IE000451A - CP1273 DUBLIN CENTRAL GRID REINFORCEMENT

Step 3 Report

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Context

This report presents an independent review and analysis of submissions received to the public consultation on the EirGrid "Dublin Central Grid Reinforcement Project".

This report has been prepared for the EirGrid by RPS Consulting Engineers Ltd.

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1 INTRODUCTION

1.1 Who is EirGrid?

EirGrid is responsible for a safe, secure and reliable supply of electricity. EirGrid develops, manages and operates the electricity transmission grid. This brings power from where it is generated to where it is needed throughout Ireland. EirGrid uses the grid to supply power to industry and businesses that use large amounts of electricity. The grid also powers the distribution network. This supplies the electricity used every day in homes, businesses, schools, hospitals and farms.

1.2 Project Description

EirGrid, as the Transmission System Operator (TSO) of Ireland, and ESB Networks, as the Distribution System Operator (DSO) and Transmission Asset Owner (TAO) of Ireland, work collaboratively to ensure that the needs of transmission and distribution connected customers are met. This includes planning the development of transmission interface stations. A transmission interface station or transmission substation is a point of connection between the transmission and distribution system. A primary function of these stations is to facilitate power flows between the transmission and distribution systems to enable power to be distributed to where it is needed.

As part of feedback collected during the Shaping our Electricity Future consultation, the DSO has highlighted to EirGrid emerging needs for additional capacity at transmission interface stations in the Dublin area. This capacity is needed to accommodate forecast growth of electricity demand in the distribution network. This projected demand growth is driven by several factors including residential, electrification of heat and transport and growth in commercial sectors.

The significant electricity demand growth in the distribution system also leads to a significant pressure on the transmission system, particularly at existing transmission substations and the associated transmission circuits. The existing transmission substations and the associated transmission circuits are at risk of reaching their capacity limits and as a result the existing infrastructure will not be capable to supply sufficient power to where it is needed. To address this need, new infrastructure is required.

Since publication of the Shaping Our Electricity Future v1.0 Roadmap in 2021, the emerging needs have translated into connection requests made by the DSO to the TSO. Currently there are three projects underway to deliver new transmission substations, one each in North County Dublin (CP1214), West County Dublin (CP1226), and Dublin Central (CP1273). This report pertains to Capital Project 1273.

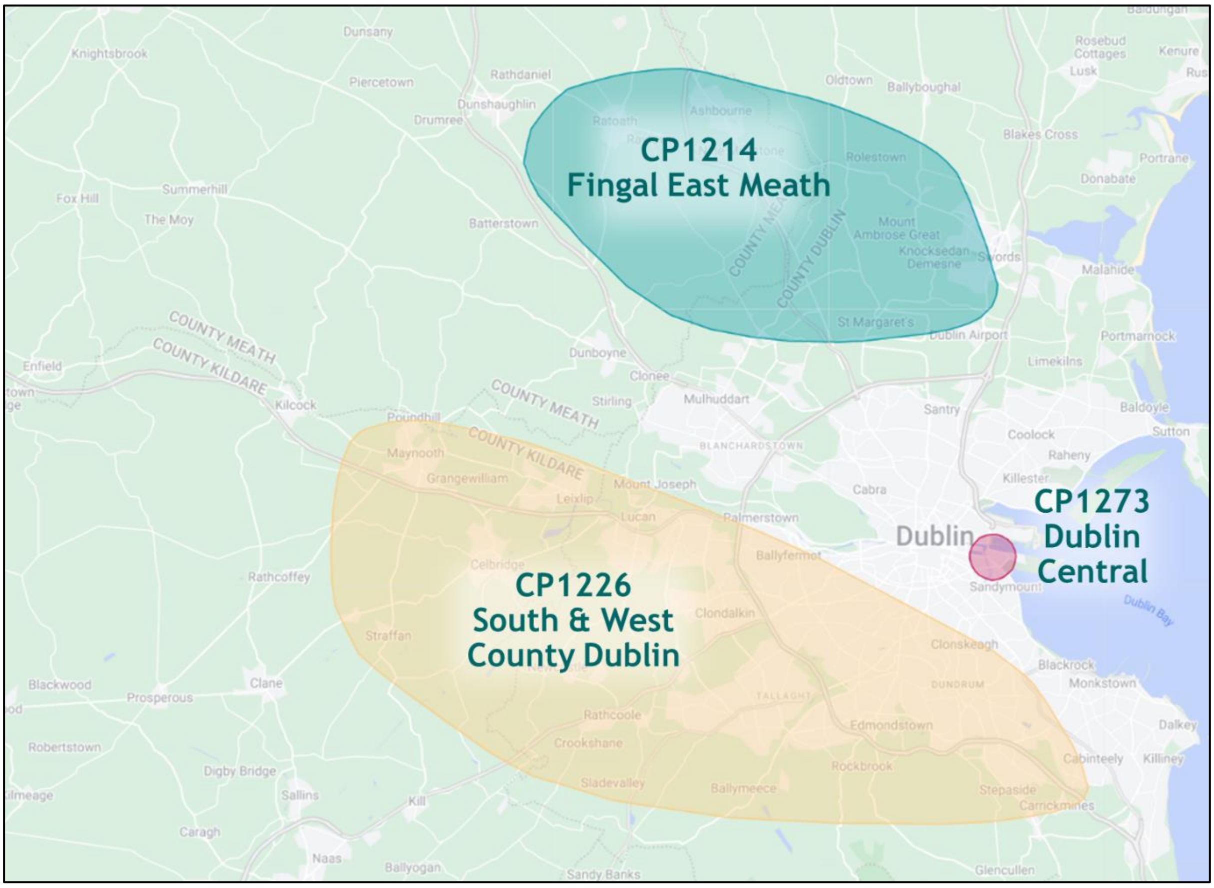


Figure 1-1: The Grid Reinforcement Projects: CP1214, CP1226, and CP1273

The Dublin Central Grid Reinforcement project is following the Framework for Grid Development, which is an end-to-end process for all EirGrid's grid development projects. The framework takes projects from their conception - the identification of a need to develop the electricity transmission grid - to their eventual construction and subsequent energisation. The framework is explained in EirGrid's "Have your Say" document and is illustrated in Figure 1-2.

This approach facilitates engagement and consultation with stakeholders and the public which helps to explore options fully and make more informed decisions. Previous studies by EirGrid have brought the Dublin Central Grid Reinforcement project through Steps 1 and 2 of their Framework for Grid Development and the project is currently at Step 3.

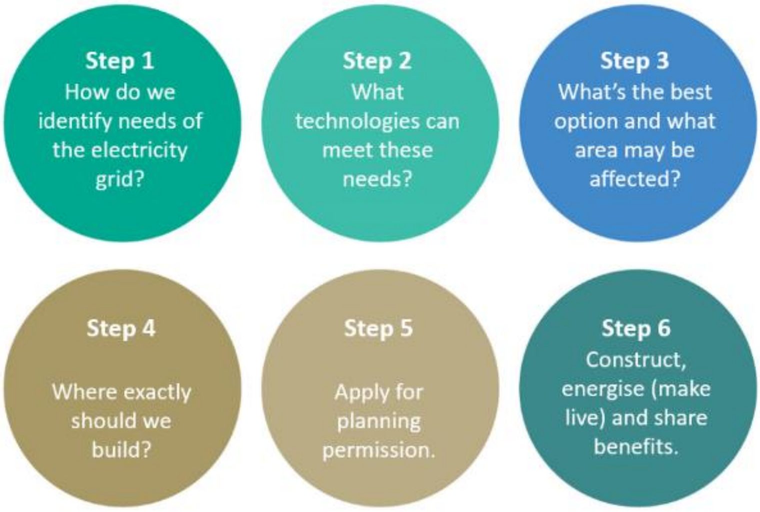


Figure 1-2: EirGrid's Six-Step Framework for Grid Development

1.2.1 What Step is the Dublin Central Grid Reinforcement Project at?

The Dublin Central Grid Reinforcement Project is currently at the beginning of Step 3 of EirGrid's six-step Framework for Grid Development. The key output of Step 3 is the identification of a best performing technology solution and corresponding study area to meet the need for the development of a project. This technology solution will include information such as the location of the project and/or the existing grid substation node(s) involved, as well as a heat mapped study area within which that solution occurs.

1.2.2 What is the Aim of this Step 3 Report?

The aim of this report is to identify the Emerging Best Option for the location of the Dublin Central Grid Reinforcement project as well as the 220 kV circuit tie-in location. This report includes a review of available technologies and technical feasibility. The Emerging Best Option is identified through assessment using multi-criteria analysis.

1.2.3 CP1273 Dublin Central Grid Reinforcement

EirGrid is responding to the Distribution System Operator's concern (DSO) that the existing transmission substations feeding the Dublin City Centre area will reach their capacity limits in the coming years. The DSO is planning to transfer load from Ringsend and Finglas Urban 110 kV stations to a new proposed transmission substation to accommodate further load growth in Dublin City Centre area.

A new transmission substation looped into one of the existing 220 kV circuits in the North Inner City has been identified as the best solution option for solving the need. The ESB owns land in the East Wall area and a potential site to locate the substation has already been identified. The suitability of this and other potential sites were investigated, and this is outlined in this Step 3 Report. To connect this proposed transmission substation to the transmission network, there are two connection options given below, which were brought to Step 3.

The anticipated feeding arrangements are as follows:

- Loop-In the existing Finglas – North Wall 220 kV circuit; or
- Loop-In the existing Finglas – Shellybanks 220 kV circuit

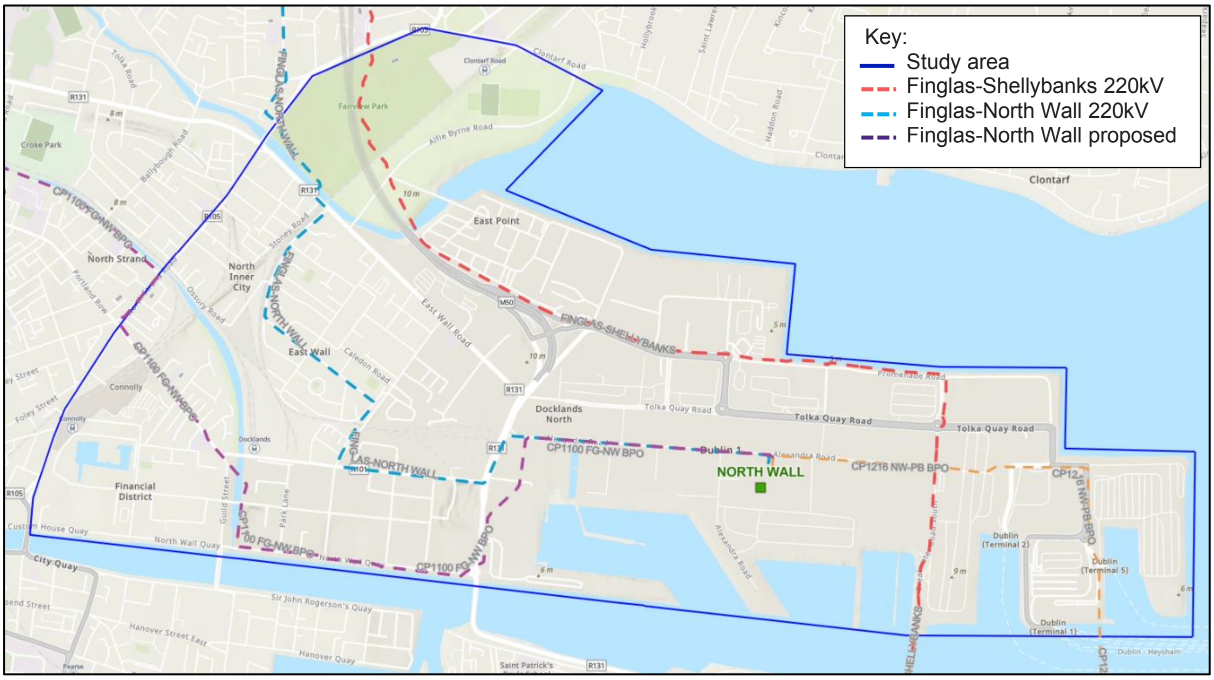


Figure 1-3: CP1273 study area and existing 220kV circuits

Supporting System Diagrams and initial Single Line Diagrams are provided in Section 2.

