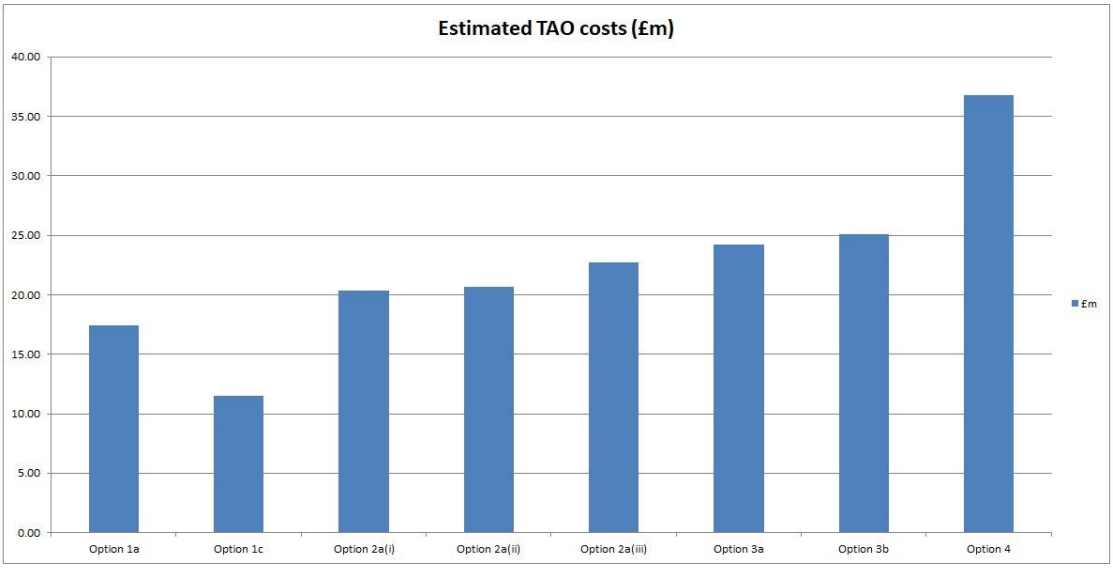

Figure 6 Cost estimate for long list options

Clearly from the above Option 1c AIS extension is the least cost option. The other main GIS options are about twice the cost with new switching station approaching four times the cost.

6.2. Technical

6.2.1. Option 0 Do Nothing

This option would result in the present configuration remaining. This presents a high risk to security of supply due to the risk of a failure of the one bus coupler and the consequent complete loss of the node. This event would result in loss of demand at Coolkeeragh and the disconnection of the steam turbine, with the gas turbine also likely to trip. The sectionalising of the 110kV system could also lead to the overload of 110kV circuits in the north west with the potential for cascade tripping, further loss of renewables and load shedding.

Furthermore, the inability to connect the 3rd interbus transformer or any system services to the node is detrimental to the need to decarbonise.

6.2.2. Option 1 AIS extension

Option 1 is technically the least complex option as it is simply an extension to the existing switch board and provides the least disruption to the existing circuits, therefore fewer outages. Secondly the further bay structures and switchgear can be added at a later date as required so long as space is available to do so.

6.2.3. Option 2 GIS at upper bund

GIS bays are very difficult and expensive to add at a later date especially if the type is no longer manufactured. Therefore, when comparing initial capital costs for each of the option it has been necessary to include the cost of future GIS bays up front.

The GIS insulating technology is continually evolving, and the most common gas used in GIS at present, SF6, may be subject to environmental restrictions in future. If that were the case it may be not be possible to add any future bays to an existing SF6 board.

The GIS solution requires many more bays overall when compared with the AIS solution since three bays are lost on each board (eight in total) to provide suitable interlinking cables, as well as needing two bus couplers on both boards. This requires additional space and cost when compared with the AIS.

Option 2 is a much more complex technically than Option 1 AIS with significantly more outages.

6.2.4. Option 3 – GIS Western Land Bank site

The same points that apply to Option 2 are also relevant to this option. However, this is considered the stronger of the two GIS options.

6.2.5. Option 4 - Switching station at Mobuoy

This option does not provide additional circuits above the minimum requirement. It is also quite a complex solution to obtaining additional bays at Coolkeeragh, compared to the technically less complex Option 1 AIS extension.

6.3. Environmental

6.3.1. Option 0 – Do Nothing

This option would require the bunds to be remediated upon closure of the power station. Whilst having no capital investment cost at this stage the option does not achieve the capacity or fault rating requirements outlined as needs.

6.3.2. Option 1 – AIS extension

Option 1 requires significant environmental work and costs up front to remediate all three of the bunds. Both options are considered appropriate to remediate the site as required in the Site Closure Plan.

A major advantage of this option is that once complete it is planned that it will remove long term environmental concerns in this important site.

Option 1c[13] is superior to Option 1a as it is cheaper and faster method. Option 1a is therefore rejected as a sub-option.

6.3.3. Option 2 – GIS Upper bund

The pH issue could re-emerge as the material in the lower two bunds, whilst covered by an improved membrane, would still remain untreated. In the end treatment of the material is only deferred and it is expected that either on site or offsite remediation will be required when the station closes. This is inferior to Option 1 which would result in an earlier treatment of the material.

A further environmental consideration for Option 2 is the use of SF6 insulating gas which compares unfavourably with AIS.

[13] This is referred to as Option 1c in the RPS report

6.3.4. Option 3 – GIS Western land bank site

Option 3 has the same disadvantages as Option 2 above.

6.3.5. Option 4 – Switching station at Mobuoy

Option 4 has the same disadvantages as Option 2.

6.4. Deliverability

This section compares option on how difficult each will be to deliver. There is a particular focus on the safety aspects of the various options.

6.4.1. Option 1a - AIS extension (material treated offsite)

This option involves remediation of the material in the bunds upfront. However, this is quite common at power station sites and is considered deliverable.

For sub-option a, RPS have assessed that it would take 44 weeks to clear the two upper bunds and a further 28 weeks to clear the lower bund. A further risk is that full yearly capacity of the Northern Ireland site may not be available leading to long delays.

Mitigation measures for this risk however would be for the plant owners to apply for an increase to the 20,000t/year limit however there is no guarantee with this. An alternative solution would be to transport material to GB, but with increased transportation costs.

6.4.2. Option 1c - AIS extension (material treated onsite)

RPS have advised that this approach is commonly taken on contaminated land remediation projects and is acceptable to NIEA on the condition that the use of the material does not adversely affect the environment. RPS have estimated a typical timeline to sample, treat and infill this material over a period of 4-6 months. The deliverability of Option 1c is however dependent on the outcome of a material treatability study. This sub-option considered superior to all other options from a delivery perspective.

6.4.3. Option 2 - GIS Upper bund

The problem with this option is the significant number of 110kV cables required to a) link the existing AIS to any proposed new GIS board and b) the diversion of circuits from the terminal tower lines into the GIS. There are significant safety concerns related to installing the cables in an area where there is already a high volume of existing cables. From a CDM perspective this option would perform poorly, both in the construction phase and also post-delivery of the project as there would be a permanent ongoing risk with any future cable work in the area due to the high volume of cables.

NIEN have provided the following commentary on the cable routes for Option 2.

"The cable routes in routes i, ii and iii all present issues which from a high-level assessment do not appear to be feasible. The congestion of the 110kV cable at various points on each of the options is unlikely to fit. There will be derating factors from grouping and at certain point cross the existing Coolkeeragh – Magherafelt 275kV double circuit.

There is unlikely to be adequate space in the roads for getting the proposed cables laid when accounting for existing cables and services already located in the same areas.

For route iii there are a number of issues with this. In the approach to the new terminal tower locations the cable cross an area with a form of reservoir with some form of pipework visible which would present barriers to this route.

All three cable route proposals would land lock the existing 33kV switch house making in difficult or even impossible to bring new distribution cable out of this substation."

Option 2 proposes a 14 bay GIS switchboard on the site of the upper bund. From the indicative GIS building dimensions provided by NIEN (see Figure 16) it is seen that the length is 70m. It would be very difficult to accommodate this size of building on the site of the upper bund. Option 2 would require a major outage programme since each of the Lisaghmore and meshed 110kV OHLs need to be taken out for the duration of time taken to cable them to the GIS.

Option 2 is considered to have a poor deliverability for the reasons given above relating to lack of space and safety with regards to the cable installation.

6.4.4. Option 3 - GIS Western land bank site

NIEN have advised that the cable routing proposed for this option is very difficult due to the number of cables proposed in this space and also accounting for existing services in the same route.

Similar to Option 2, for this option there are significant safety concerns related to installing the cables in an area where there is already a high volume of existing cables. From a CDM perspective this option would perform poorly, both in the construction phase and also post-delivery of the project as there would be a permanent ongoing risk with any future work in the area due to the high volume of cables.

For Option 3a there would be some outages to the Springtown circuits. It is assumed that one circuit would be able to remain in place at all times and therefore no reliance on a 33kV re-supply. For Option 3b there would be some disruption to the IBTXs, however, only it is envisaged that one would be out of service at any time during construction.

The nature of the works required to divert the potential transmission customer will depend on how far the customer connection works are developed.

Option 3 is considered to have a poor deliverability due to the safety implications and cable routing.

6.4.5. Option 4 - Switching station at Mobuoy

There would be considerable disruption to the 110kV OHLs for this option.

With this option, as with Options 2 and 3, the long-term requirement to remediate the bunds would remain.

This option is based on establishing a new 110kV substation at a site appropriate to turn in all of the adjacent 110kV lines. The delivery of this option would involve extensive stakeholder engagement with landowners, the procurement of an appropriate sites, outline deign of the substation as well as new terminal towers a planning application.

Option 4 is considered to have a poor deliverability for the reasons given above.

6.5. Conclusion of reduction of the long list

Based on the above assessment, Option 2 and all its variations do not perform preferably compared to the other options. As such Option 2 and its variants will not be taken forward for further assessments. The main issues relate to cable routing, particularly health and safety, and also accommodating the required GIS building on the upper bund.

Similarly, Options 4 does not perform preferably compared to the other options. As such Option 4 will not be taken forward for further assessments. The main issues relate to this option does not deliver enough new bays at Coolkeeragh 110kV to allow for future expansion of the substation. Option 4 is also the most expensive of the options. However, it could be considered at a later date for other system needs if they arise.

While there would be significant problems with the cable routing for Option 3 as noted by NIEN, for the purpose of carrying out a more detailed comparison between AIS and GIS, including demonstrating lifecycle costs for the two technologies, it is useful to carry one GIS option to the short list. Option 3a is slightly less expensive that Option 3b and therefore Option 3a is chosen as the preferred GIS option to be carried into the shortlist.

Option 1 and its variation will also be brought forward to the shortlist.

7. APPRAISAL OF SHORT-LISTED OPTIONS

7.1. Short listed options

The following options are shortlisted for further investigation:

- Option 0 - Do nothing;
- Option 1a and c – AIS Extension;
- Option 3a – GIS at northwest corner.

The only additional criteria the shortlisted options have been assessed on (in addition to the technical, environmental, initial build cost and deliverability carried out in the previous section) is lifecycle cost. The purpose of this section is to compare the AIS and GIS options considering any deferred costs specific to the options.

7.2. Lifecycle costs

An assessment of the lifecycle costs of each of the shortlisted options has been undertaken. This has included the capital cost of each of the options, deferred capital costs, TSO costs, constraint costs and an allowance for operation and maintenance.

The net present cost for each of the short-listed options has been included in the option appraisal multi criteria assessment in Table 3. For a full breakdown of this analysis see Appendix 3.

For Option 0 the deferred cost of remediating the bunds is included. This does not include the potential cost of loss of generation and demand from a cascade tripping event following a bus coupler fault which is difficult to evaluate due to the complexity of such an event but would be substantial.

The main difference between the capital and lifecycle costs is that with Option 1 the deferred cost of future bays is included, and with Option 3 the deferred cost of decontaminating the bunds is included.

7.3. Multi-criteria assessment

Table 3 combines the technical performance, deliverability, capital cost, net present cost and environmental scoring for each of the reinforcement options. The best performing option across the criteria is Option 1c.