Based on technical and economic performance, it was concluded that both the connection options have similar performance and either option can be used to connect the new transmission substation.

This proposed development consists of a suite of transmission reinforcement elements which are all required to provide a solution to the need identified. Due to the restrictions of the urban city environs the technologies under consideration for substations is Gas-Insulated Substations (GIS) and for circuits underground cables (UGC).

Table 1-1: Summary of the project need and short list of options

Stations	Circuits	No. of bays/Future Proofing
1x new 220/110 kV station	2 x 220V connections on existing cables. Circa 1-2km route lengths each	No. of bays = (Initial + future)
		Dublin Central 220 kV – 8 bays – (8+0 - 4 will be occupied initially)

2 METHODOLOGY AND APPROACH

2.1 Introduction

The purpose of this report is to assess the potential location options and determine the feasibility and the Emerging Best Performing Option to develop further through Step 4 to completion. This section outlines the methodology applied to achieve this.

Initial location and route options were identified using high-level considerations as listed in Section 2.4, following the identification of constraints within the study area. The constraints identified in the study area were primarily based on a review of publicly available datasets, as well as route walkover surveys.

The data sources include but are not limited to the following:

- Development Plans –Dublin City Council
- Myplan.ie Mapping
- Central Statistics Office, CSO
- National Parks and Wildlife Services, NPWS
- Irish Ramsar Wetland Committee
- Environmental Protection Area (EPA) mapping
- Geological Survey Ireland, GSI
- National Monuments Service
- Heritage Mapping
- Corine 2018 and 2012 data (sourced from the EPA). This dataset was used with aerial imagery and supplemented with datasets obtained directly from other sources covering the Dublin area, to determine land use.
- Digital terrain mapping was sourced by EirGrid from the Ordnance Survey Ireland (OSI) for the study area. An orthographical map of the study area, sourced from OSI, was also reviewed.
- Information from local authorities, asset owners and utility providers.

To help minimise disruption and work as efficiently as possible, this project will coordinate with other state-owned utilities, transport providers and local authorities through the Dublin Infrastructure Forum (DIF). The forum meets quarterly.

The DIF has also setup three working groups at operational level:

- Stakeholder engagement and communications;
- Technical expertise; and
- Planning and environment.

While the initial focus of the work of the DIF has been on the ***Powering Up Dublin*** programme, it is intended to work more broadly across other major infrastructure projects being delivered in the area such as water, gas and transport.

2.2 Study Area

The study area for this specific project, CP1273 Dublin Central Grid Reinforcement, is shown in Figure 2-1. This study area starts north of Fairview Park and extends down to just south of the River Liffey.

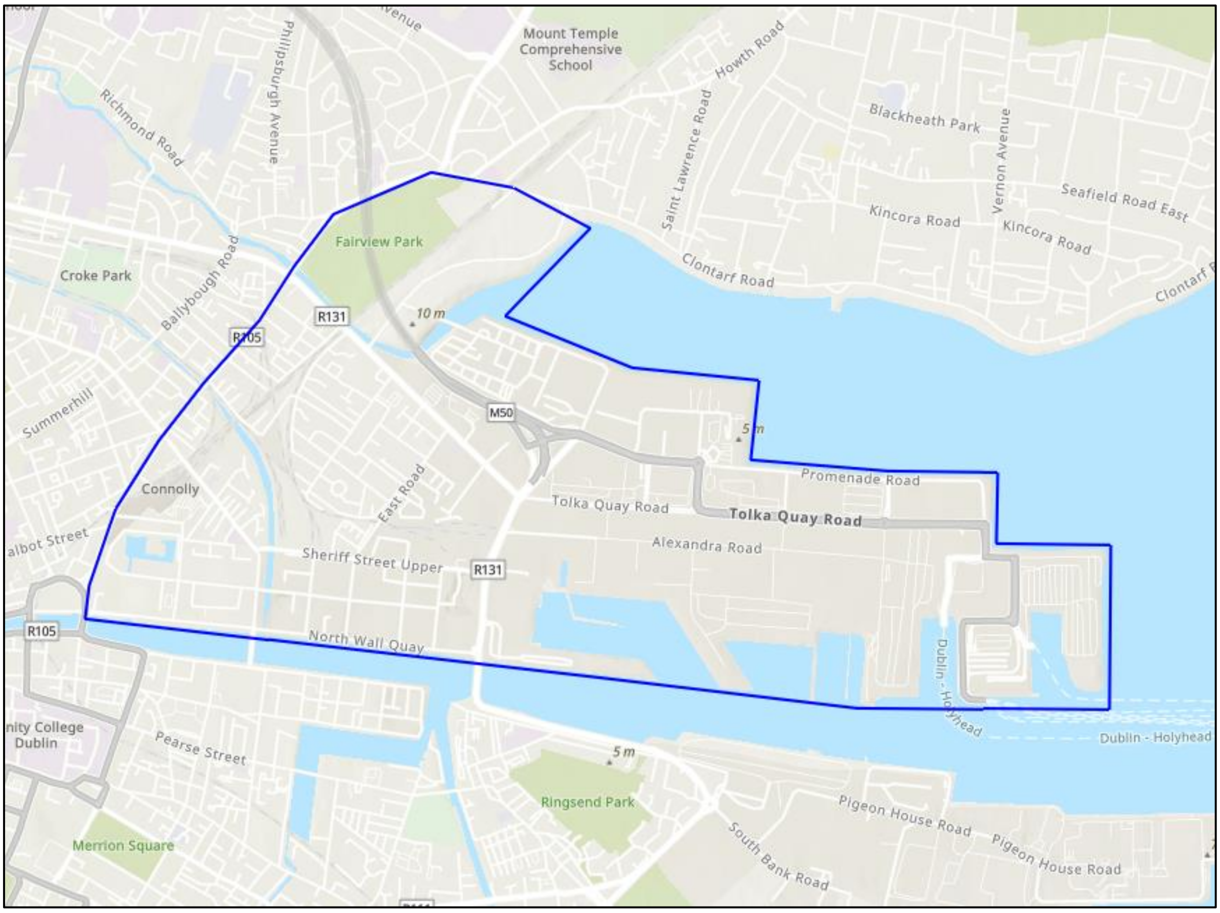


Figure 2-1 CP1273 Dublin Central Transmission Substation Study Area

2.3 Indicative Single Line Drawing and Master Layout

The indicative Single Line Drawing (SLD) for this transmission substation at this point in the project is shown in Figure 2-2. This SLD was used in conjunction with the indicative Master Layout to determine the minimum size required for the substation to select potential locations within the study area.

To determine the high level feasible transmission substation locations within the study area, a high-level substation layout was designed to determine the area required by the transmission substation. This minimum footprint was determined to be approximately 1.04 hectares. This was used in conjunction with the methodology discussed in Section 2.4 to identify potentially feasible substation locations.

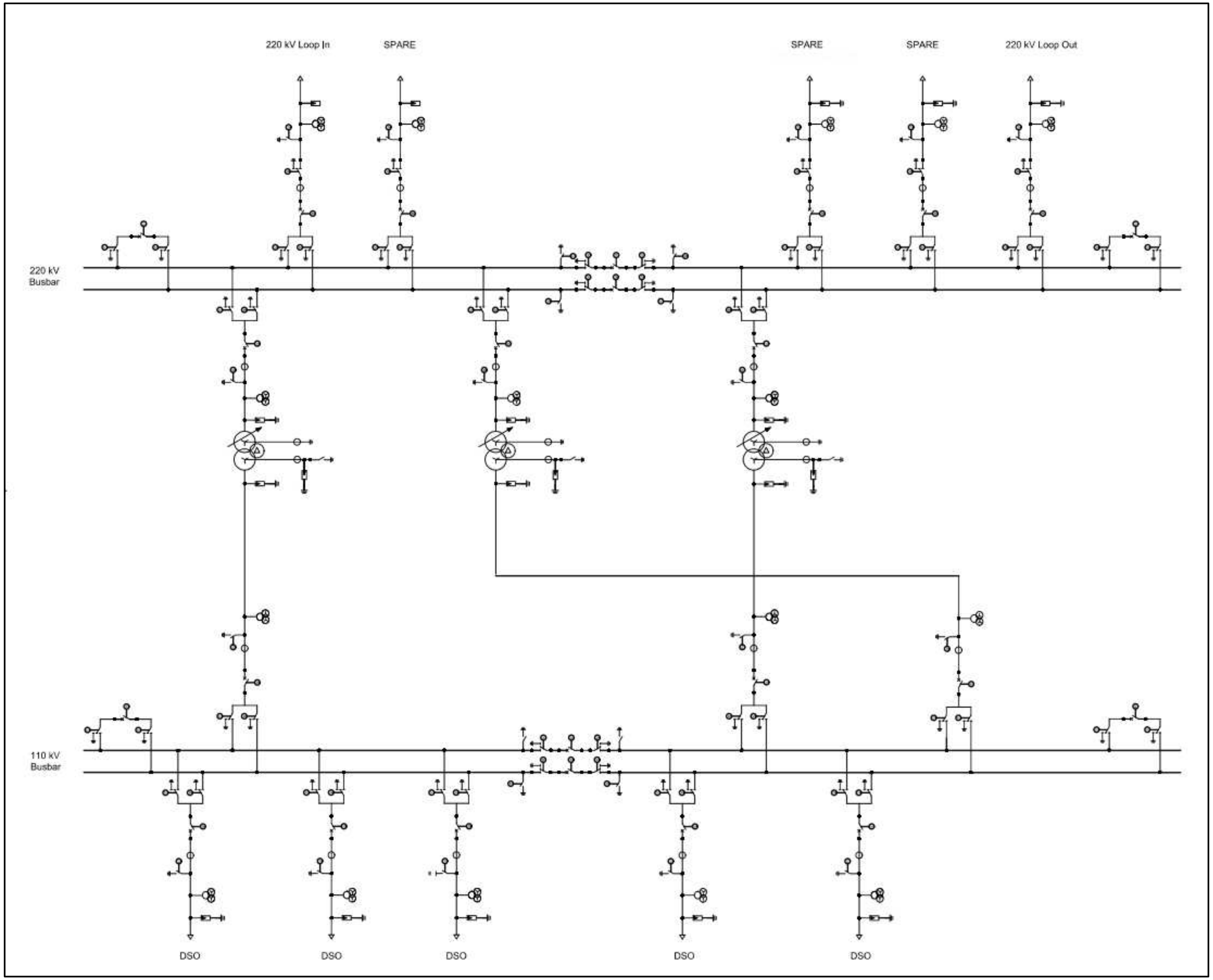


Figure 2-2: Single Line Drawing of the proposed Dublin Central transmission substation

2.4 Identification of Potential transmission Substation Locations

Potential locations for the Dublin Central transmission substation have been identified following high-level considerations under the following headings:

- Technical
    - Size of site
    - Accessibility to existing 220 kV circuits
        - Major obstacles (crossings that may require trenchless techniques)
        - Proximity
        - Route geometry
- Environmental
    - Ecology
    - Water bodies
    - Contaminated land
- Social
    - Residential, amenity, commercial
    - Archaeology/Cultural heritage
- Economic
    - Land ownership
    - Length of route for 220 kV circuit loop-in options
- Deliverability
    - Land availability
    - Site accessibility

The potential options identified were then assessed in the Multi-Criteria Analysis to determine the Emerging Best Performing Option to progress to Step 4.

2.5 Criteria Used for Comparison of Options

The potential locations were assessed using EirGrid's five multi-criteria assessment criteria. These are as follows:

- Technical
- Deliverability
- Economic
- Socio-Economic
- Environmental

The criteria were further divided into sub-criteria which are described below. For each sub-criterion, the location was ranked according to the colour scale shown in Table 2-1.

Table 2-1: Colour coding of Risk / Significance / Sensitivity levels

Colour Key	Level of Risk / Significance / Sensitivity
Yellow	Low
Green	Low-Moderate
Dark Green	Mid-Level / Moderate
Blue	Moderate-High
Dark Blue	High

2.5.1 Technical

Table 2-2 outlines the sub-criteria considered under Technical.

Table 2-2: Technical sub-criteria for the Multi-Criteria Assessment

Sub-criteria	Description
Technical Operating Risk	Will the route lead to areas which are difficult to access to complete maintenance activities, examples include access to railways, motorways, fast lanes of major roads, etc.
Expansion/Extendibility	This considers the ease with which the solution option can be expanded, for example it may be possible to uprate an overhead line to a higher capacity or a new voltage in the future.

2.5.2 Deliverability

The table below outlines the sub-criteria considered under Deliverability.

Table 2-3: Deliverability sub-criteria for the Multi-Criteria Assessment

Sub-criteria	Description
Dependence on other projects	Considers the likely interface, both positive and negative on the cable routes (Metro North and others)
Design complexity	Assessment of crossings, obstacles or constraints that may complicate or impact the design. The project should also comply with the specified ratings as provided by EirGrid.
Implementation Timelines	Relative length of time until energisation. This assesses significant differences, such as current landownership.

2.5.3 Economic

The table below outlines the sub-criteria considered under Economic.

Table 2-4: Economic sub-criteria for the Multi-Criteria Assessment

Sub-criteria	Description
Project Implementation Costs	Costs associated with the procurement, installation and commissioning of the grid development and therefore includes all the transmission equipment that forms part of the project’s scope.
Project Benefits	Avoided costs and difference in constraint costs for example due the lack of capacity to export a forecast volume of generation. The proximity to existing circuits.

2.5.4 Socio-Economic

The table below outlines the sub-criteria considered under Socio-Economic.

Table 2-5: Socio-Economic sub-criteria for the Multi-Criteria Assessment

Sub-criteria	Description
Settlements and Communities	The expected impact of a grid development option on towns, villages and rural housing, as well as on commercial activity
Amenity	Impact on recreational activities (e.g., fishing, sports) and tourism during and after construction, that are not included in the other sub-criteria.
Cultural heritage	Considers the potential impact / proximity to areas (and specific points) of Cultural Heritage.

Sub-criteria	Description
Landscape & Visual	An assessment of landscape constraints and designations and the impact on visual amenity.

2.5.5 Environmental

The table below outlines the sub-criteria considered under Environmental.

Table 2-6: Environmental sub-criteria for the Multi-Criteria Assessment

Sub-criteria	Description
Biodiversity, Flora and Fauna	Considers the possible impact of the selected route on biodiversity – based on the significance from constraints mapping
Water Impact	Considers the risk arising from proximity to water bodies – based on the significance from constraints mapping. Number of crossings, proximity of location of site and circuits etc.

3 POTENTIAL SUBSTATION LOCATION AND 220 kV TIE IN OPTIONS

Using the high-level considerations identified in Section 2.4, eight potential transmission substation locations were identified for further assessment. Locating the substation within public amenity lands has not been considered due to the high impact of this option. All eight locations are shown in Figure 3-1 below.

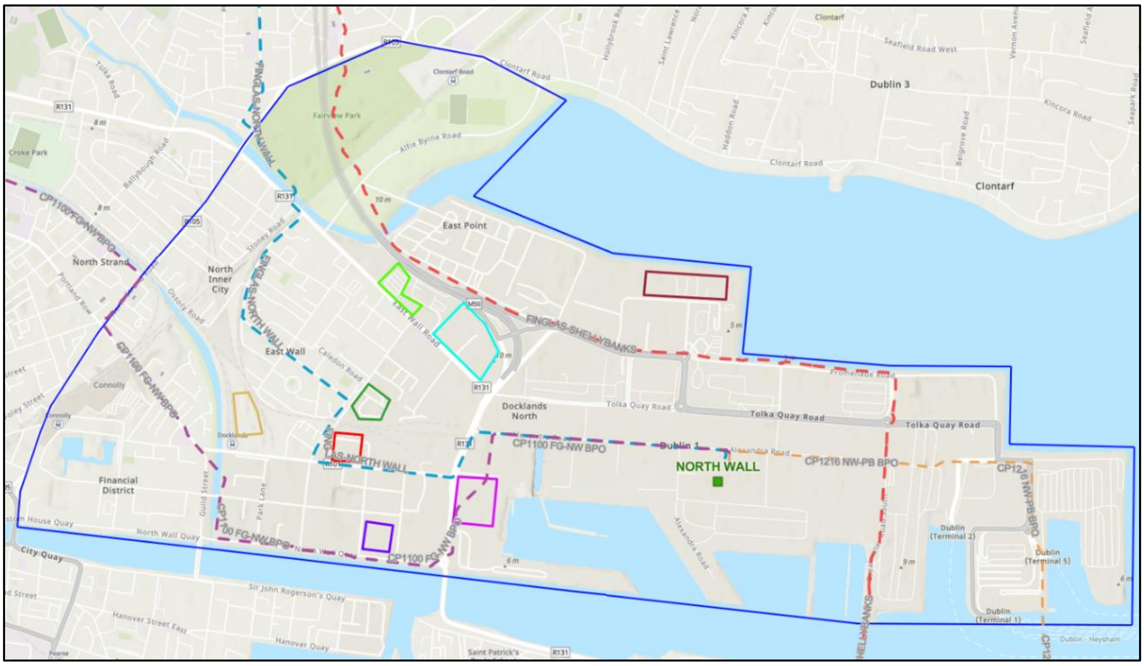


Figure 3-1: All identified potential transmission substation locations

From the initial eight sites, during the constraints study four were screened out initially due to existing planning permissions for projects on those sites. Four locations were bought forward to assess using the Multi-Criteria Analysis. This section describes each location as well as the identified 220 kV circuit tie in options. Figure 3-2 shows the potential transmission substation locations that were analysed in the Multi-Criteria Analysis.

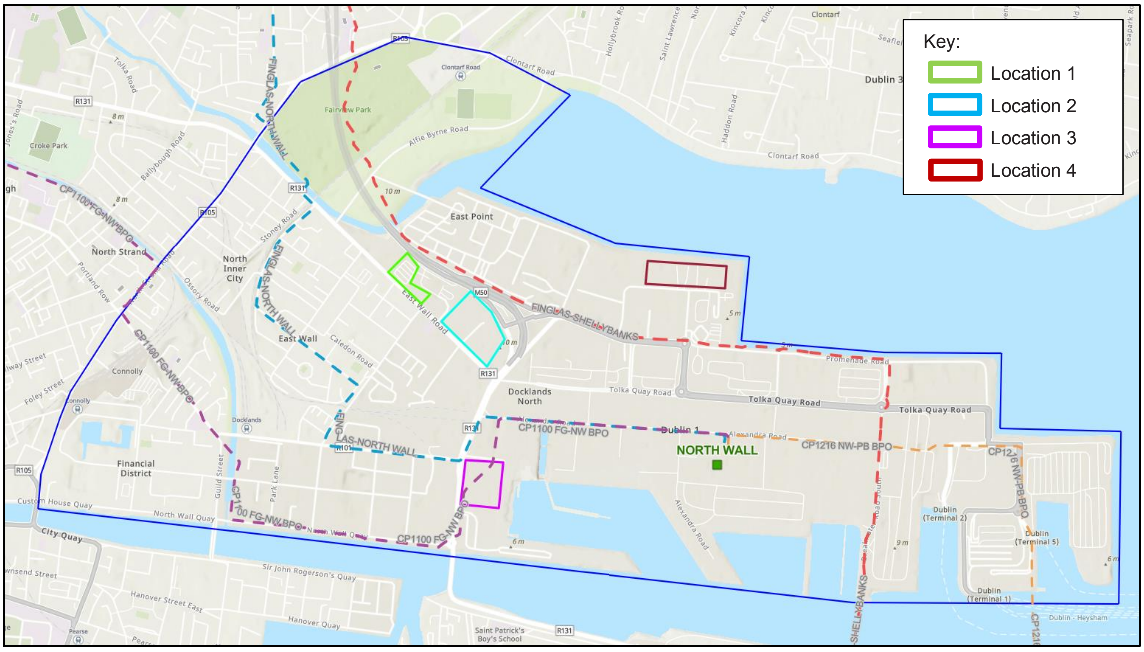


Figure 3-2: Potential transmission substation locations progressed to the Multi-Criteria Analysis

3.1 Location 1

Location 1 is the ESB owned parking lot and vacant brownfield site on East Wall Road. The location is approximately 50m from the Finglas – Shellybanks 220 kV circuit which currently runs on the northern side of the M50.

The size of this location is approximately 1 ha. Due to the site geometry, the generic high-level site layout was customised to fit the available space.

Figure 3-3: Potential Location 1 with adjusted generic substation layout and potential 220 kV tie in

The potential 220kV circuit tie in, shown in pink in Figure 3-2, loops in the Finglas – Shellybanks 220 kV circuit. This tie in crosses the M50, and the crossing methodology is envisaged to be trenchless.

3.2 Location 2

Location 2 is the Dublin Port Company (DPC) owned parking lot on East Wall Road. The location is approximately 60m from the Finglas – Shellybanks 220 kV circuit which currently runs on the northern side of the M50.

The size of this location is approximately 3.5 ha.

Figure 3-4: Potential Location 2 with generic substation layout and potential 220 kV tie in

The potential 220 kV circuit tie in, shown in pink in Figure 3-3, loops in the Finglas – Shellybanks 220 kV circuit. This tie in crosses the M50, and the crossing methodology is envisaged to be trenchless.

3.3 Location 3

Location 3 is the Dublin Port Company (DPC) owned container storage adjacent to East Wall Road. The location is approximately 40m from the existing Finglas – North Wall 220 kV circuit which travels on Sheriff Street Upper and East Wall Road.

The proposed Finglas – North Wall replacement circuit (CP1100) also runs directly through the zone.

The size of this location is approximately 2.6 ha.

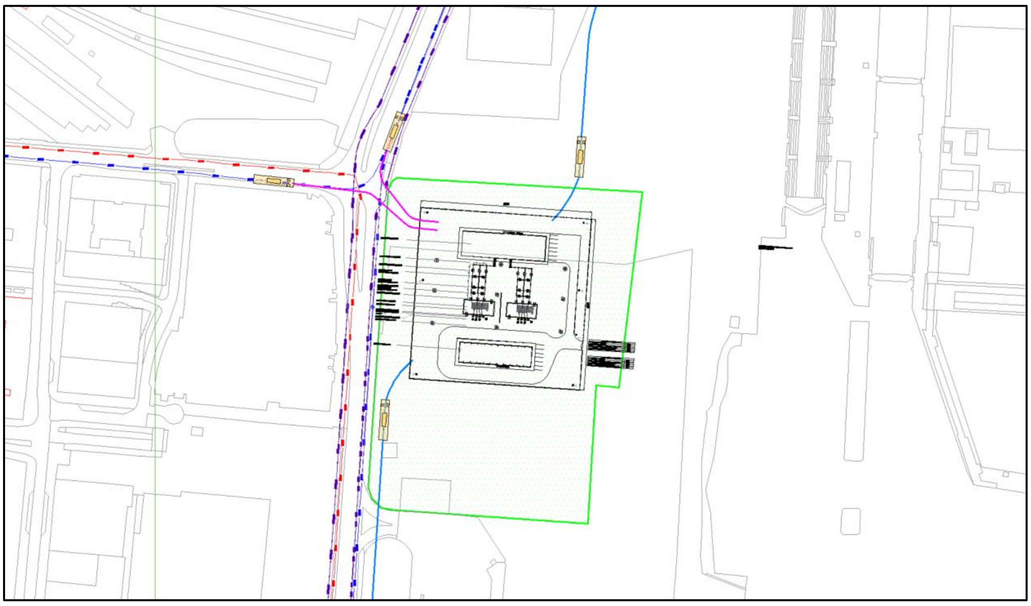


Figure 3-5: Potential Location 3 with generic substation layout and potential 220 kV tie in

There are two potential 220 kV circuit tie ins. The first, shown in pink in Figure 3-4, loops in the existing Finglas – North Wall 220 kV circuit. As this circuit is set to be decommissioned, this is not considered a viable loop in option for this project.

The second tie in option, shown in blue in Figure 3-4, loops in the proposed replacement Finglas – North Wall 220 kV circuit.

3.4 Location 4

Location 4 is the T11 Customs Parking lot owned by Dublin Port Company (DPC). The location is approximately 200m from the Finglas – Shellybanks 220 kV circuit which travels on Promenade Road.

The size of this location is approximately 2.7 ha.

Figure 3-6: Potential Location 4 with generic substation layout and potential 220 kV tie in

The potential 220 kV circuit tie in, shown in pink in Figure 3-7, loops in the Finglas – Shellybanks 220 kV circuit.