Key:

Less favourable					More favourable

Table 3 Multi-criteria assessment for shortlisted options

Option	Environmental	Technical	Deliverability	Cost of option (£m)[14]	Net present cost (£m)[15]
0 Do nothing			N/A	N/A	3.63[16]
1a AIS extension – offsite treatment of material in bunds				17.63	22.69
1c AIS extension – onsite treatment of material in bunds				11.52	16.14
3a GIS northwest corner of the site				24.44	30.73

[14] Cost of option (£m) colour scale: less than £10m – yellow; between £10m and £15m – light green; between £15m and £20m – green; between £20m and £30m – blue; and greater than £30m – dark blue.

[15] Net present cost colour scale: less than £5m – yellow; between £10m and £15m – light green; between £15m and £20m – green; between £20m and £30m – blue; and greater than £30m – dark blue.

[16] Deferred cost of remediating the bunds. This does not include the potential cost of loss of generation and demand from a cascade tripping event following a bus coupler fault which is difficult to evaluate due to the complexity of such an event but would be substantial.

8. PRELIMINARY PREFERRED OPTION

The Option 0 – Do Nothing option would result in the identified needs not being addressed. This could lead to a breach of planning standards and require wind generation to be constrained. The lack of a second busbar coupler presents a long-term risk to security of supply. The lack of upgrade of the fault rating on the CTs would also present an unacceptable safety risk. For the above reasons this option does not perform preferably compared to the options remaining options.

Option 1c (AIS extension) addresses reliability and security of supply need in the station and the need for additional 110kV bays in the substation at Coolkeeragh. This option is less expensive than any of the other options, both for upfront and deferred costs, and performed best against the technical and deliverability criteria compared to the other options. Option 1c results in considerably less disruption to existing circuits and therefore fewer outages are required when compared with other options.

While Options 1a and c achieve the same outcome, Option 1c is significantly less expensive and faster to implement. Option 1c will address the need to extend the substation through a solution which will treat the material in the bunds onsite to stabilisation of the material. A new water treatment plant will be required during the construction works and it is envisaged that there would be a separate consent to discharge for the works area that would be held by the contractor. A further survey and analysis of sampled material is required to confirm the feasibility of this option.

Option 1c will address the material in the bunds sooner than otherwise anticipated but it is likely these will have to be dealt with at some stage anyway due to the commitments provided to NIEA within the Coolkeeragh Power Station Site Closure Plan, and the lifecycle costing compares the cost of remediating the bunds upfront versus at the end of power station life.

The RPS report also notes that it would be more efficient to manage and remove all infilled material at the site during a single operation rather than retaining any on site in the long term. RPS have therefore concluded that this is the environmentally preferred option providing immediate improvements in environmental performance at the site and minimising long-term management and disposal costs associated with the presence of infilled demolition materials within the bunds.

Selection of the preferred solution and completion of the Part 1 stage of the SONI Grid Development Process will be subject to stakeholder engagement, which may change the outcome of the assessments.

Based on the assessments in this report the preliminary preferred option is Option 1c (AIS extension via onsite treatment and distribution). This option has the least cost, performed best in the technical, deliverability, cost and lifecycle cost assessment, and is environmentally the best option post completion of the project. For the purposes of the TNPP preparation and stakeholder engagement this option is selected.

9. RISKS FOR PREFERRED OPTION

This section outlines risks associated with the preferred option. These are noted previously in the report and are further summarised below.

9.1. Treatment of material in bunds

The feasibility of treating and re-using the material as infill to the bunds can only be confirmed after the completion of a material treatability study which will include gathering samples from site, laboratory analysis and monitoring. SONI is progressing the initial risk assessment for this study.

There is a low risk that the treatability study concludes that the preferred solution for dealing with the material in the bunds is not feasible in which case SONI would be required moving to the next best option. It should be noted that the risk of the preferred option being unfeasible is considered to be low based on information from the consultant regarding the successful deployment of a similar method at other sites.

There is a further risk that the works to treat the material would disturb the environmental equilibrium and breach permits for environmental limits. It is planned that this risk would be managed through installation of a temporary plant to treat leachates generated during the construction phase. This treatment plant is included in the costs presented for the preferred option. A risk assessment will be completed by the contactor carrying out the works prior to commencement. Environmental elements subject to permit will be monitored for the duration and discharge of the leachate temporarily slowed/halted to ensure compliance.

The preferred option is subject to agreement with the NIEA on new permitting arrangements including the potential requirement for a separate discharge consent for the construction area.

Following removal of the material and in the absence of the source of contamination it would be expected that no further management of leachate would be required, however, in order to demonstrate this, RPS have advised that the monitoring and sampling system should remain in place until it is established that the pH issue is absent.

9.2. Foundations

NIEN have highlighted that the surveys which have been carried out till now, on which the RPS report is based, would not have considered the suitability of this area for foundations. The RPS report notes that no costs have been included for piled foundations. There is a risk that this would eventually be required which would increase the cost. However, this is normal for any AIS substation extension and the piling of foundations for new bays would be included in those projects.

9.3. Consents

It is expected that planning permission will be required to divert the roadway and extend the compound inside the Coolkeeragh site. Given the environmental considerations an EIA might be required. This may be identified during the Part 1 stakeholder engagement phase.

9.4. Permits

It is envisaged that there would be a separate temporary consent to discharge permit issued for the works area during construction. At completion of the project it is intended that the separate discharge consent would be tied back in again to the main ESB discharge permit and that there would be only one remaining discharge permit in the long term which would be held by ESB.

9.5. Third party agreements

The preferred option is subject to agreement with ESB on the change of the lease boundary and also to ensure the ground and surface water management system could remain in place during and after construction.

The ESB owned CTs within the main substation will need to be replaced at their expense to bring the overall fault rating up to 40kA. This will be achieved through a Modification Notification.

9.6. Number of bays delivered by this option

The number of bays which could be achieved by this option would only be confirmed after detailed design.

10. NEXT STEPS

The report will be used as the basis for the preparation of the Transmission Network Pre-construction Project (TNPP) submission. The TNPP will also include funding request for the Part 1 stakeholder engagement costs.

It should be noted however that the outcome of the Part 1 stakeholder engagement process may require amendments to the appraisal process. It is possible that the Preferred Option may be different from that identified in this report, in which case an updated TNPP submission will be required.

The next steps for the project will be as follows:

- Plan and progress Part 1 stakeholder engagement;
- Finalise selection of preferred option;
- Prepare and submit TNPP;
- Publish decision and accompanying reports on the SONI website;
- Progress Part 1 governance steps in parallel with application for TNPP funding; and
- Commence Part 2 of the SONI Grid Development Process.

11. STAKEHOLDER ENGAGEMENT

NIE Networks has provided feedback on the preliminary preferred options report in their role as asset owner and in line with the Transmission Interface Arrangements (TIA). NIE Networks are supportive of the preliminary preferred option and of the conclusions reached in this report subject to the conclusion of the RPS material treatability study report confirming the feasibility of the solution and an acceptable level of risk following the implementation of suggested mitigation measures

SONI has also discussed this project with the Utility Regulator at the monthly SONI-UR meetings. A session for further engagement with Utility Regulator will be arranged at an appropriate time.

ESB have been consulted on the project and provided information to facilitate the environmental assessment carried out by RPS as well as a site visit. SONI requested NIEN to undertake initial discussions with ESB in May 2021 with regards lease alteration to extend the substation. ESB have indicated their willingness for this and have not raised any objections to the extension of the AIS.

Further engagement with ESB took place in May 22, along with the NIEA which highlighted the need to safeguard water quality during construction phase. SONI have taken the feedback from NIEA into account in the conclusions from this options report. Further engagement was held with ESB and NIEA on 3rd October 2022 to update them on the preliminary preferred option.

ESB have indicated their agreement with the preferred option.

Part 1 stakeholder engagement:

The table collates the main stakeholders that SONI has engaged with for the 'Coolkeeragh 110kV Extension' project. In accordance with SONI's Grid Development for Northern Ireland 3 Part Process this stakeholder engagement with be commenced during Part 1 of project development.

The following stakeholders were consulted:

- ESB
- NIEA
- Derry City and Strabane District Council including CEO and director of planning;
- Londonderry Chamber of Commerce
- Local MLAs and Councillors

Stakeholder Engagement feedback:

SONI met with a number of elected representatives covering the Foyle constituency and Faughan District Electoral Area (DEA), which the Coolkeeragh power station site is situated in. SONI also met with planning and development officers from Derry and Strabane Council and members of the Londonderry Chamber of Commerce. Prior to these meetings, SONI also met with Coolkeeragh, NIE Networks and the Northern Ireland Environment Agency. At the request of invitees, this engagement took place virtually.

In total, 7 individual stakeholders were consulted as part of this process; with all elected representatives contacted and offered a briefing on the project. In Part 2, of SONI's three-part grid development process, SONI will expand its public engagement to include a couple of public information events, as well as follow up briefings with all key stakeholders briefed in Part 1.

The majority of the feedback was largely positive, with stakeholders recognising the need for the project and the wider benefits that it would provide, particularly in relation to future investment and enhancing economic development in the North West.

A number of stakeholders suggested that in Part 2 of SONI's engagement process, that local environmental groups are made aware of the planned public information events, particularly given the project's proximity to the river Foyle. There were also several queries around the proposed project timescales and the importance of engaging as early as possible with Derry and Strabane's Planning Department. All stakeholders welcomed the opportunity to be briefed at this early stage and asked to be kept informed of developments.

In order to deliver on our key value of transparency, SONI will publish the stakeholder report on our website shortly.

Further stakeholder engagement with the affected parties will be carried out in the latter parts of the SONI Grid Development Process[17]. By then SONI and NIE Networks will have carried out investigations into the detailed design requirements of this project. Stakeholder engagement at this stage will help to inform the stakeholders of the project proposals and take on board any feedback to help finalise proposals.

[17] http://www.soni.ltd.uk/the-grid/grid-development-process/

12. APPENDICES

APPENDIX 1 – Drawings for each option

Option 1

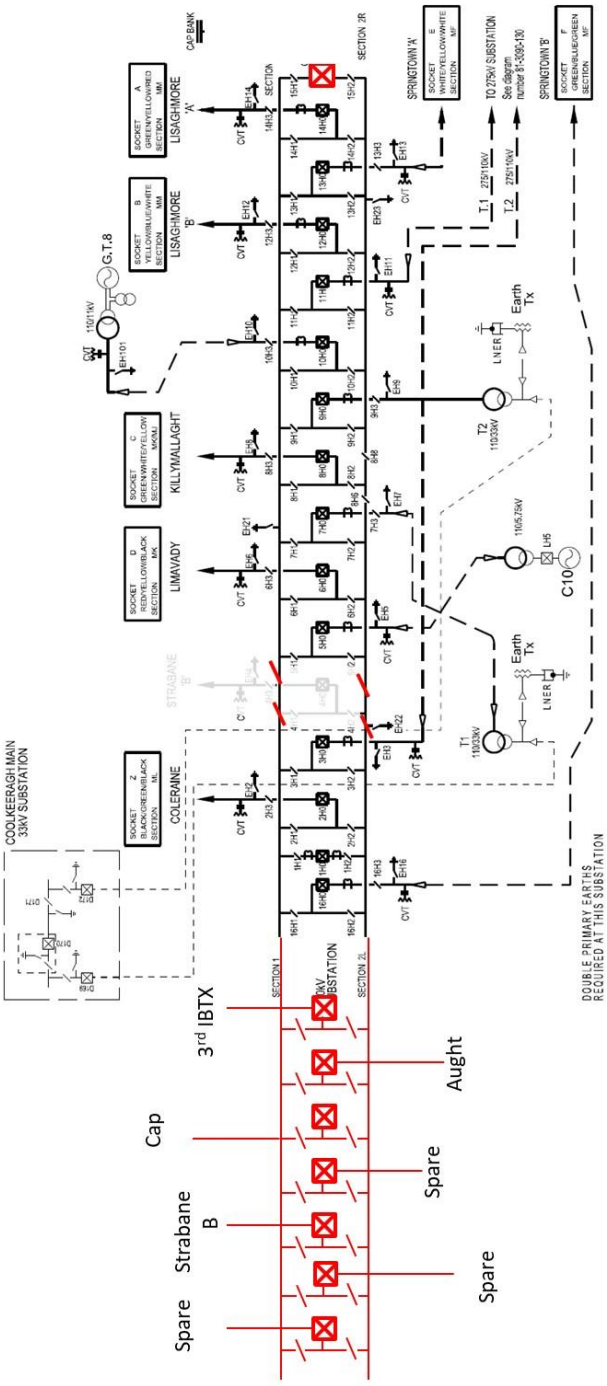

Figure 7 Option 1 SLD

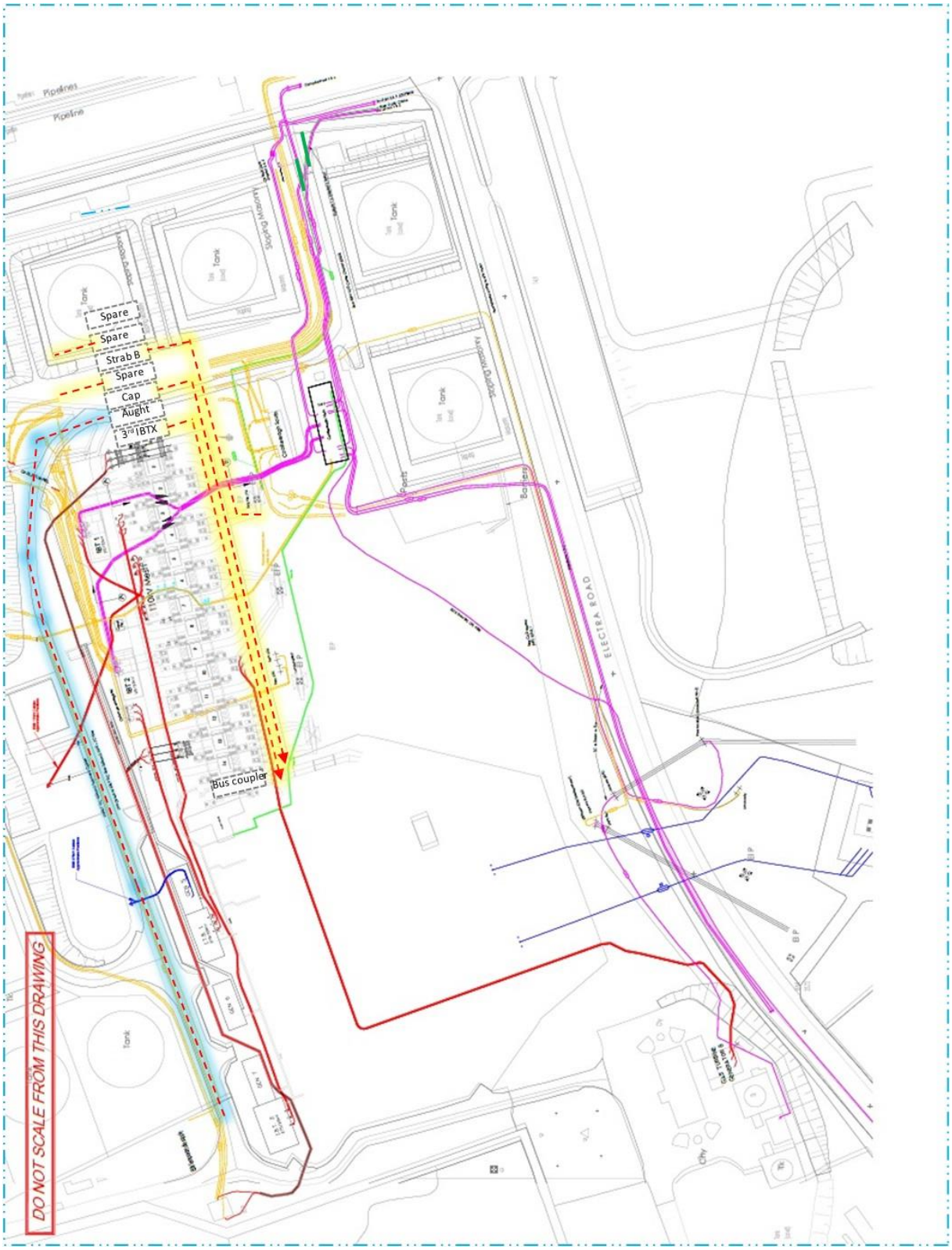

Figure 8 Option 1 location of AIS and indicative cable layout (new cable routes highlighted in yellow and blue)