4 MULTI-CRITERIA ANALYSIS

The potential transmission substation locations identified and described in Section 3 were further evaluated using the methodology outlined in Section 2.5. Each of the locations were assessed using the five criteria and the associated sub-criteria.

This section summarises the Multi-Criteria Analysis for each location and identifies the Emerging Best Option (EBO) that will be progressed further to Step 4.

Figure 4-1 shows the four locations assessed during this analysis.

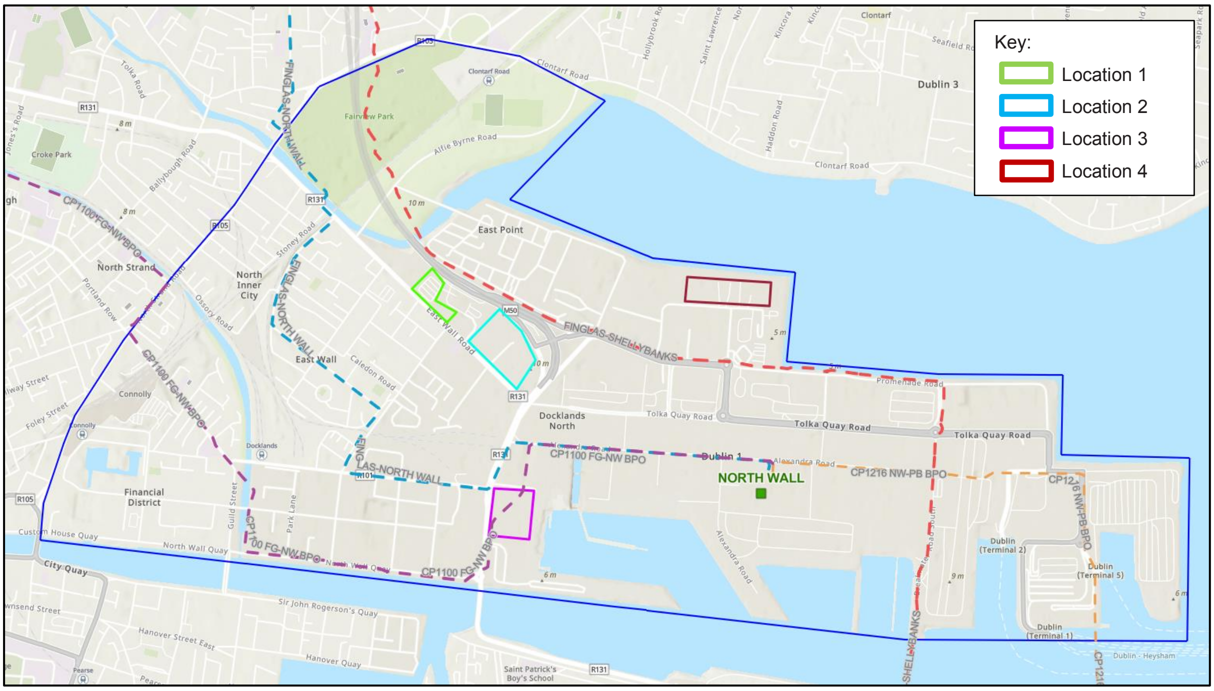


Figure 4-1: Identified potential transmission substation locations

4.1 Emerging Best Option from Multi-Criteria Analysis

Table 4-1 summarises the performance of each location across five criteria and their overall performance. The detailed performance assessments for each criterion, broken down into the sub-criteria evaluated, are available in the next sections of this report.

The Multi-Criteria Assessment identifies Location 1 as the EBO to progress to Step 4 of this project.

Table 4-1: Criteria level summary of Multi-Criteria Analysis

Criteria	Location 1	Location 2	Location 3	Location 4
Technical Performance				
Deliverability Performance				
Economic Performance				
Socio-Economic Performance				
Environmental Performance				

Criteria	Location 1	Location 2	Location 3	Location 4
Overall Performance				

Technical feasibility evaluates the practicality and viability of implementing each option from an engineering perspective, considering factors like site access, infrastructure requirements, and technical constraints. The technical criteria and relevant sub-criteria for each location is discussed in Section 4.2. All locations are rated moderate-high.

Deliverability assesses the ease with which each option can be successfully executed, taking into account factors such as project dependencies, design complexity, and implementation timelines. The deliverability criteria and relevant sub-criteria is discussed in detail in Section 4.3. Location 1 performs the best for this criterion with a rating of low-moderate. Location 3 is the highest rated with a ranking of moderate-high. All other locations are rated as mid-level/moderate in terms of deliverability.

Economic considerations involve evaluating the financial implications of each option, including project implementation costs and potential benefits. The economic criteria and relevant sub-criteria is discussed in detail in Section 4.4. Location 1 performs the best for this criterion with a rating of low-moderate. All other locations are rated as mid-level/moderate.

Socio-economic factors consider the impact of each option on settlements, communities, cultural heritage, amenity, and landscape. The socio-economic criteria and relevant sub-criteria is discussed in detail in Section 4.5. All locations are rated as mid-level/moderate.

Finally, environmental impact assessment involves evaluating the potential effects of each option on biodiversity, flora and fauna, and water resources. The environmental criteria and relevant sub-criteria is discussed in detail in Section 4.6. Locations 1 and 2 were rated as low for this criterion, with location 3 rated as moderate-low. Location 4 was rated higher as moderate-high.

The overall rating for each option is calculated by aggregating the rankings across all criteria, providing a comprehensive assessment of each option's overall suitability and performance. This information allows the comparison of locations based on their respective strengths and weaknesses across different categories, ultimately aiding decision-making processes in the project planning and development stages.

From the overall performance, Location 1 is rated as low-moderate, with the other locations being rated higher. Due to this, Location 1 has been identified as the Emerging Best Option (EBO) to bring forward into Step 4 for further assessment and analysis. Location 1 was assessed in greater detail for high-level technical feasibility. This assessment is outlined in Section 5.

4.2 Technical Analysis

Table 4-2 summarises the technical performance of each location assessed in the Multi-Criteria Analysis. The three sub-criteria assessed at this stage of the project were the technical operating risk and the expansion and extendibility of each location, focusing on both 110 kV and 220 kV configurations.

Table 4-2: Summary of technical analysis

Sub-Criteria	Location 1	Location 2	Location 3	Location 4
Technical Operating Risk				
Expansion / Extendibility – 110 kV				

Sub-Criteria	Location 1	Location 2	Location 3	Location 4
Expansion / Extendibility – 220 kV				
Overall Technical Performance				

The technical operating risk column evaluates the difficulty of accessing areas for maintenance activities, considering factors like proximity to railways, motorways, or major roads. It examines potential constraints that might hinder maintenance operations in the future.

Location 1 scored as mid-level/moderate for this sub-criterion, as while the site access through East Wall Road may be constrained from a traffic impact, there is available space for HV vehicles. Location 2, 3 and 4 all scored as moderate-high due to the access of the site through Port land, which will need to account for Port activities.

Regarding expansion/extendibility, the assessment evaluates the ease with which the project can be expanded or upgraded. For the 110 kV option, the evaluation looks at how many 110 kV circuits may feasibly be routed out of the substation site (assessed at a high level from available record data). For the 220 kV option, it examines the ease of looping in the second 220 kV circuit to the substation site.

Due to the high congestion of East Wall Road, which affects all the locations (once the circuits have left Port land from location 4), the expansion for 110 kV circuits is moderate-high for these locations. There is potential to locate up to 3 110 kV circuits in either direction on this road, however trefoil configuration may be required.

The high congestion on East Wall Road results in the moderate-high rating for the 220 kV expansion sub-criteria for location 1, 2 and 3. For these sites, from a high-level review, it is likely that trefoil arrangements and copper cables be required to locate the two 220 kV circuits in this road and reach the required rating. For this sub-criterion, location 4 is rated as mid-level moderate. This is due to the tie in to the second 220 kV circuit (Finglas - North Wall) being located approximately 800m through Port land. This is an easier tie in when compared to the other locations.

Overall, all locations are rated as moderate-high.

4.3 Deliverability Analysis

Table 4-3 summarises the deliverability performance of each location assessed in the Multi-Criteria Analysis. The three sub-criteria assessed at this stage of the project were the dependence on other projects, design complexity and implementation times for each location.

Table 4-3: Summary of deliverability analysis

Sub-Criteria	Location 1	Location 2	Location 3	Location 4
Dependence on other projects				
Design complexity				
Implementation Timelines				
Overall Deliverability Performance				

The dependence on other projects sub-criterion evaluates whether the project relies on the completion of other projects for its successful execution. Location 1, 2 and 4 all score low for dependence on other projects as there are no known current projects at these locations. Location 3 scores as moderate-high due to the Dublin Port Company's 3FM Project which aims to develop a road network through this site.

In terms of design complexity, the table assesses the level of complexity associated with the project's design, considering factors such as crossings, obstacles, or constraints that may complicate or impact the design. This includes compliance with specified ratings provided by EirGrid. Options are rated based on the relative complexity of their design requirements.

Location 1 scores as mid-level/moderate in terms of design complexity due to the need for a complex trenchless crossing of the M50 for the 220 kV tie-in, as well as the size and shape of the site adding to the design complexity. Location 2 scores at mid-level moderate also due to the need for a complex trenchless crossing of the M50 for the 220 kV tie-in. Locations 3 and 4 scored as low-moderate as the circuit tie in to the primary 220 kV circuit identified as relatively accessible and the site size and geometry is appropriate.

The implementation timelines sub-criterion evaluates the anticipated timeline until energization, highlighting any significant differences among the options. At this stage one of the main differentiating factors between the sites is considered to be the current landownership status, which can influence project implementation. Location 1 is rated as low as the land is owned by ESB with no anticipated stakeholder or compulsory purchase order (CPO). The rest of the locations are rated as moderate-high as the land is owned by Dublin Port Company so land acquisition and stakeholder engagement would be required.

Overall, location 1 is rated as low-moderate. Locations 2 and 4 are rated as mid-level/moderate, while location 3 is rated as moderate-high.

4.4 Economic Analysis

Table 4-4 summarises the economic performance of each location assessed in the Multi-Criteria Analysis. The two sub-criteria assessed at this stage of the project were the project implementation costs and the project benefits of each location.

Table 4-4: Summary of economic analysis

Sub-Criteria	Location 1	Location 2	Location 3	Location 4
Project Implementation Costs				
Project Benefits				
Overall Economic Performance				

The Project Implementation Costs assesses the expenses associated with the procurement, installation, and commissioning of the transmission equipment necessary for the project. This includes all costs directly related to the project's scope, such as infrastructure and equipment expenses. At this stage, equipment considerations with all locations are considered to the similar. The differentiating factor for this sub-criterion at this stage is the costs associated with land ownership. Location 1 was rated as low as the land is owned by ESB. The rest of the locations are rated as mid-level/moderate as the land is owned by Dublin Port Company.

The Project Benefits evaluates the benefits derived from the project, including avoided costs and differences in constraint costs. Avoided costs may arise from factors such as the ability to export a forecast volume of generation, while constraint costs may result from the lack of capacity to meet certain demands. At this stage in the project, the main differentiating factor between the sites is the proximity to the existing 220 kV circuits circuit (for the first 220 kV tie-in). Locations 1 and 2 are rated mid-level/moderate due to the complex trenchless crossing of the M50 for the 220 kV tie-in.

Location 4 is also rated mid-level/moderate as the tie-in length is over 200m. Location 3 has the lowest rating of moderate-low as this site is directly adjacent to the proposed tie-in circuit.

Overall, location 1 is rated as moderate-low. The remaining locations (2, 3, and 4) are rated as mid-level/moderate.

4.5 Socio-Economic Analysis

Table 4-5 summarises the socio-economic performance of each location assessed in the Multi-Criteria Analysis. The four sub-criteria assessed at this stage of the project were the potential impacts on settlements and communities, amenity, cultural heritage and landscape and visual of each location.

Table 4-5: Summary of socio-economic analysis

Sub-Criteria	Location 1	Location 2	Location 3	Location 4
Settlements and Communities				
Amenity				
Cultural heritage				
Landscape & Visual				
Overall Socio-Economic Performance				

In terms of settlements and communities, the table assesses the expected impact of each option on residential, as well as current commercial activity onsite. Location 1 is situated in the residential and industrial area of East Wall, potentially affecting local residents and businesses. Locations 2, 3 and 4 were rated as high due to the current land use of the location being long term parking for imported cars, parking adjacent to Port Terminal 4 and parking for T11 Customs respectively. All three locations are within Dublin Port Company land.