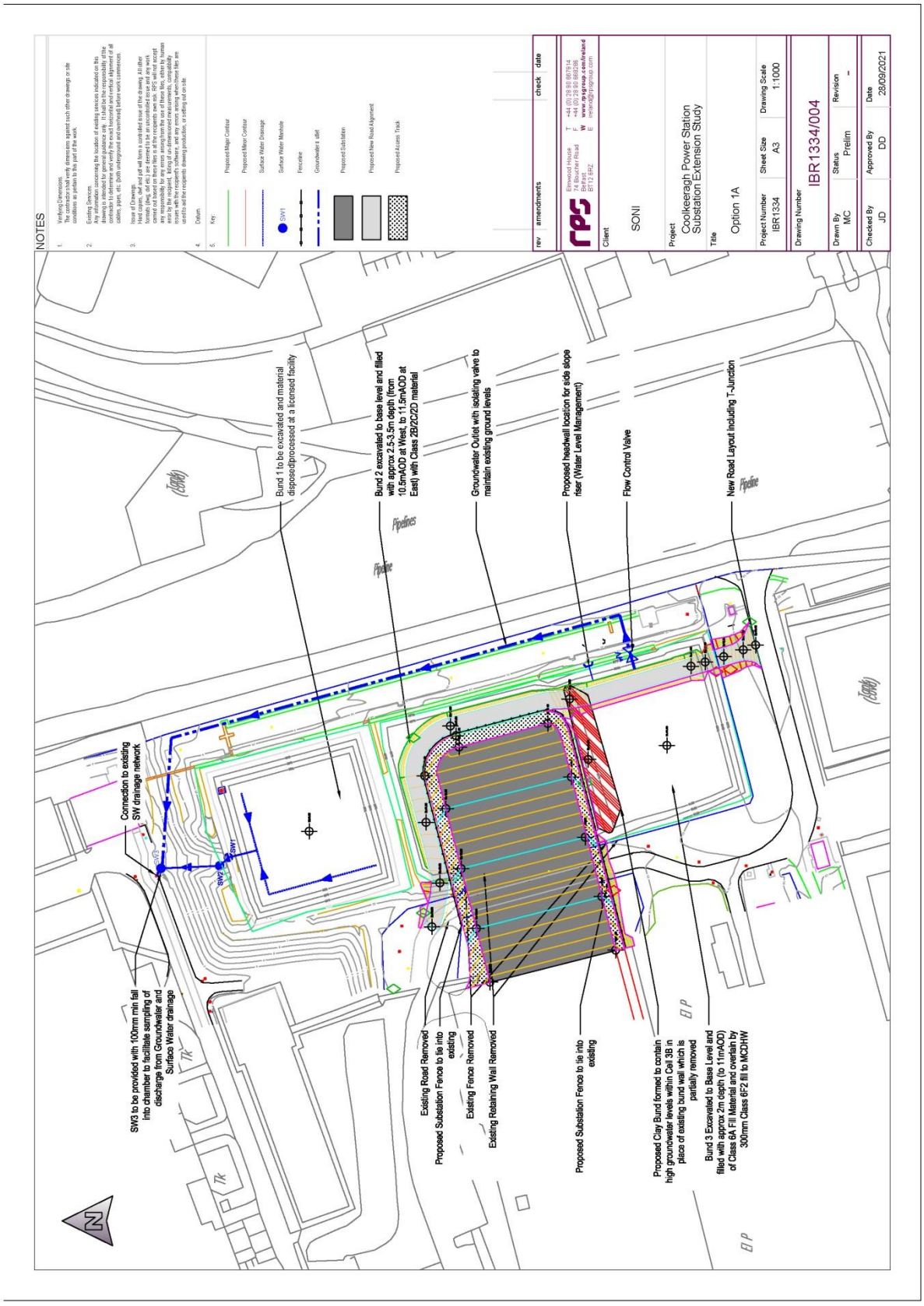

Figure 9 Option 1 schematic provided by RPS

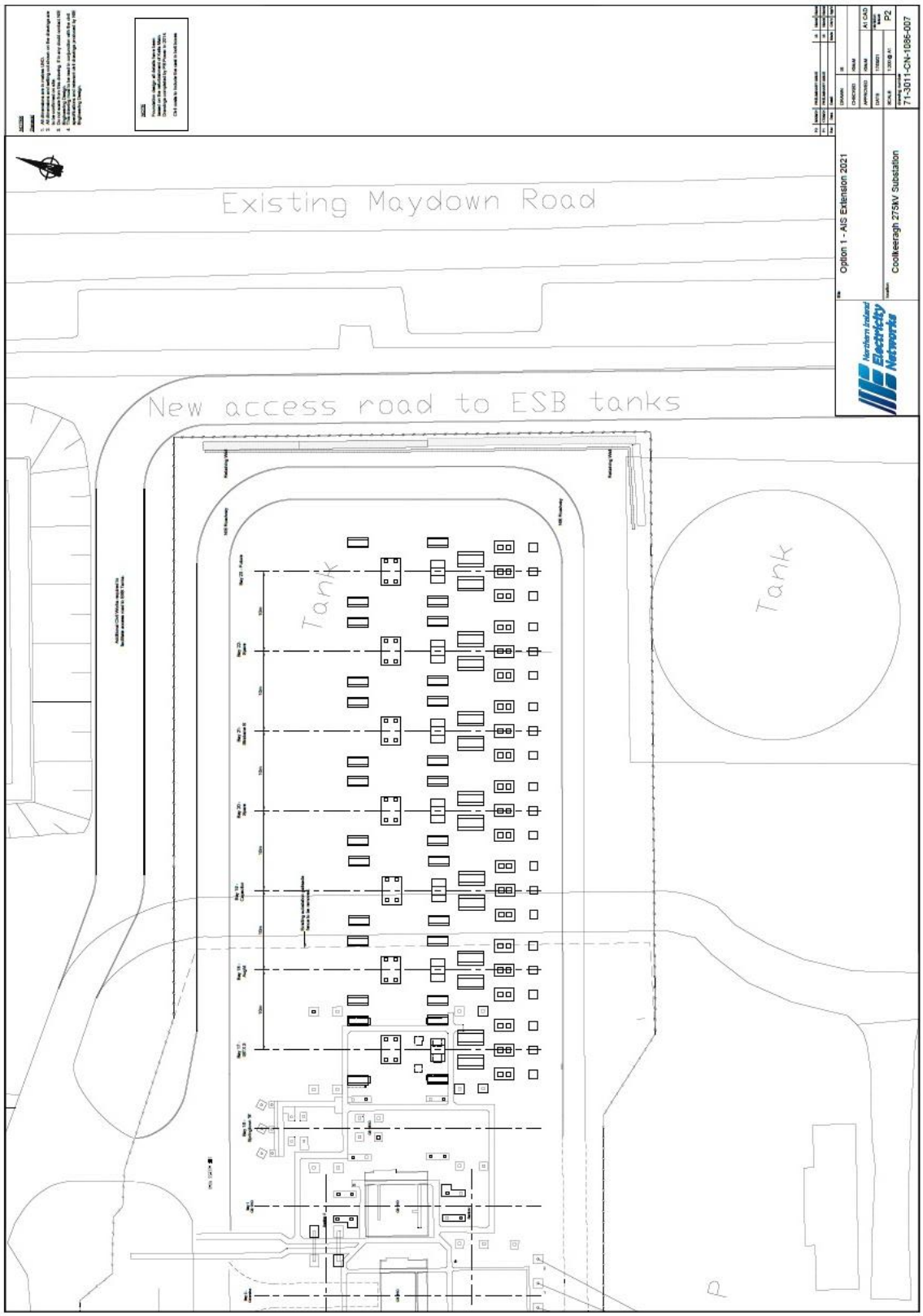

Figure 10 NIEN indicative layout for Option 1

Option 2

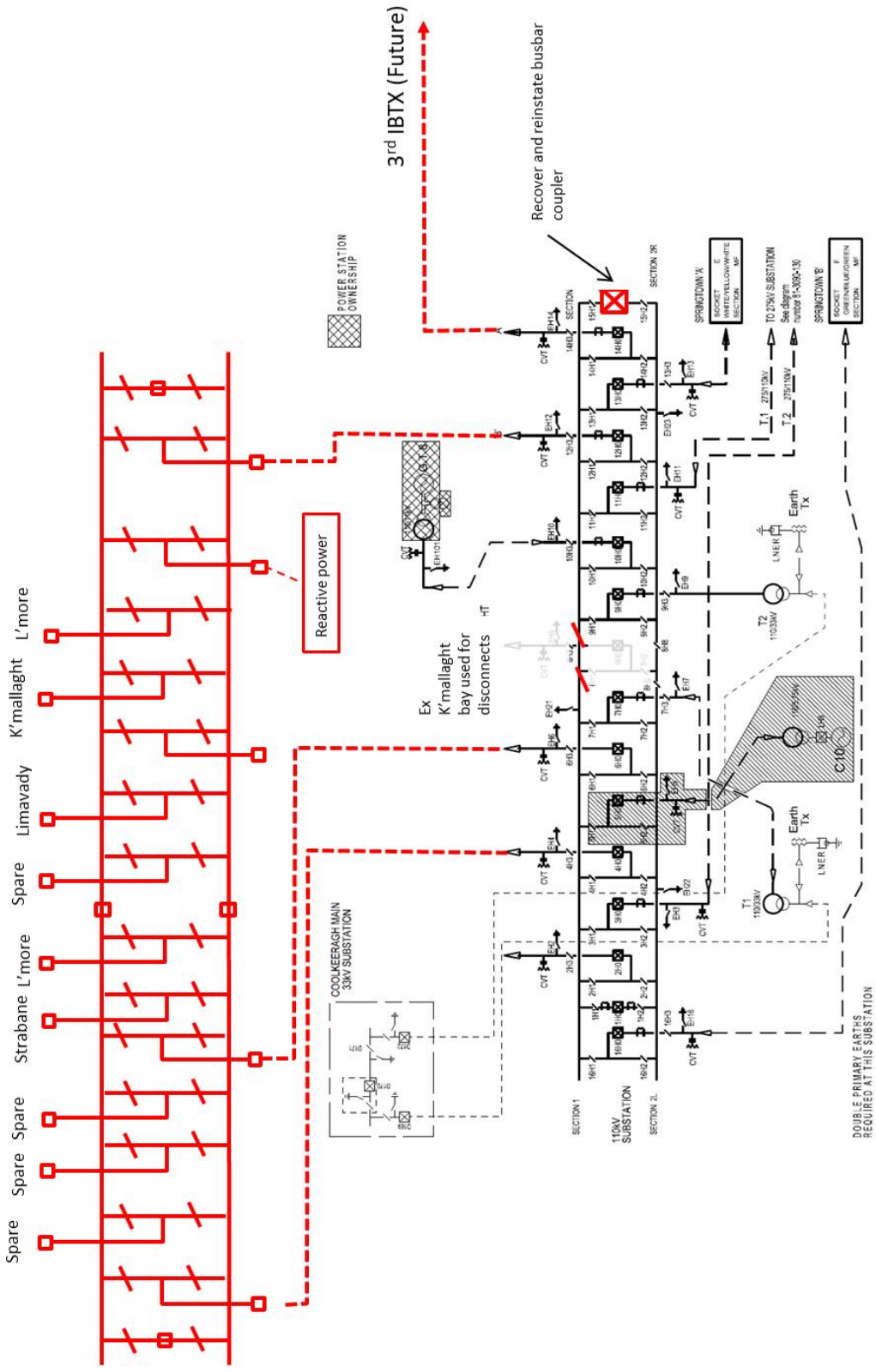

Figure 11 Option 2 SLD

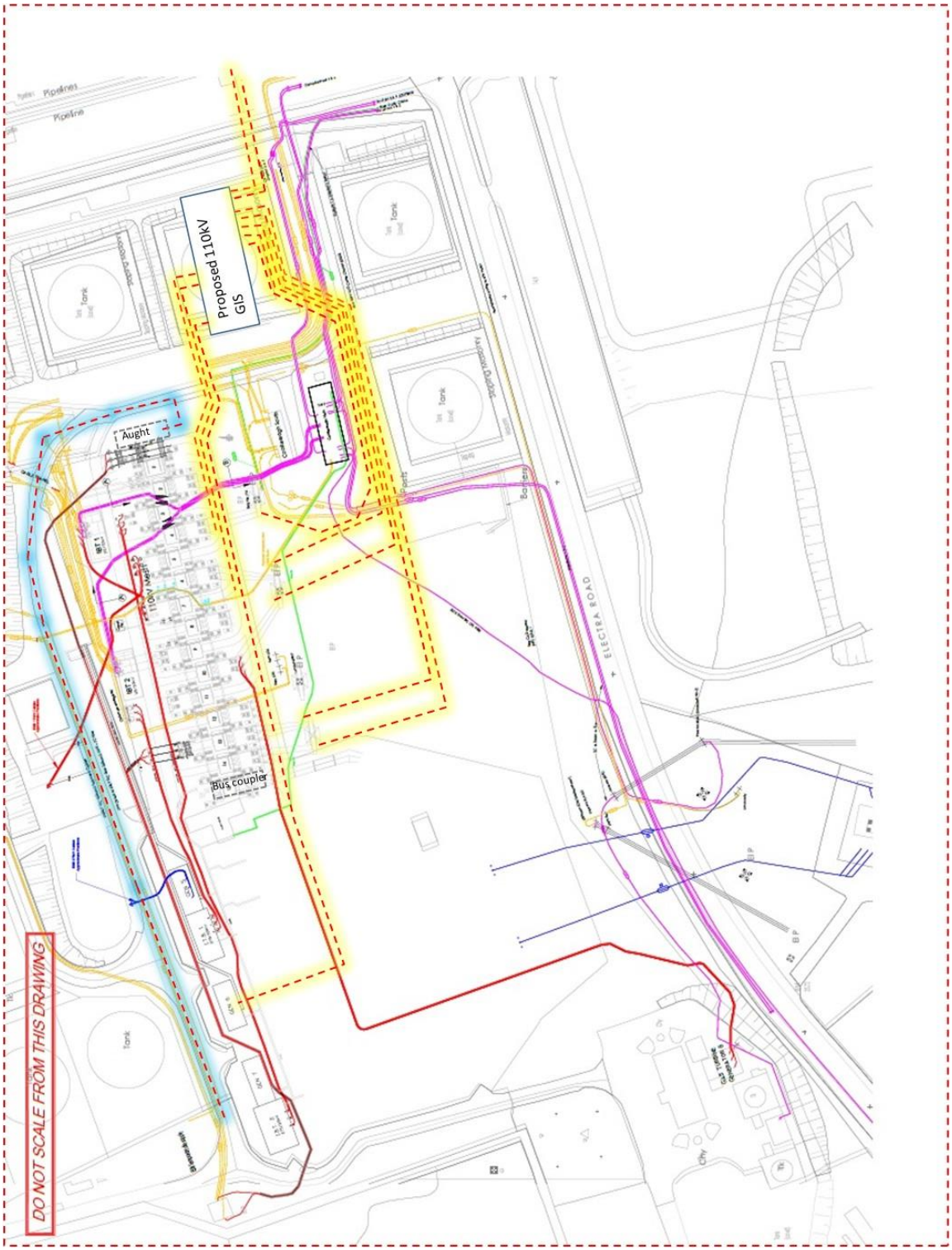

Figure 12 Option 2a(i) location of GIS and indicative cable layout (new cable routes highlighted in yellow and blue)

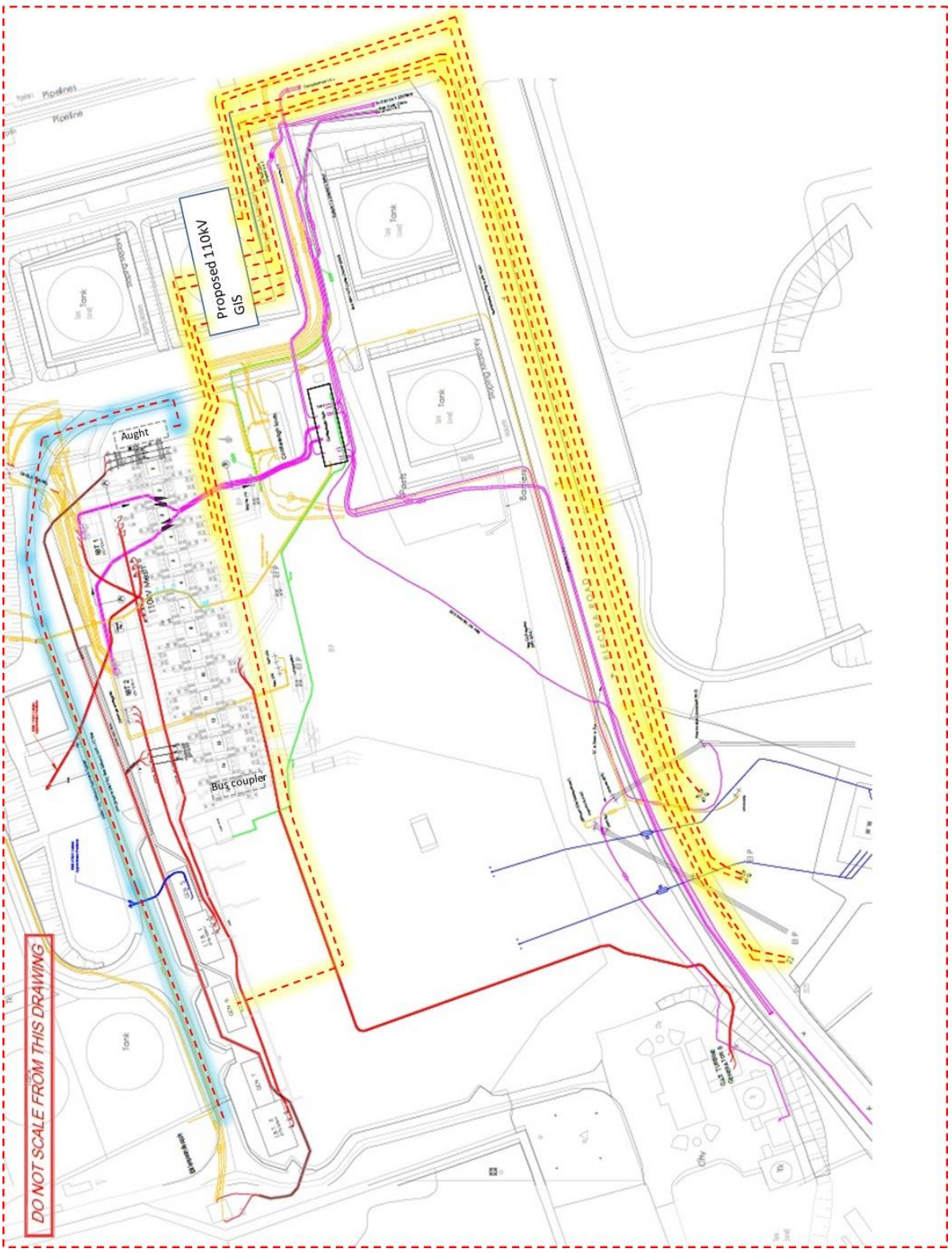

Figure 13 Option 2a(ii) location of GIS and indicative cable layout (new cables highlighted in yellow and blue)

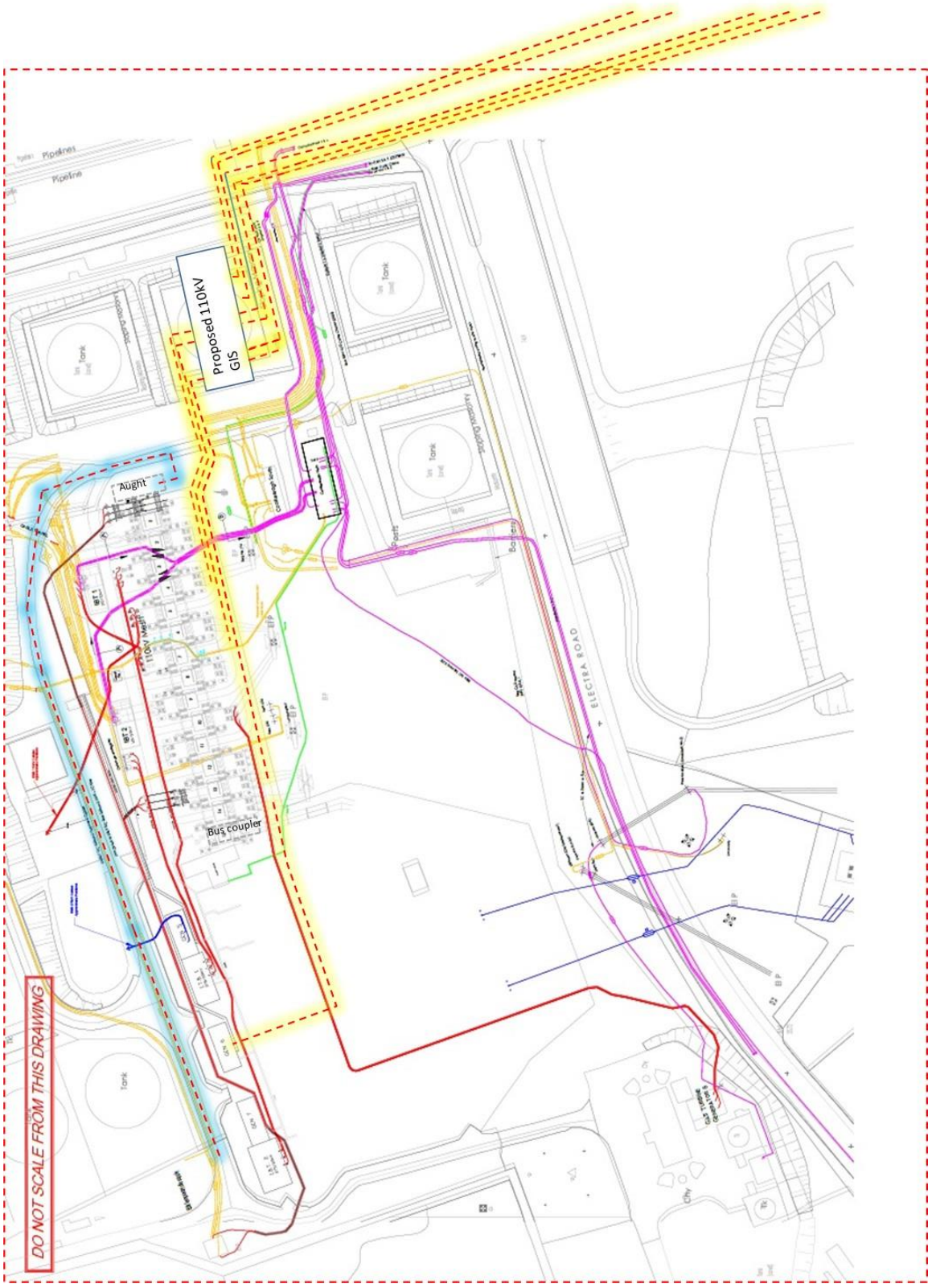

Figure 14 Option 2a(iii) location of GIS and indicative cable layout (new cables highlighted in yellow and blue)

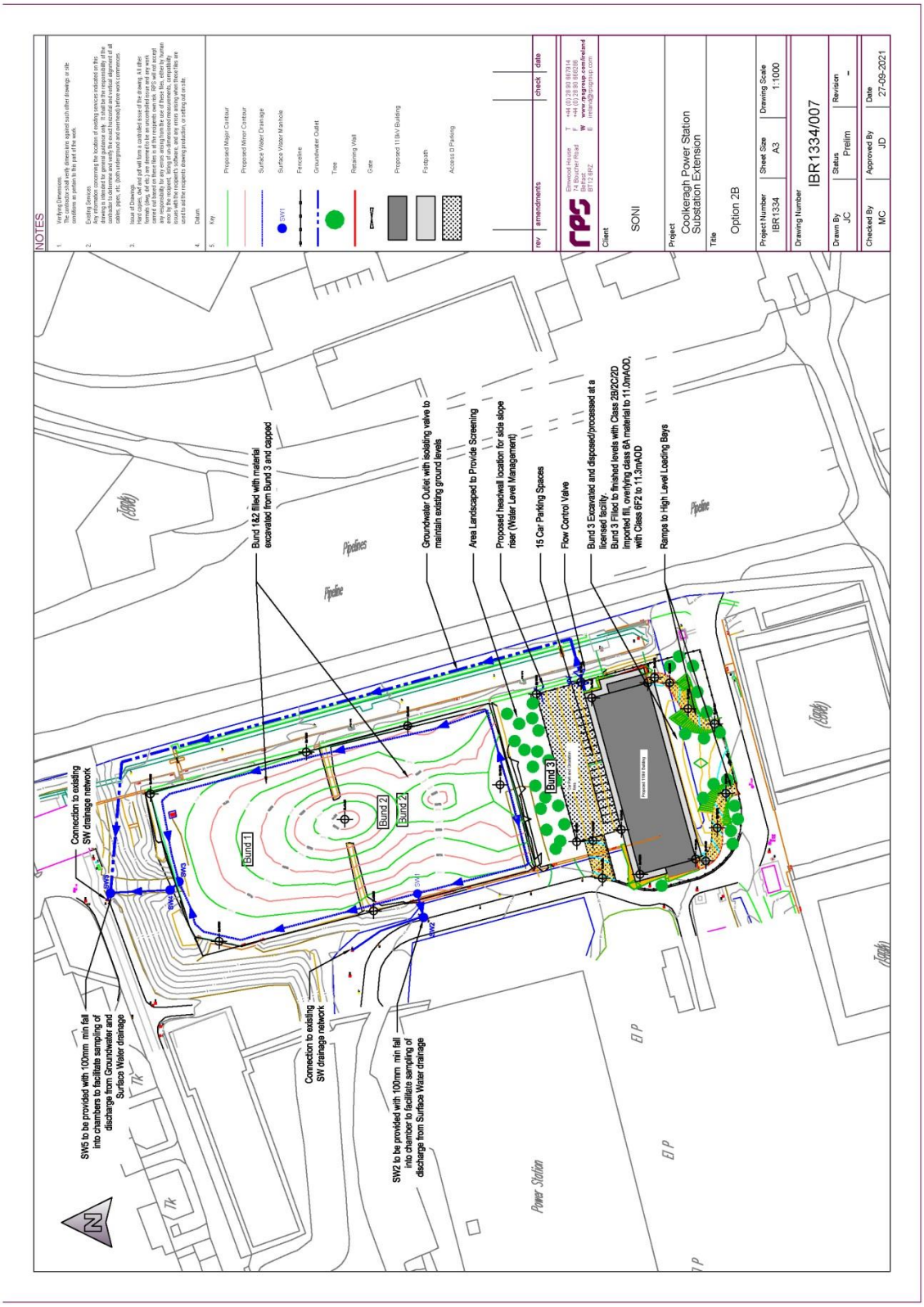

Figure 15 Option 2 schematic provided by RPS

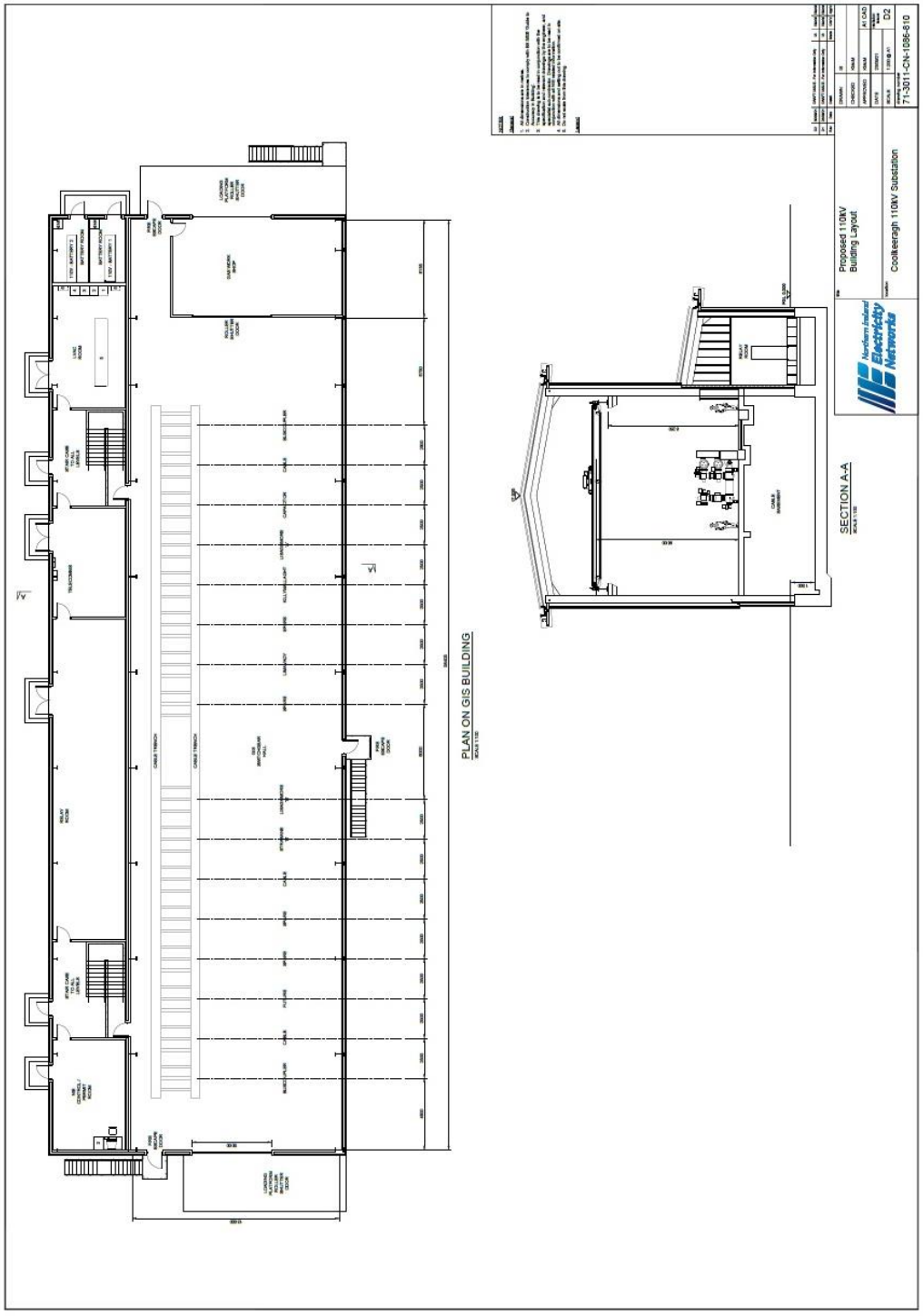

Figure 16 Indicative dimensions for GIS building (similar dimensions for Options 2 and 3)