Amenity considerations focus on the impact on recreational activities and tourism during and after construction. All the locations are rated low in this sub-criterion as they will have minimal to no impact on amenity areas.

Cultural heritage evaluation involves assessing the impact of each option on recorded cultural heritage resources. At this stage, from a high-level desktop review, all options were rated as mid-level/moderate as they do not contain any SMR's, ACA's or areas of known cultural heritage importance.

Finally, the assessment of landscape and visual factors considers landscape constraints, designated landscapes, and visual amenity. Location 2 and 4 were rated as low impact, with no expected loss of valued landscape elements or impacts on designated landscapes. Location 1 and 3 were rated as mid-level/moderate as there may be limited impacts on the residents on East Wall Road (location 1) and limited visual impacts apart from residents of dwellings and recreational users of boat and yacht clubs on the south side of the River Liffey (location 3).

Overall, all locations are rated as mid-level/moderate in terms of socio-economic impact.

4.6 Environmental Analysis

Table 4-6 summarises the environmental performance of each location assessed in the Multi-Criteria Analysis. The two sub-criteria assessed at this stage of the project were the potential impacts on biodiversity, flora and fauna and water impact of each location.

Table 4-6: Summary of environmental analysis

Sub-Criteria	Location 1	Location 2	Location 3	Location 4
Biodiversity, Flora and Fauna				
Water Impact				
Overall Environmental Performance				

The biodiversity, flora and fauna sub-criterion evaluates the potential impact of each location on biodiversity, including flora and fauna. Location 1, 2 and 3 received a rating of low, indicating no anticipated impact on biodiversity, flora, or fauna. Location 4 is rated mid-level/moderate as it is adjacent to the North Dublin Bay pNHA and SPA.

The water impact assesses the potential impact of each location on river crossings, lakes, and groundwater. Location 1 and 2 are rated low as there is no envisaged water impact in these locations. Location 3 was rated mid-level/moderate due to its proximity to Alexandra Basin, which forms part of Dublin Port. Location 4 is rated as moderate-high as it is adjacent to North Dublin Bay.

Overall, locations 1 and 2 are rated as low in terms of environmental impact. Location 3 is rated as low-moderate, while location 4 is rated as moderate-high.

5 TECHNICAL FEASIBLITY

5.1 Transmission Asset Technology Review

All equipment supplied for the GIS substation shall comply with EirGrid Transmission Standards. Technical schedule shall be provided to ensure equipment ratings and specifications satisfy EirGrid's transmission requirements. All equipment is subject to approval by the TAO. The following sections list EirGrid standards that are applicable to this project. Multiple frameworks have been set up where equipment manufacturers are pre-approved to supply equipment for use on the transmission system.

5.1.1 High voltage AC cables

CDS-GFS-00-001-R1	110/220/400 kV Underground Cable Specification

Please see Al & Cu Cable datasheet in Appendix I.

5.1.2 Switchgear

XDS-GFS-25-001-R4	110/220/400 kV GIS Specification

5.1.3 Transformers

XDS-GFS-00-001-R4	1110/220/400 kV Station General Requirements
XDS-GFS-08-001-R3	Station Auxiliary Power Supplies Specification
XDS-GFS-09-001-R4	Station 220 V, 48V and 24 V Lead Acid Batteries and Chargers
XDS-GFS-13-001-R2	Substation Civil and Building Works

5.1.4 Control and protection

XDS-GFS-06-001-R2	Control, Protection and Metering Specification

5.1.5 Earthing

XDS-GFS-12-001-R4	Earthing and Lightning Protection

5.2 Design Options for EBO

Location 1 has been identified as Emerging Best Option (EBO) for advancement to Step 4. The high level design options have been developed for this location.

The 220 kV tie-in to the EBO is challenging as it is a trenchless crossing of the M50. All other circuits leaving the substation site are expected to travel on East Wall Road, which is highly congested.

It must be noted that all designs are based off available record data. No specific site investigation has been completed for this project to confirm these utilities.

5.2.1 Single Line Diagram

The Single Line Diagram can be found in Appendix A.

The project brief listed the requirement for an 8 bay 220 kV substation. An 8 bay substation typically has 2 no. 220/110 kV Transformers and an initial SLD was submitted for review. Subsequently EirGrid requested the inclusion of a third transformer. The attached SLD in Appendix A shows and 8 bay station with 3 transformers, which is a non-standard arrangement and we suggest this is assessed further in the next step of the project. We have configured the transformers in a way to maximise the redundancy of the system.

5.2.2 Cable Circuit Ampacity Calculations

The cable circuit ampacity calculations can be found in Appendix B.

The ampacity considers the following scenarios in Table 5-1 and 5-2. The configurations selected reference available space requirements and possible de-ratings due to the proximity of other electrical circuits in the vicinity. As a number of circuits are existing and some future, in both cases ratings unknown, we have selected the following circuit ratings:

- 110 kV Circuits 190 MVA
- 220 kV Circuits 537 MVA

Summer ratings are considered:

- Summer Ground Temperature 20 ℃ May to September
- Summer Soil Thermal Resistivity 1.2 K.m/W
- Summer Concrete (CBGM B) Thermal Resistivity 1.0 K.m/W

HDD (below 3 m):

- Soil Temperature 10 ℃ (All year round)
- Soil Resistivity 1.0 K.m/W (All year round)

The cable for the 220 kV circuits is proposed to be 2 500 mm^2 Al. EirGrid's preference is to use aluminium conductors in flat formation. Where there is insufficient space for flat formation, trefoil may be required. Our analysis has determined that in trefoil, the aluminium conductors cannot meet the system ratings, in which case copper conductors are proposed. Also, in cases where cables are laid in the vicinity of existing cables, our analysis has determined that copper cables may be selected to achieve the ratings.

Table 5-1: 220 kV scenarios and configurations investigated to determine ampacity ratings achieved

Scenario	Direction	No. of 220 kV	220 kV formation	Cable formation physically achievable	220 kV rating achieved
A	N	2	HDD - flat	No	N/A
B	N	2	HDD - trefoil	Yes	Yes

Scenario	Direction	No. of 220 kV	220 kV formation	Cable formation physically achievable	220 kV rating achieved
C	SE	2	Flat	No	N/A
D	SE	2	1 flat; 1 trefoil	Yes	Yes
E	SE	2	Trefoil	Yes	Yes
F	NW	1	Flat	No	N/A
G	NW	1	Trefoil	Yes**	Yes

Table 5-2: 110 kV scenarios and configurations investigated to determine ampacity ratings achieved

Scenario	Direction	No. of 110 kV	110 kV formation	Cable formation physically achievable	110 kV rating achieved
H	SE	3	Flat	Yes**	Yes
I	SE	3	Trefoil	Yes	Yes
J	NW	2	Flat	Yes**	Yes
K	NW	2	Trefoil	Yes	Yes

**Depends on other circuits within roadway

5.2.3 Indicative Master Layout

We have developed the Master Layout for the EBO which can be found in Appendix C.

The following standards were used in generating the master layout:

- Generic design standard for 110 kV GIS Station – XDN-LAY-ELV-STND-H-012-003
- Generic design standard for 220 kV GIS Station – XDN-LAY-ELV-STND-F-005-002
- Station design standard for 110 kV GIS Station - XDN-LAY-ELV-STND-H-012-001

The layout was based on the above standard requirements from EirGrid which details the following:

- Minimum distance from the palisade fence (Internal fence) being 10m to the edge of the building both 110 kV & 220 kV buildings.
- Minimum distance from the customer fence being 7m to the edge of the building both 110 kV & 220 kV buildings.
- The minimum size of a footpath around the buildings is 2m wide.
- The minimum size of the compound road within the site is 4.5m wide.
- The standard size of a110 kV GIS building 8-bay station is 14.88m wide by 48.10m long.
- The standard size of a 220 kV GIS building 8-bay station is 18.50m wide by 49.00m long.

Based on the above standards, the following was achieved for the layout:

- The distance from the palisade fence (Internal fence) to the edge of 220 kV GIS Building is 19m on the wide side.
- The distance from the customer fence to the edge of 220 kV GIS Building is 15m on the long side.
- The distance from the palisade fence (Internal fence) to the edge of 110 kV GIS Building is 10m on the long side.

- The distance from the customer fence to the edge of 220 kV GIS Building is 10m on the wide side.

5.2.4 Indicative Master Elevations

We have developed the Master Elevations which can be found in Appendix D.

The building elevations for both 110 kV and 220 kV GIS buildings were generated based on the standard layouts of the two buildings. The elevations give details pertaining to the height, length and width of the buildings and features like doors and ventilation locations.

5.2.5 Indicative Primary Plant Plan View

We have developed the Primary Plant Plan View which can be found in Appendix E.

The plant plan was based on the 3 no. transformers of standard dimensions of 17.5m x 17.5m each.

5.2.6 Indicative Control Building Layouts

We have developed the Control Building Layouts which can be found in Appendix F.

The layouts of the control buildings which are 110 kV and 220 kV were based on EirGrid standard 8 bay station drawings which are:

- 110 kV layout; XDN-LAY-ELV-STND-H-012-003-00
- 220 kV layout; XDN-LAY-ELV-STND-F-005-002-00

The layouts show the general arrangement of the buildings based on various functions.

5.2.7 Indicative Cable Layouts

We have developed the Cable Arrangements which can be found in Appendix G.

The 220 kV circuit tie-ins for the EBO crosses the M50 motorway. Horizontal Directional Drill (HDD) is the envisaged crossing methodology. Appendix H shows the proposed HDD crossing, with the space required for the equipment setup.

5.2.8 Connectivity Review

To determine how accessible the EBO will be for future development, four cross sections were assessed along East Wall Road. These were used to identify available space for future circuits.

From this desktop review, it appears there is space available for all the required circuits out of the substation site. However, it must be noted that these cross sections have been created from available record data. Specific site investigations will be required to confirm these records and thus the available space.

The physical constructability of each circuit will also need to be assessed in more detail. Some circuits shown have been placed within footpaths that have houses open directly onto these footpaths. Special consideration will need to be given to limiting impact on these residents, while ensuring the circuit can be built.

The four cross sections are located along East Wall Road as shown in Figure 5-1. Further analysis has been broken down into the Central Section (location A), Eastern Section (location B), and Western Section (location C and D).