Option 3

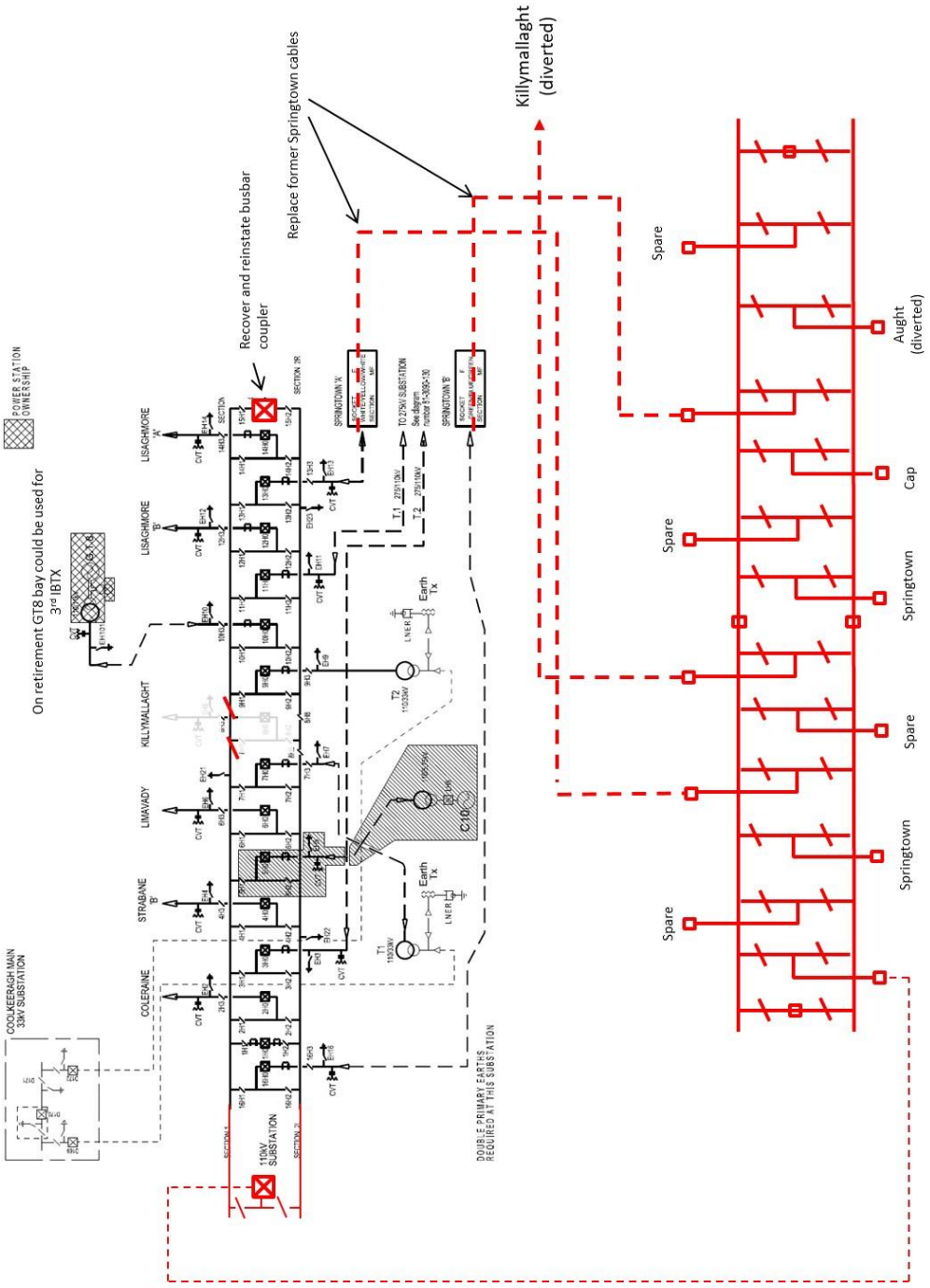

Figure 17 Option 3a SLD

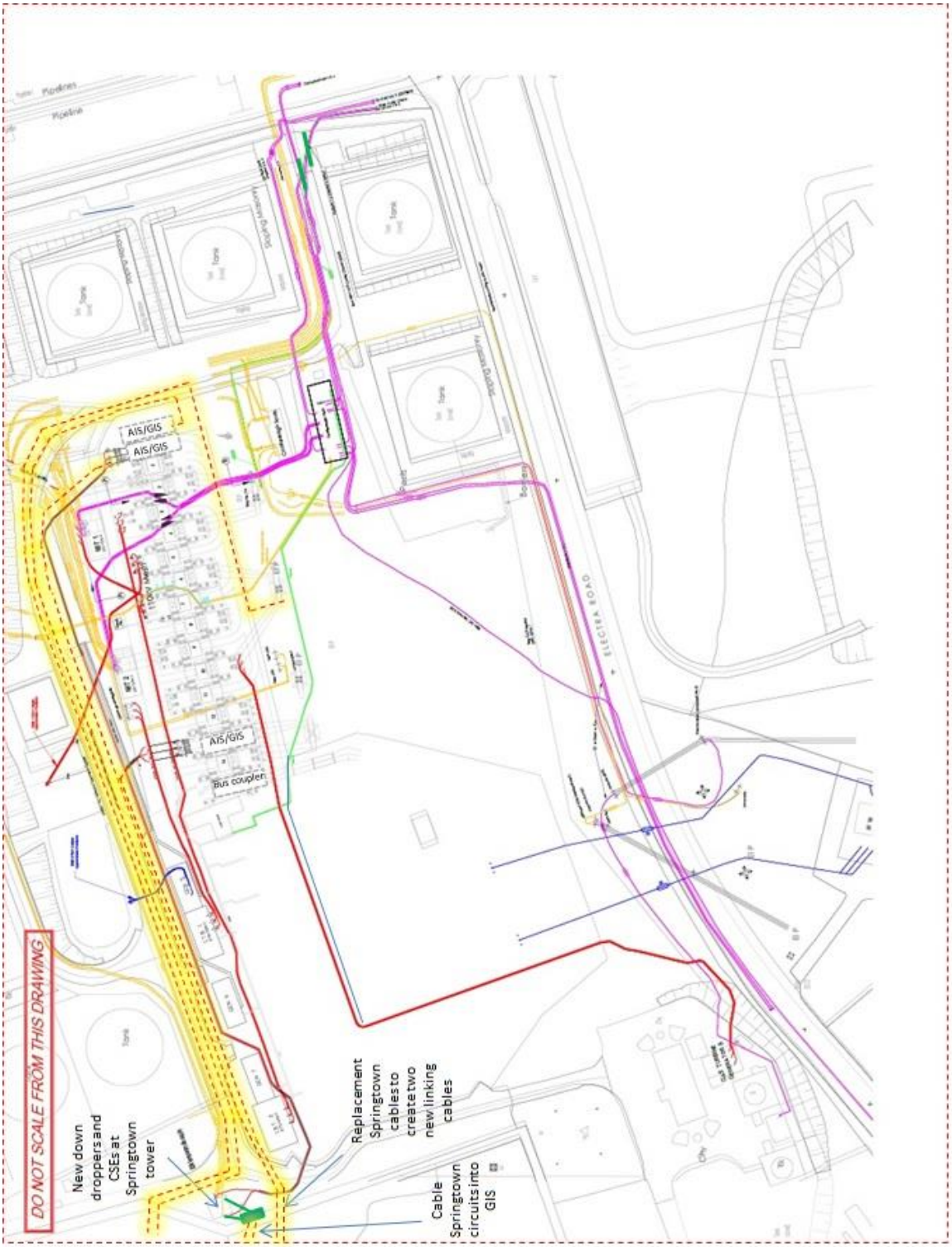

Figure 18 Option 3a location of GIS and indicative cable layout (new cables highlighted in yellow)