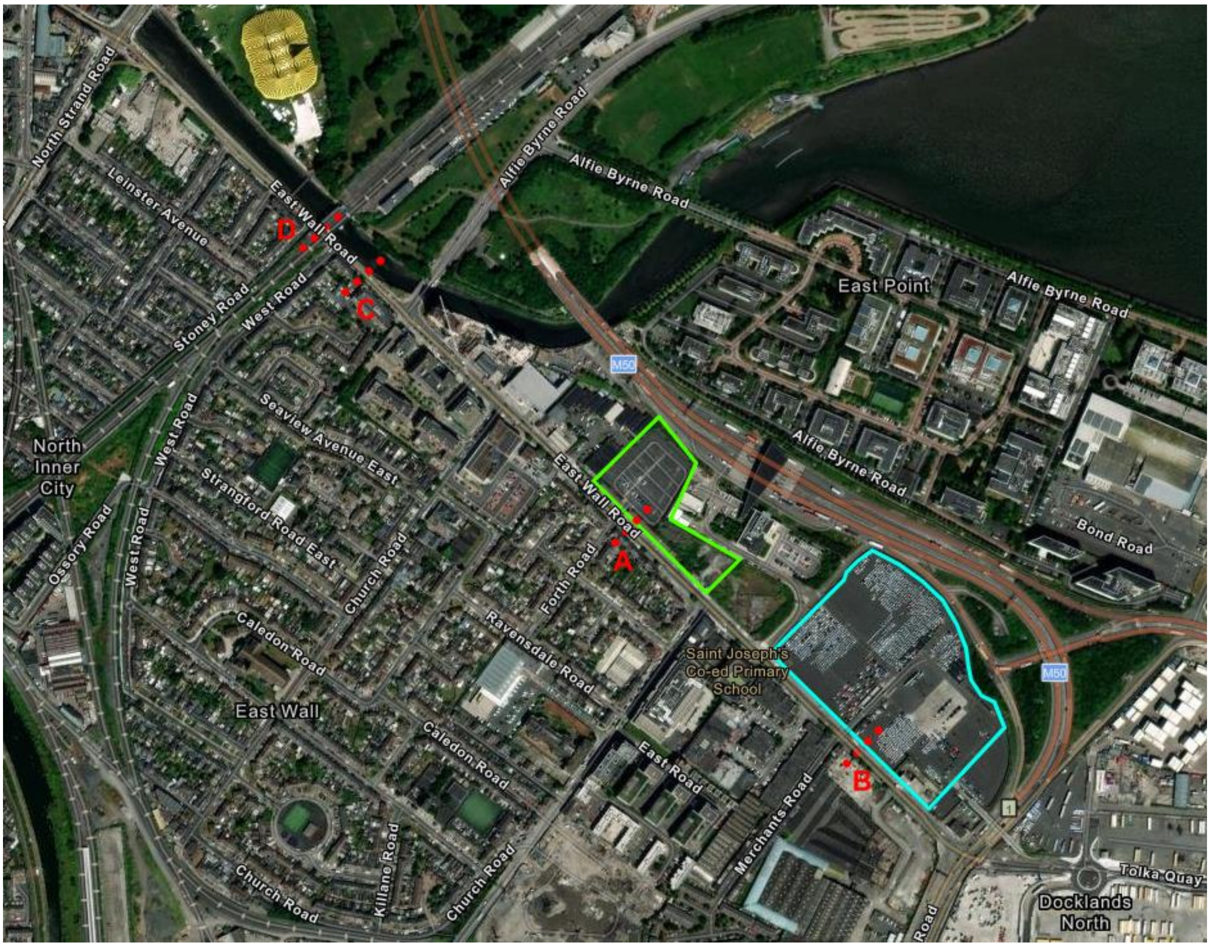


Figure 5-1: Locations of cross sections along East Wall Road

Central Section

Figure 5-2 shows the cross section of East Wall Road at Point A. A possible circuit arrangement in this cross section has been shown above the Transmission Level Services.

From this desktop review, there appears to be space for three 110 kV circuits in trefoil. These have been modelled in a trench of 600mm width, with separations of 200mm between each. The ampacity calculation for this scenario has been completed, and the calculations are in Appendix B. In this configuration it is possible to reach the desired rating for all three 110 kV circuits.

There is also space for two 220 kV circuits, one in trefoil and one flat in EirGrid standard trenches. The circuit in flat formation will need further modelling to determine if there is any derating expected on the 38 kV circuit adjacent.

The circuit in trefoil has sufficient distance between it and the three 110 kV circuits, that there is no expected derating between these two circuits.

Further assessment will be needed along the entire length of this road to determine any possible derating impacts. This modelling will be completed during Step 4 of this project. This will be applied across the entire East Wall Road, and so applies for all the cross sections depicted here.

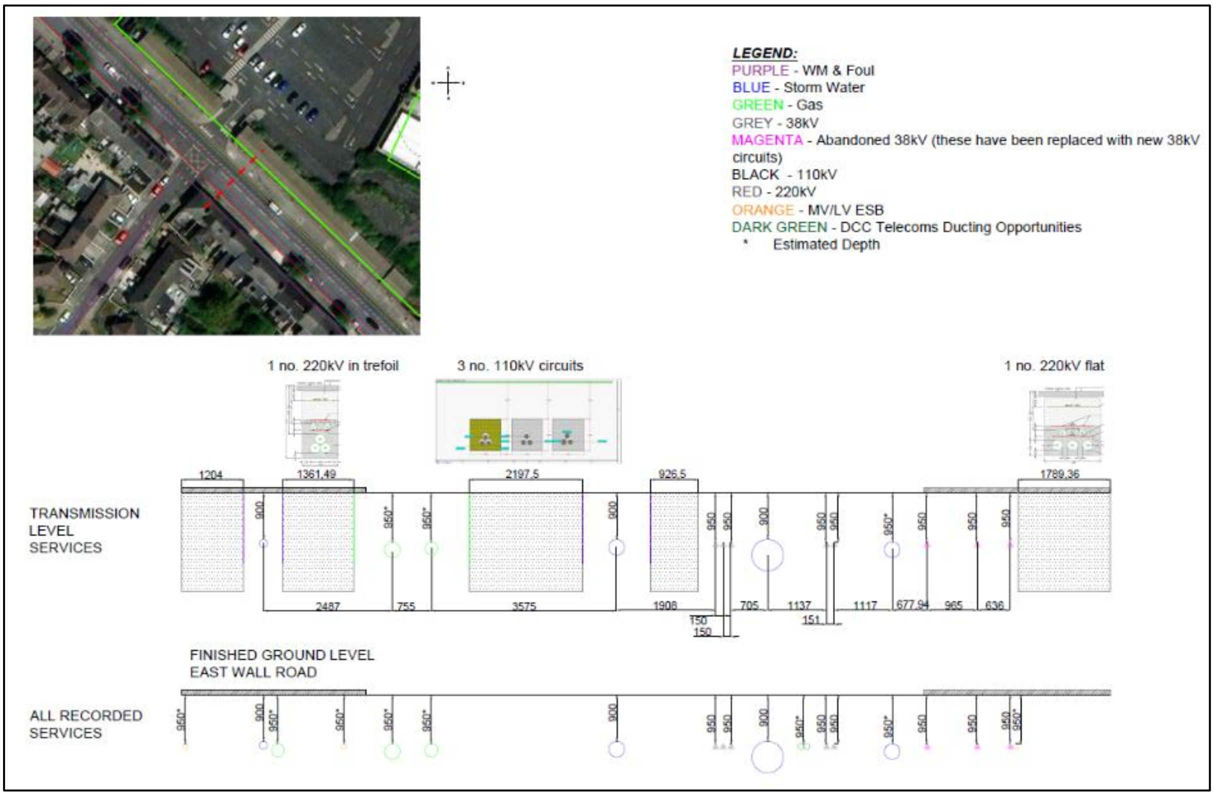


Figure 5-2: Cross section of East Wall Road at Location A

Eastern Section

Figure 5-3 shows the cross section of East Wall Road at Point B. A possible circuit arrangement in this cross section has been shown above the Transmission Level Services.

From this desktop review, there appears to be space for three 110 kV circuits in trefoil. These circuits are adjacent to two 38 kV, so there may be derating on these circuits. However, the physical separation requirements can be met.

There is also space for two 220 kV circuits, one in trefoil and one flat in EirGrid standard trenches, as with the cross section at Point A. The circuit shown in flat formation may be difficult to construct, as it is located within the footpath adjacent to residence's front doors. It may be better from a constructability point of view to have this circuit in trefoil formation to reduce the trench size further.

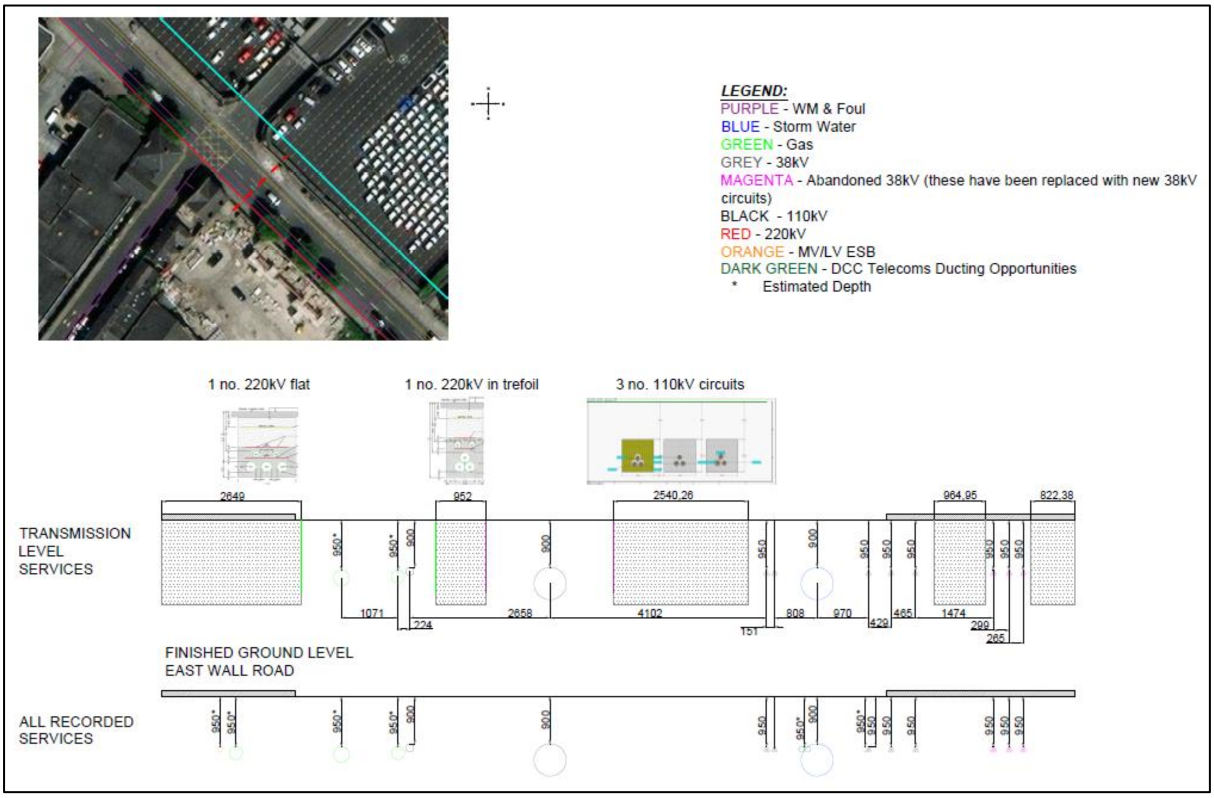


Figure 5-3: Cross section of East Wall Road at Location B

Western Section

Figure 5-4 shows the cross section of East Wall Road at Point C. This is the narrowest point in East Wall Road heading in a north-westerly direction.

From this desktop review, there appears to be space for two 110 kV circuits in trefoil. The scenario will require further modelling to determine if there is any derating expected on the 38 kV circuit adjacent. The impact of placing the circuit adjacent to the front doors of the residences will need to be carefully assessed for constructability.

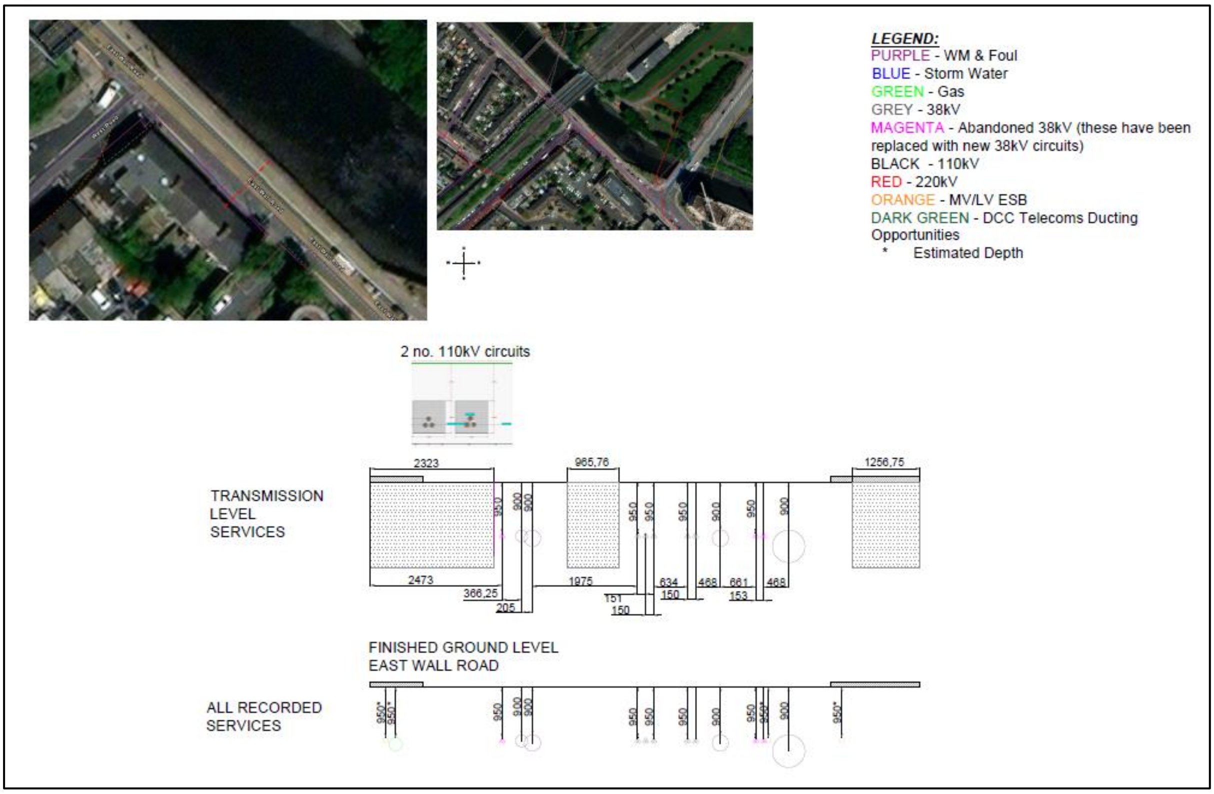


Figure 5-4: Cross section of East Wall Road at Location B

Figure 5-5 shows the cross section of East Wall Road at Point D. This is underneath the railway line on East Wall Road.