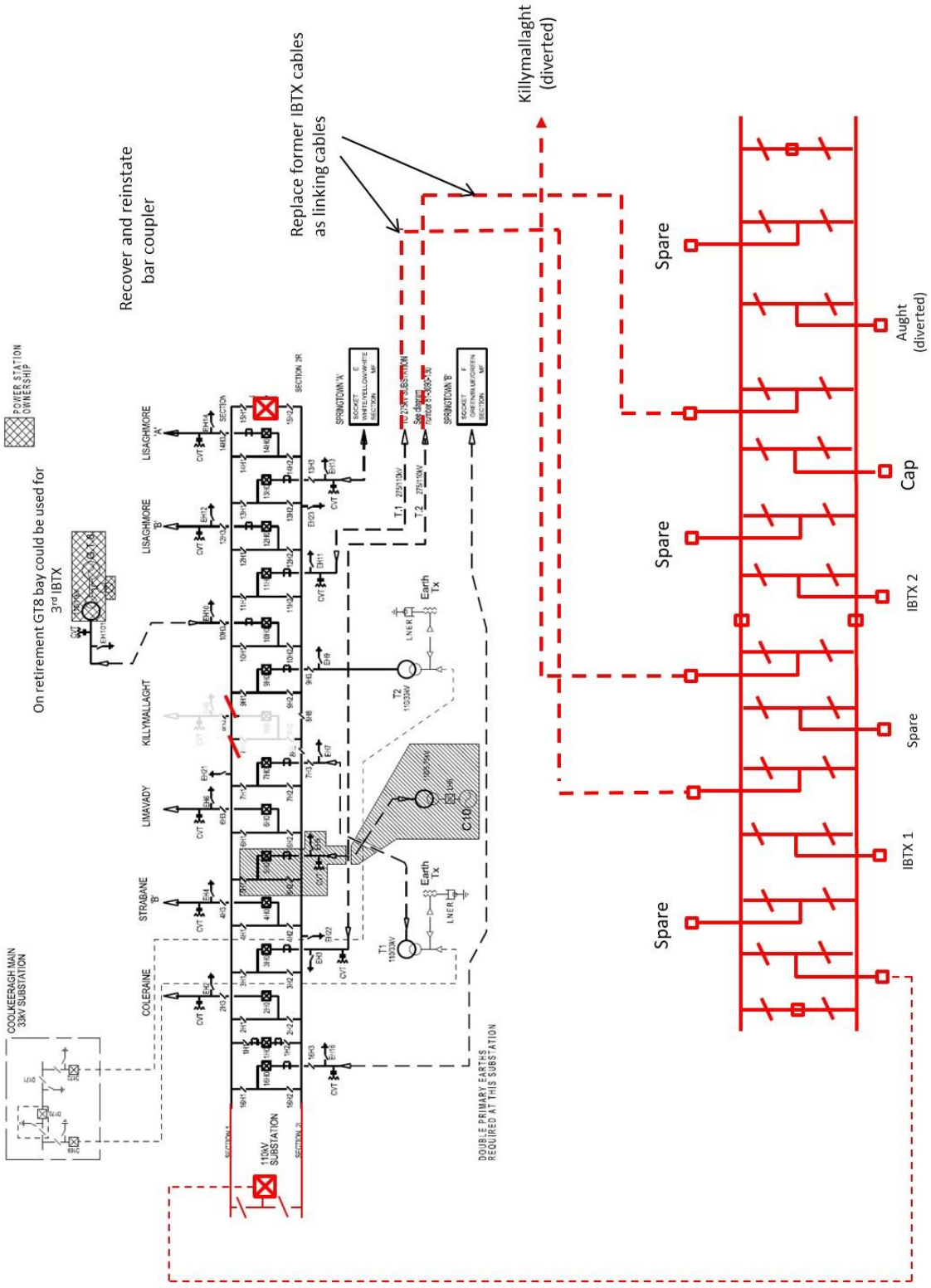

Figure 19 Option 3b SLD

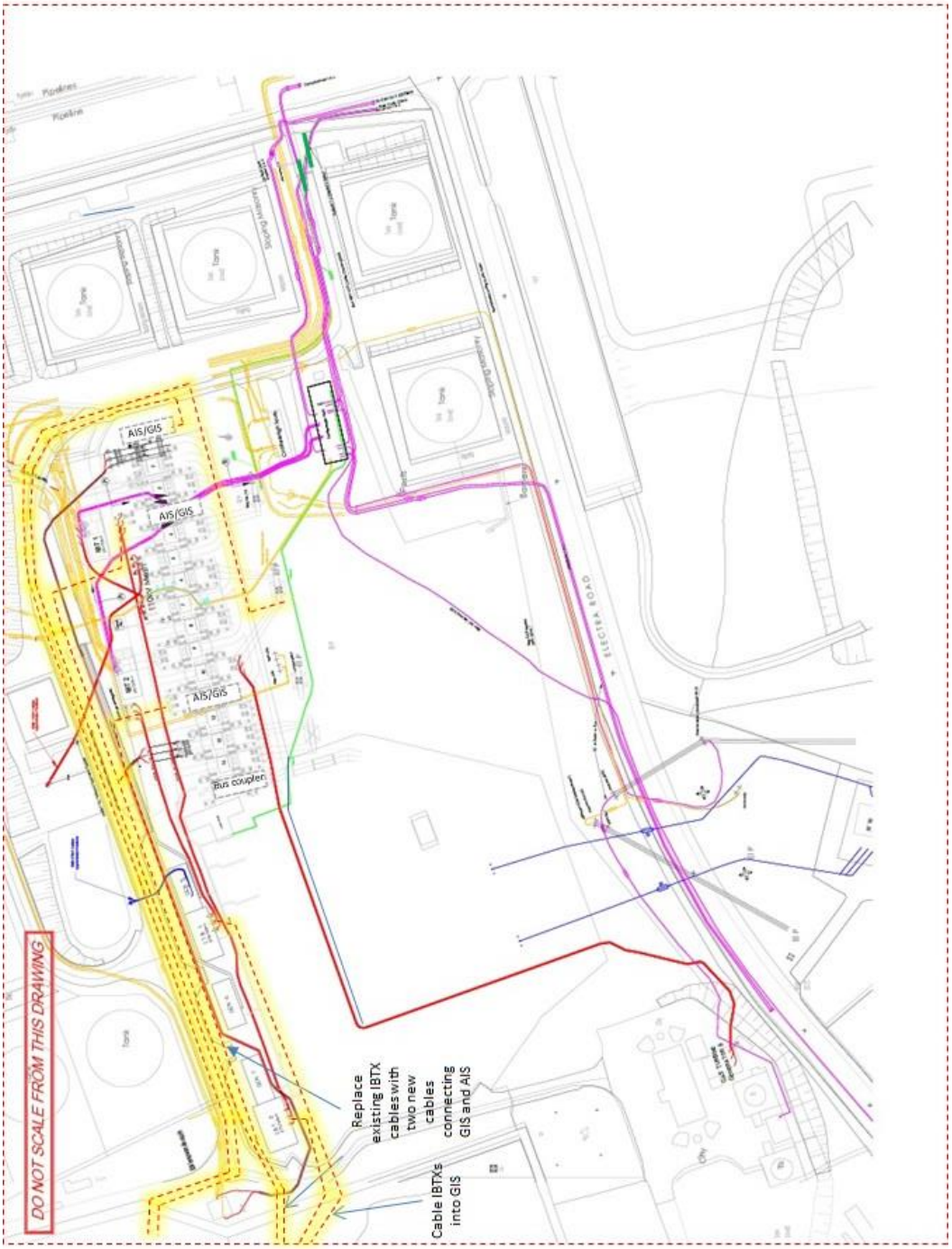

Figure 20 Option 3b location of GIS and indicative cable layout (new cables highlighted in yellow)

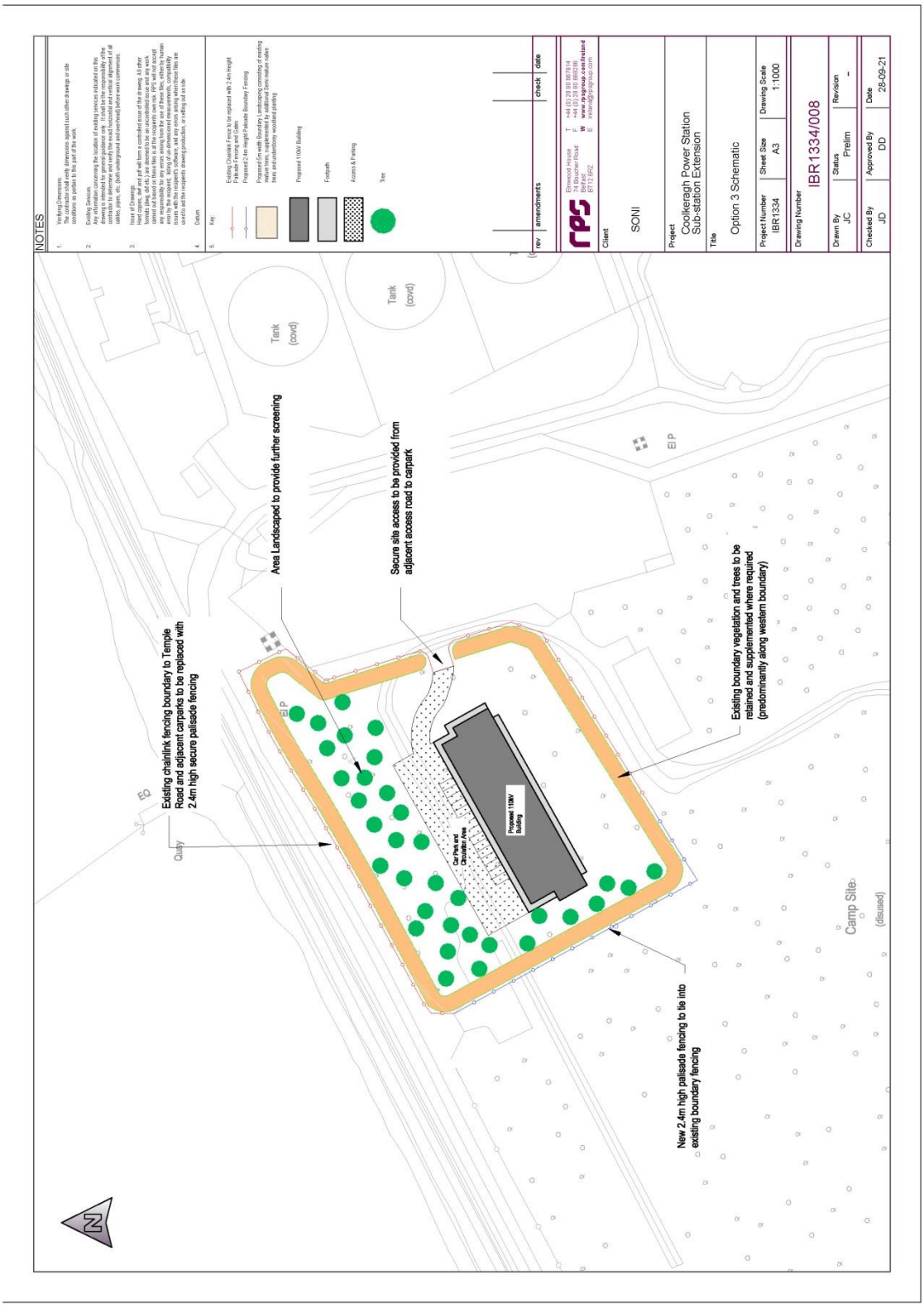

Figure 21 Option 3 schematic provided by RPS

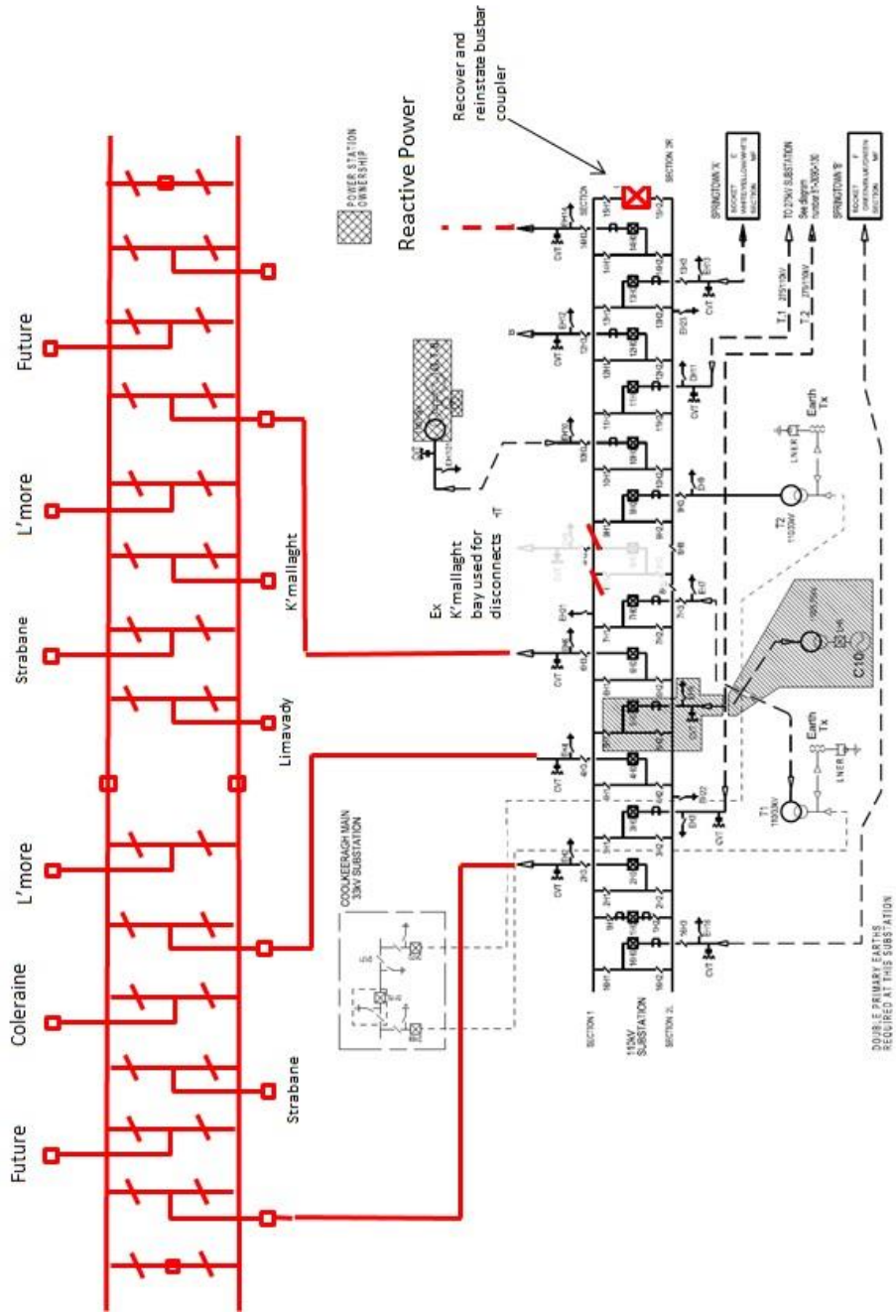

Figure 22 Option 4 SLD

APPENDIX 2 – Costs for each option

Coolkeeragh 110kV Option 1a - Extension of AIS compound

Item Description	Quantity	Unit cost (£m)	Total Cost (£m)
Civil and Environmental works to remove all material from three bunds offsite, landscaping, road diversion, drainage and fencing (from RPS report)	1	10.77	10.77
110kV AIS bay (Bus coupler, Reactive Power, Strabane B)	3	0.78	2.34
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable Strabane B into bay on extended busbars to allow mid section disconnectors to be established)	1.3	0.26	0.34
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable capacitor into new bay on east side to allow bus coupler to be re-instated in bay 15)	2.3	0.26	0.60
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Strabane B bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Extend existing control building for new bays	1	0.15	0.15
Replace three 110kV concrete structures	1	0.45	0.45
Estimate of TAO costs			**16.03**
Contingency (10%)			**1.60**
Total			**17.63**

Additional Extra-over Allowance for Movement of Material to GB if required (treatment costs in GB would remain the same as those in NI)	**1.39**

Coolkeeragh 110kV Option 1c - Extension of AIS compound

Item Description	Quantity	Unit cost (£n	Total Cost (£m)
Civil and Environmental works to remove all material from three bunds offsite, landscaping, road diversion, drainage and fencing (from RPS report)	1	5.21	5.21
110kV AIS bay (Bus coupler, Reactive Power, Strabane B)	3	0.78	2.34
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable Strabane B into bay on extended busbars to allow mid section disconnectors to be established)	1.3	0.26	0.34
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable capacitor into new bay on east side to allow bus coupler to be re-instated in bay 15)	2.3	0.26	0.60
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Strabane B bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Extend existing control building for new bays	1	0.15	0.15
Replace three 110kV concrete structures	1	0.45	0.45
Estimate of TAO costs			**10.47**
Contingency (10%)			**1.05**
Total			**11.52**

Coolkeeragh 110kV Option 2a(i) - GIS on upper bund

Item Description	Quantity	Unit cost (£m)	Total Cost (£m)
Civil and Environmental works to remove material from upper bund to lower bunds and enable upper bund for substation development, landscaping, road diversion, drainage and fencing (from RPS report)	1	1.17	1.17
110kV GIS DBB Bay substation - 6 bay switchroom pro-rata, 2500 amp busbars, 1600/2000 amp feeders, VT, protection CBF	1	4.30	4.30
8 additional DBB (to give 14 in total, including 2 for datacentre, allows for one future bay)	8	0.80	6.40
Reinstate buscoupler	1	0.78	0.78
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable capacitor into new bay on GIS to allow bus coupler to be re-instated in bay 15)	0.3	0.26	0.78
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Killymallaght bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Cable to divert Lisaghmore B to GIS	0.28	0.26	0.73
Cable to divert Killymallaght to GIS	0.212	0.26	0.55
Cable to divert Limavady to GIS	0.19	0.26	0.50
Cable to divert Strabane to GIS	0.176	0.26	0.46
Cable connecting AIS and GIS 1	0.18	0.26	0.47
Cable connecting AIS and GIS 2	0.132	0.26	0.34
Cable connecting AIS and GIS 3	0.121	0.26	0.32
Replace three 110kV concrete structures	1	0.45	0.45
Estimate of TAO costs			**18.63**
Contingency (10%)			**1.86**
Total			**20.50**

Coolkeeragh 110kV Option 2a(ii) - GIS on upper bund

Item description	Quantity	Unit cost (£m)	Total Cost (£m)
Civil and Environmental works to remove material from upper bund to lower bunds and enable upper bund for substation development, landscaping, road diversion, drainage and fencing (from RPS report)	1	1.17	1.17
110kV GIS DBB Bay substation - 6 bay switchroom pro-rata, 2500 amp busbars, 1600/2000 amp feeders, VT, protection CBF	1	4.30	4.30
8 additional DBB (to give 14 in total, including 2 for datacentre, allows for one future bay)	8	0.80	6.40
Reinstate buscoupler	1	0.78	0.78
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable capacitor into new bay on new GIS to allow bus coupler to be re-instated in bay 15)	0.3	0.26	0.78
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Killymallaght bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Cable to divert Lisaghmore B to GIS	0.56	1.18	0.66
Cable to divert Killymallaght to GIS	0.526	1.18	0.62
Cable to divert Limavady to GIS	0.527	1.18	0.62
Cable to divert Strabane to GIS	0.506	1.18	0.60
Cable connecting AIS and GIS 1	0.18	0.26	0.47
Cable connecting AIS and GIS 2	0.132	0.26	0.34
Cable connecting AIS and GIS 3	0.121	0.26	0.32
Replace three 110kV concrete structures	1	0.45	0.45
Estimate of TAO costs			**18.90**
Contingency (10%)			**1.89**
Total			**20.78**

Coolkeeragh 110kV Option 2a(iii) - GIS on upper bund

Item Description	Quantity	Unit cost (£m)	Total Cost (£m)
Civil and Environmental works to remove material from upper bund to lower bunds and enable upper bund for substation development, landscaping, road diversion, drainage and fencing (from RPS report)	1	1.17	1.17
110kV GIS DBB Bay substation - 6 bay switchroom pro-rata, 2500 amp busbars, 1600/2000 amp feeders, VT, protection CBF	1	4.30	4.30
8 additional DBB (to give 14 in total, including 2 for datacentre, allows for one future bay)	8	0.80	6.40
Reinstate buscoupler	1	0.78	0.78
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable capacitor into new bay on new GIS to allow bus coupler to be re-instated in bay 15)	0.3	0.26	0.78
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Killymallaght bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Cable to divert Lisaghmore B to GIS	0.93	1.18	1.10
Cable to divert Killymallaght to GIS	0.93	1.18	1.10
Cable to divert Limavady to GIS	0.93	1.18	1.10
Cable to divert Strabane to GIS	0.93	1.18	1.10
Cable connecting AIS and GIS 1	0.18	0.26	0.47
Cable connecting AIS and GIS 2	0.132	0.26	0.34
Cable connecting AIS and GIS 3	0.121	0.26	0.32
Replace three 110kV concrete structures	1	0.45	0.45
Estimate of TAO costs			**20.79**
Contingency (10%)			**2.08**
Total			**22.86**

Coolkeeragh 110kV Option 3a - GIS at northwest corner, diverting Springtown

Item Description	Quantity	Unit cost (£m)	Total Cost (£m)
Civil and Environmental costs to enable seafront site for GIS (from RPS report)	1	0.74	0.74
110kV GIS DBB Bay substation - 6 bay switchroom pro-rata, 2500 amp busbars, 1600/2000 amp feeders, VT, protection CBF	1	4.30	4.30
8 additional DBB (to give 14 in total, including 2 for datacentre, allows for one future bay)	8	0.80	6.40
Reinstate buscoupler	1	0.78	0.78
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable capacitor into new bay on GIS to allow bus coupler to be re-instated in bay 15)	0.5	0.26	1.31
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Killymallaght bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Cable to divert Springtown A to GIS	0.14	0.26	0.37
Cable to divert Springtown B to GIS	0.14	0.26	0.37
Cable to divert Killymallaght to GIS	0.77	0.26	2.01
Cable connecting AIS and GIS 1 (Former Springtown A bay)	0.42	0.26	1.10
Cable connecting AIS and GIS 2 (Former Springtown B bay)	0.52	0.26	1.36
Cable connecting AIS and GIS 3 (Former Aught bay)	0.64	0.26	1.67
Replace three 110kV concrete structures	1	0.45	0.45
Estimate of TAO costs			**22.22**
Contingency (10%)			**2.22**
Total			**24.44**

Indicative Additional Extra-over Allowance for Provision of Gas Protection Measures	0.19

Coolkeeragh 110kV Option 3b - GIS at northwest corner, diverting IBTXs

Item Description	Quantity	Unit cost (£m)	Total Cost (£m)
Civil and Environmental costs to enable seafront site for GIS (from RPS report)	1	0.74	0.74
110kV GIS DBB Bay substation - 6 bay switchroom pro-rata, 2500 amp busbars, 1600/2000 amp feeders, VT, protection CBF	1	4.30	4.30
8 additional DBB (to give 14 in total, including 2 for datacentre, allows for one future bay)	8	0.80	6.40
Reinstate buscoupler	1	0.78	0.78
1 x 1000sqmm Al XLPE (100m, 144MVA) Cable capacitor into new bay on GIS to allow bus coupler to be re-instated in bay 15	0.5	0.26	1.31
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Killymallaght bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Cable to divert IBTX 1 to GIS	0.3	0.26	0.78
Cable to divert IBTX 2 to GIS	0.3	0.26	0.78
Cable to divert Killymallaght to GIS	0.77	0.26	2.01
Cable connecting AIS and GIS 1 (Former IBTX 1 bay)	0.44	0.26	1.15
Cable connecting AIS and GIS 2 (Former IBTX 2 bay)	0.47	0.26	1.23
Cable connecting AIS and GIS 3 (Former Aught bay)	0.64	0.26	1.67
Replace three 110kV concrete structures	1	0.45	0.45
Estimate of TAO costs			**22.98**
Contingency (10%)			**2.30**
Total			**25.28**

Indicative Additional Extra-over Allowance for Provision of Gas Protection Measures		0.19

Coolkeeragh 110kV Option 4 - New NW switching station near Mobuoy

	Quantity	Unit cost (£m)	Total Cost (£m)
Works at Coolkeeragh			
Reinstate buscoupler	1	0.78	0.78
1 x 1000sqmm Al XLPE (100m, 144MVA) (Cable capacitor into new bay on GIS to allow bus coupler to be re-instated in bay 15)	0.3	0.26	0.78
Replace existing CTs in 11 bays (not including Bay 15) which are currently 31.5kA	11	0.09	0.99
Replace existing earthswitches in Bay 10 (EH101) currently rated at 15.3kA	1	0.09	0.09
Remove switchgear in existing Killymallaght bay and replace with bus section disconnectors on both busbars.	1	0.30	0.30
Replace three 110kV concrete structures	1	0.45	0.45
Works at Mobuoy			
Land purchase	1	0.50	0.50
Substation pre-enabling	1	0.55	0.55
110kV AIS DBB Bay	16	0.78	12.48
Control building	1	0.20	0.20
Mesh extension at Strabane	1	0.50	0.50
Turn in of Lisaghmore double circuit			
Coolkeeragh - Lisaghmore circuit turn in	1	0.82	0.82
Coolkeeragh - Lisaghmore #1 cable section	2.3	2.06	4.75
Coolkeeragh - Lisaghmore #2 cable section	0	0.00	0.00
Turn in of Killymallaght/Limavady double circuit			
Coolkeeragh - Killymallaght/Limavady turn in to Mobuoy	1	0.82	0.82
Mobuoy - Coolkeeragh #3 turn in (formerly section of Coolkeeragh - Limavady cct turned in to Mobuoy)	0.5	0.82	0.41
Uprate Cool-Mobuoy #3 OHL section from Limavady single cct	4.7	0.20	0.94
Coolkeeragh - Limavady cable section	1.5	2.06	3.10
Coolkeeragh - Killymallaght cable section	0	0.00	0.00
Mobuoy - Coolkeeragh #3 cable section	0.9	1.18	1.06
Mobuoy - Coolkeeragh #4	0	0.00	0.00
Turn in of Coleraine/Strabane double circuit			
Uprate Cool- Mbuoy #1&2 OHL sections from Cole/Strabane terminal tower at Mobuoy	4.7	0.40	1.88
Coleraine - Coolkeeragh turn in to Mobuoy	1	0.41	0.41
Coolkeeragh - Strabane #1 turn in to Mobuoy	1	0.82	0.82
Coolkeeragh - Strabane #2 turn in to Mobuoy	0	0.00	0.00
Mobuoy - Coolkeeragh #1 turn in (formerly section of Coolkeeragh - Strabane cct turned in to Mobuoy)	1	0.82	0.82
Mobuoy - Coolkeeragh #2 turn in (formerly section of Coolkeeragh - Coleraine cct turned in to Mobuoy)	0	0.00	0.00
Estimate of TAO costs			**33.43**
Contingency (10%)			**3.34**
Total			**36.77**

APPENDIX 3 – Net Present Cost and Assumptions

Assumption	Option			
	0 – Do nothing	*1a – AIS extension*	*1c – AIS extension*	*3a – GIS northwest corner of the*
Capital Cost of Assets	-	£17.63m	£11.52m	£24.44m
Duration of SONI pre-construction	-	April 2023 – April 2025	April 23 – Feb 26[18]	April 23 – Sept 25
Duration of NIEN pre-construction		June 24 – Feb 26	June 24 – Feb 26	June 24 – Feb 26
Duration of construction	-	Feb 26 – March 2030	Jan 26 – Sept 29	March 26 – March 2029
Estimated Completion Date and Energisation	-	2030	2029	2029
TSO costs (10%)	-	£1.76m	£1.15m	£2.44m
O&M (1.3%)	-	£9.87m, over 40 years	£7.02m	£13.30m, over 40 years
Deferred capital costs	£5.73m in 2042 (remediate at site closure)	£3.43m in 2032. (four future bays)	£3.43m in 2032. (four future bays)	£5.73m in 2042 (remediate at site closure)
TOTAL NET PRESENT COST	**£3.63[19]m**	**£22.69m**	**£16.14m**	**£30.73m**

[18] April 2023 is the estimated date of TNPP approval, however, some pre-construction activities have been brought forward and will be funded through Opex

[19] This does not include the potential cost of loss of generation and demand from a cascade tripping event following a bus coupler fault which is difficult to evaluate due to the complexity of such an event but would be substantial.