From this desktop review, there appears to be space for two 110 kV circuits in trefoil. When the existing Finglas – North Wall 220 kV circuit (shown in red in the cross section), is decommissioned, the space available in this corridor will increase.

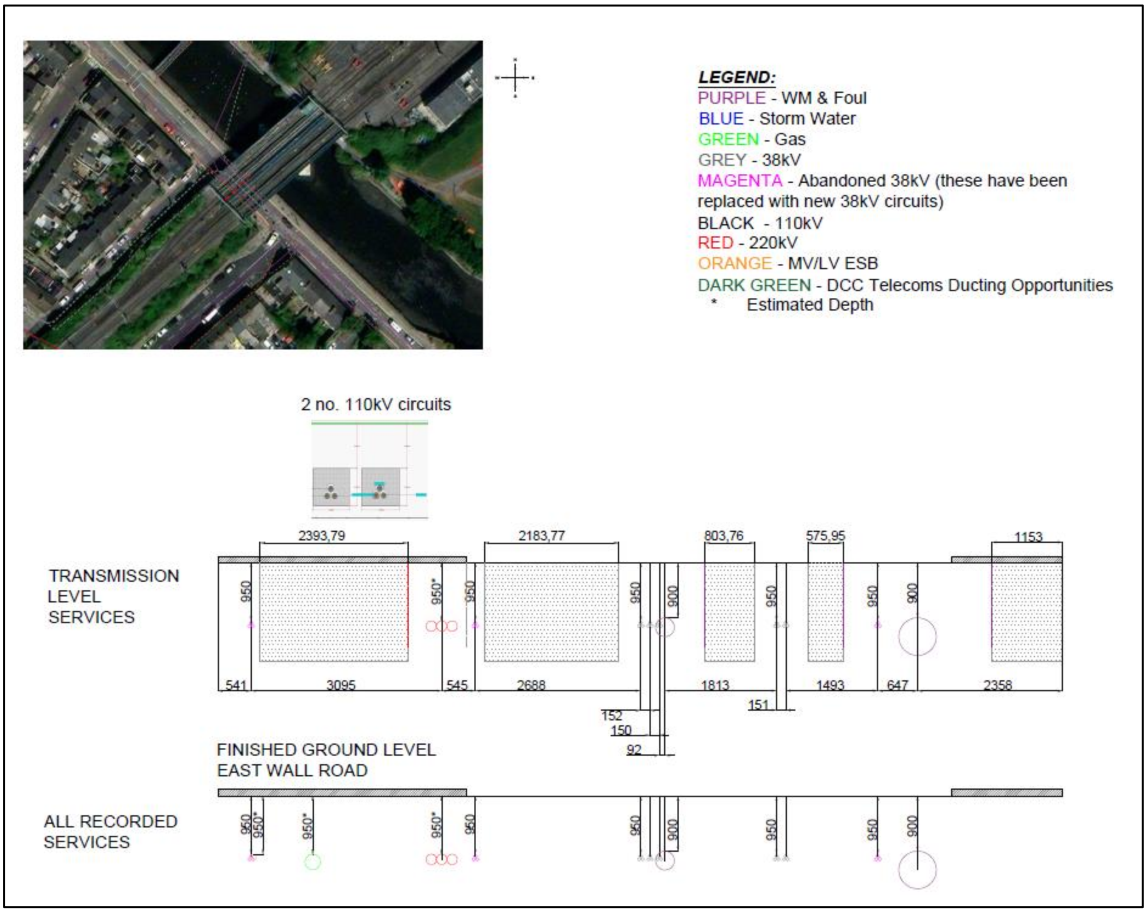


Figure 5-5: Cross section of East Wall Road at Location D

Summary

As detailed above we have carried out an assessment of the potential to connect new circuits into the proposed transmission substation on the EBO site. EirGid has requested that we consider up to 5 x 110 kV circuits and a second 220 kV circuit. As part of this assessment, we have considered available space for new circuits on the East Wall Road and then have undertaken ampacity calculations to determine the circuit arrangement and the potential impacts.

Based on the assessments carried out to date we have identified that there is available space to accommodate some circuits. It is noted that the East Wall Road is a busy urban carriageway containing existing utilities [water, wastewater, gas, power, comms] which is bounded by commercial and residential properties for some sections and by the Tolka River for other sections.

Our assessment is based on record data from utility providers, available mapping for the area and idealised layouts. On the basis of the assessment, we believe that it will be extremely challenging to accommodate all of the circuits requested by EirGrid this is due to the available space [existing services, and proximity to existing properties] and also the potential for de-rating impact of various circuits on each other.

It is our opinion that further investigations are required to confirm the exact number of circuits that can be accommodated, this will include;

- Utility survey to PAS 128
- Slit trenching
- Resistivity testing
- Topographical survey, including boundary survey.

Following these investigations further design, constructability review and ampacity modelling are required to confirm the number of circuits that can be practically accommodated.

5.3 Constructability

5.3.1 Overview of Works

The construction works associated with the project includes the following;

- Substation Construction
  - Construction of 110 kV & 220 kV GIS substations
  - Boundary walls
  - Site services
  - Internal roads
  - Drainage including surface water attenuation
- Circuit Construction
  - Trenching, ducting, backfill and reinstatement
  - Joint bay construction
  - Cable pulling
  - Construction of Trenchless crossings

High-level details of each of the above steps are presented in the following sections.

5.3.2 Construction of 110 kV & 220 kV GIS substation

The construction of the 220 kV and 110 kV substations require detailed design and planning, adherence to safety protocols, and consideration of various technical factors. Of particular importance is understanding the bearing capacity of the ground and the soil resistivity of the site, as it directly impacts grounding systems and foundation design.

The construction of a GIS substation typically begins with site preparation, including clearing vegetation, levelling the ground, and installing temporary facilities for workers and equipment storage. Once the site is prepared, foundation construction commences, with specific attention to the design of grounding systems based on soil resistivity data. As the soil resistivity for this site is currently unknown, preliminary soil testing should be conducted to inform foundation design accurately.

The GIS equipment, including switchgear, transformers, and associated components, is then installed according to manufacturer specifications and engineering drawings. Careful coordination and supervision are essential during this phase to ensure proper alignment, connection, and testing of equipment.

Following equipment installation, interconnections between GIS components, as well as connections to external power sources and transmission lines, are established. This phase also involves comprehensive testing and commissioning to verify the functionality and performance of the substation. Soil resistivity measurements should be conducted during commissioning to validate the effectiveness of grounding systems and ensure compliance with regulatory standards. Finally, documentation of construction activities, as-built drawings, and operational procedures are prepared for future reference and maintenance.

This site has limited space available. Special consideration will need to be given to the sequencing of works and space available onsite for storage and works areas.

5.3.3 Trenching

Trenching is a construction technique that involves digging a narrow trench in the ground for the installation, maintenance, or inspection of pipelines, conduits, or cables. It is expected that the majority of the ducting for the circuits leaving the substation site for this project will be installed by means of trenching.

There are two primary trench configurations proposed for this project for both 220 kV circuits and 110 kV circuits. These are flat and trefoil formations. Where space allows, flat formation will be used as the preferred cable formation. The standard trench configurations for 110 kV circuits are shown in Figures 5-6 and 5-7.

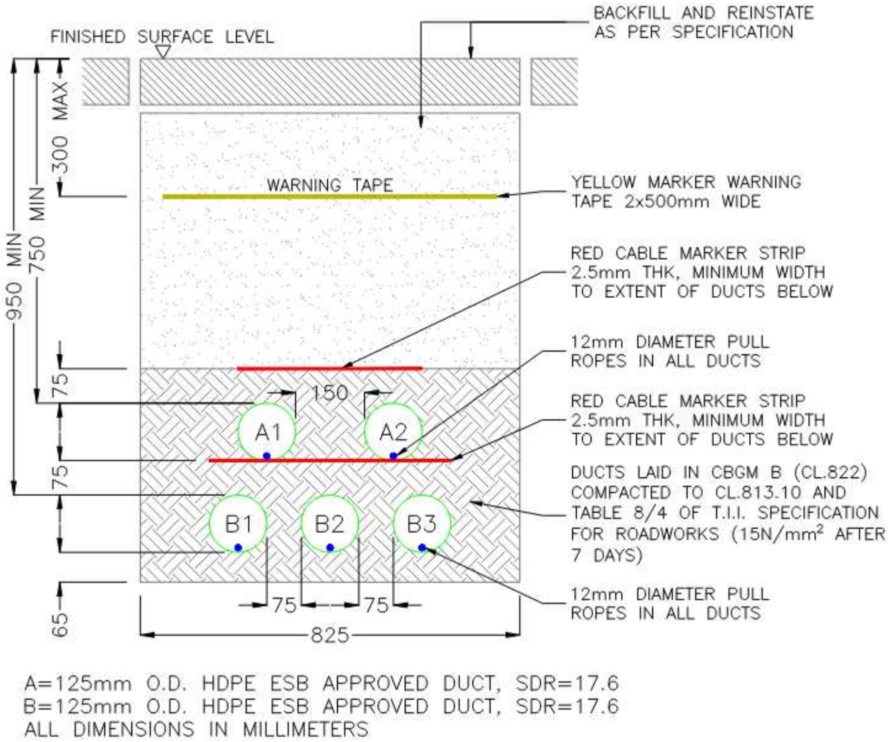


Figure 5-6: Standard trench specifications for 110 kV circuit in flat formation (XDC-CBL-STND-H-008)

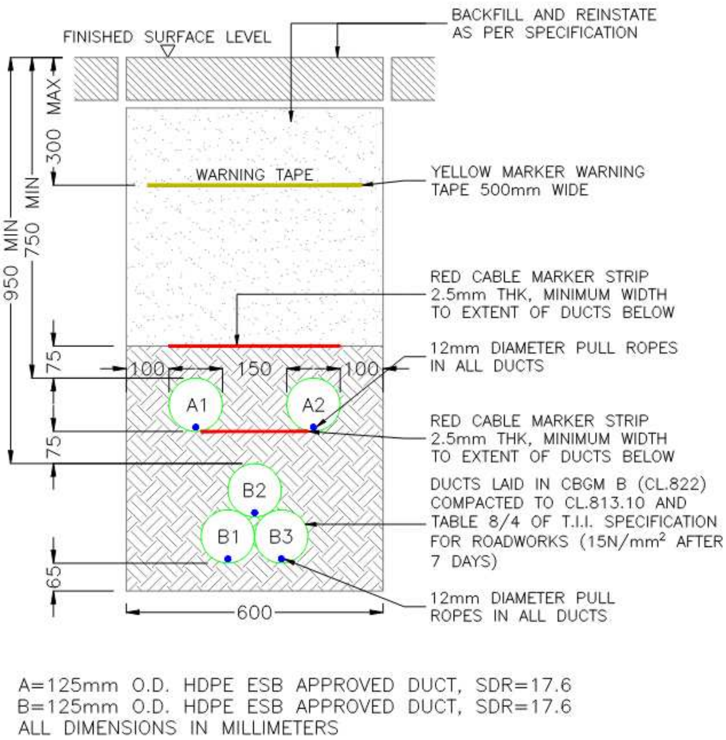


Figure 5-7: Standard trench specifications for 110 kV circuit in trefoil formation (XDC-CBL-STND-H-008)

The standard trench configurations for 220 kV circuits are shown in Figures 5-8 and 5-9.

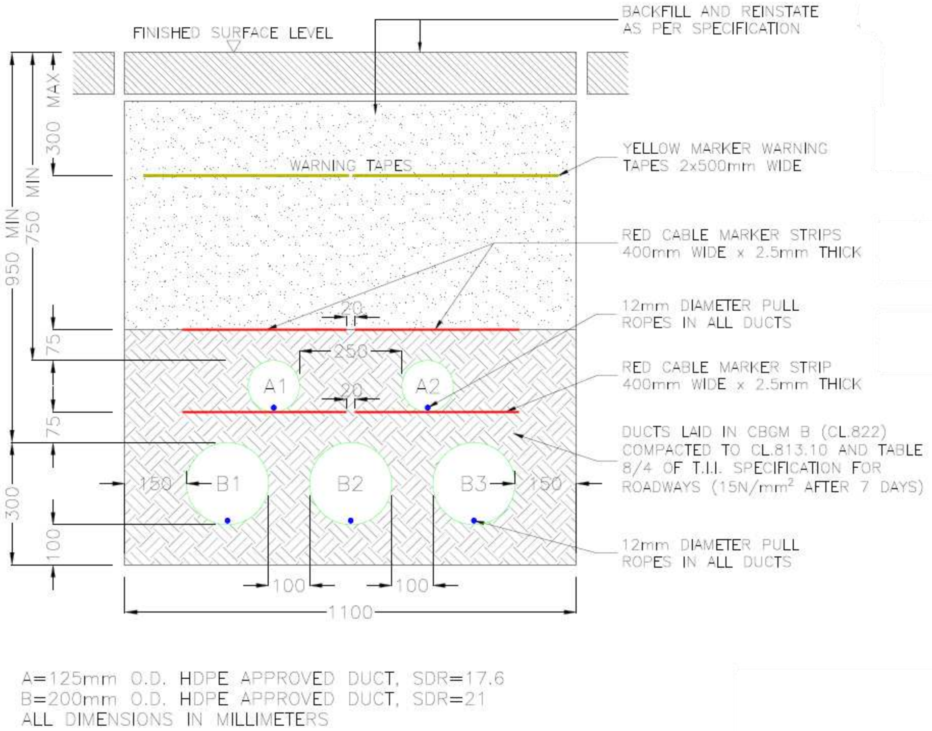


Figure 5-8: Standard trench specifications for 220 kV circuit in flat formation (XDC-CBL-STND-F-008)

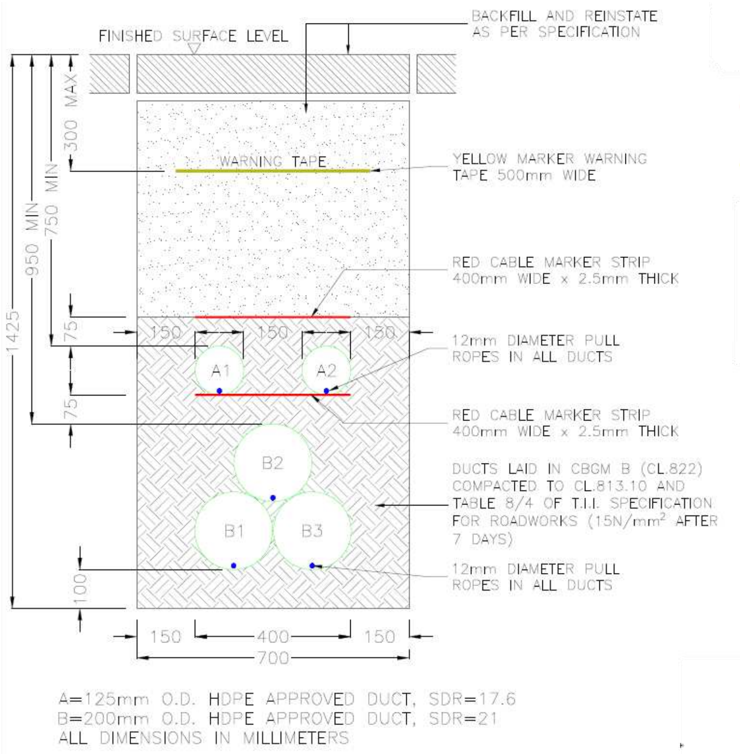


Figure 5-9: Standard trench specifications for 220 kV circuit in trefoil formation (XDC-CBL-STND-F-008)

In wide streets where road space and traffic management considerations permit, or in areas where road closures are possible it is likely that medium sized tracked or wheeled excavators (approx. 13T to 20T) will be used to excavate trenches, these excavators would be supported by wheeled dumpers, trucks or tractors towing dump trailers.

In narrower streets, where only narrow sites can be established or where utility congestion does not facilitate excavation by larger plant a combination of small and medium sized tracked or wheeled excavators (approx. 6T to 8T and 13T to 20T) will likely be used to excavate trenches. In especially difficult locations vacuum excavation may be used locally.

On wider roads it is envisaged that works would generally progress at up to 20-40 meters a day and narrower road or where utilities present a greater constraint an average rate of up to 15-25 meters a day could be expected. This rate may be even lower in certain highly constrained locations.

5.3.3.1 Ducting Works

The cables are laid inside underground ducts which offer protection to the cable. This cable laying method is generally used in urban areas as it offers good mechanical protection of the cables.

Ducted cabling has a major advantage over direct lay in an urban environment, in that it decouples the civil works from cable installation and means that work can if necessary be completed in a piecemeal fashion, whereas in a direct lay scenario the entire cable drum length from one joint bay to the next must be completed in one continuous operation which necessitates long sections of open trenches for a prolonged period in urban areas.

Ducts are manufactured from High Density Polyethylene (HDPE) and typically delivered to site in lengths of 12m however shorter lengths are available if required. The ducts have a spigot and socket and are push fitted together.

5.3.3.2 Backfill and Reinstatement

Once the ducts have been installed in the correct configuration and maintaining the required separation distances from other services, they are backfilled using a cementitious bound aggregate mix to the levels shown on the appropriate section (Figures 5-1 to 5-4).

The remainder of the backfill and reinstatement will depend on the location of the trench, where trenches are in or to adjacent roadways and footpaths the backfill and reinstatement will be in line with the requirements of the controlling road authority (typically as per The Purple Book). Dependant on the requirement of the road authority this may also include areas of temporary reinstatement which will have a final reinstatement completed at a later date.

5.3.4 Joint Bay Construction

Joint bays are underground chambers which are used for two primary purposes during the construction stage of the project:

1. For the installation of the individual cable lengths into the ducts by pulling cables from one joint bay to the next using draw ropes within the installed ducts
2. As a working space to complete the connection (joint) between individual cable lengths to complete each circuit

These joint bays are required at regular spacings because there is a limit on the length of cable supplied which is dictated by the cable drum diameter, the diameter of the cable itself and the maximum weight that can be transported by plant that can access the joint bay.

Based on the cable sizes required for this project the joint bays will likely be spaced at 550–700m, however in areas with multiple changes in direction or other limiting factors it may be necessary to space joint bays more closely. The exact spacing is be determined during the design stage and scope to adjust this spacing without impacts on the spacing of adjacent joint bays is limited.

The joint bays proposed for this project will typically measure 8.0m long, 2.5m wide and 2.5m deep. Joint bays will either be delivered to site prefabricated from precast concrete (typically in 4 sections) and lifted into the pre-excavated location or cast in situ. Joint bays will be fully reinstated after construction is complete.

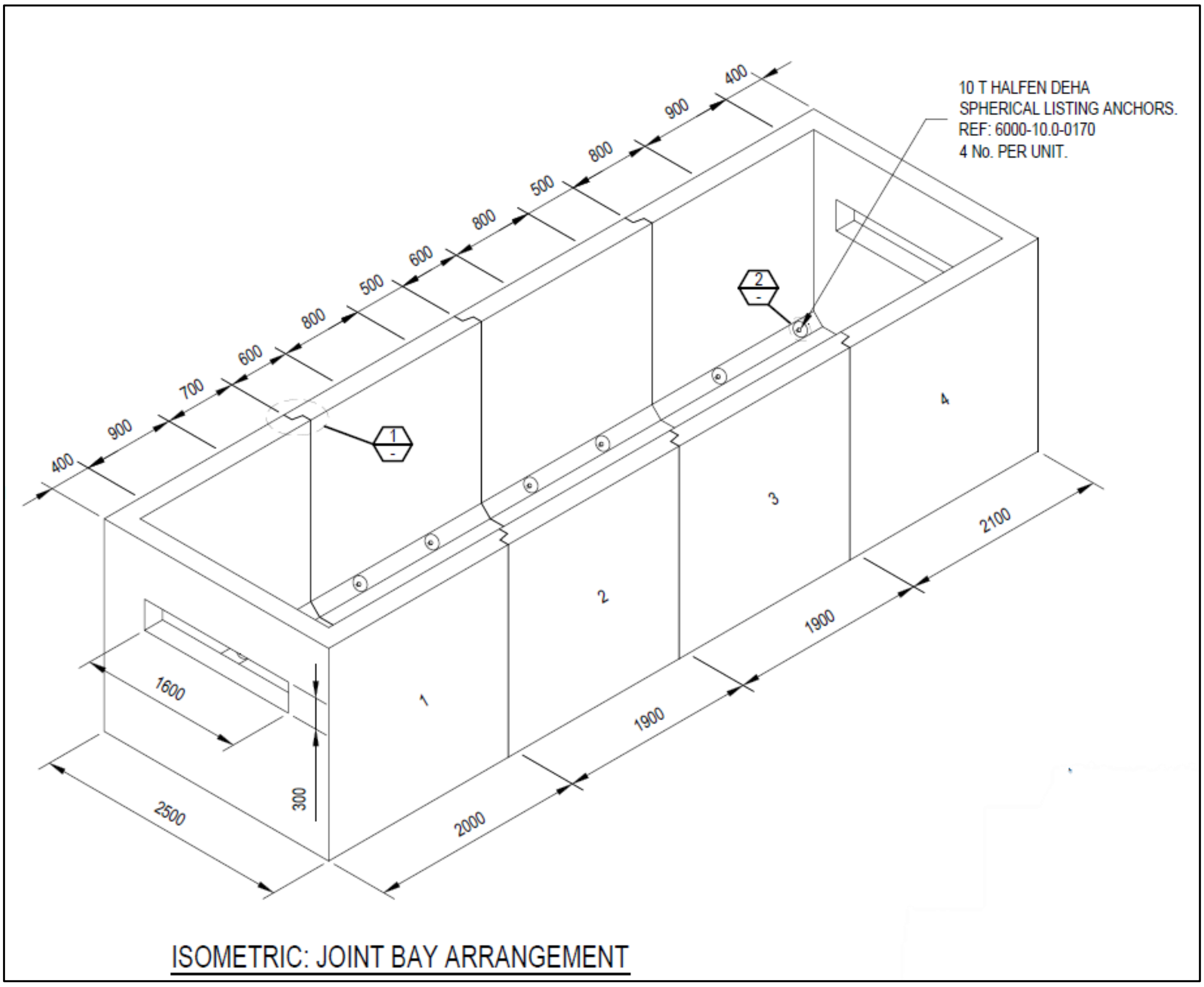


Figure 5-10: Isometric joint bay arrangement (XDC-CBL-STND-F-012)

5.3.5 Cable Pulling

Once the underground cable ducts have been installed from joint bay to joint bay it is then necessary to carry out a test of the ducts (duct proving) to confirm that no deformation has occurred in the duct which might hinder cable installation. To do this the ducts are thoroughly cleaned, brushed and a propriety mandrel is pulled through the ducts a number of times to ensure no deformation has occurred in the ducting.

The power cable drums are then brought to site from their delivery location (Dublin Port or an ESB Substation) on a suitable transporter, these transporters are typically articulated trucks with plant or step frame trailers or can also be specialist cable trailers drawn by tractors.

The cable drums can then either be removed from the transporter by suitable plant (crane, large forklift etc.) and positioned in line at the rear of the joint bay, or if space permits the transporter can be positioned at the rear of the joint bay to feed the cable directly into the ducts. A cable winch attached to an appropriate vehicle is positioned at the next joint bay location. The power cable is then pulled through the ducting using a steel wire and the cable winch.

5.3.6 Construction of Trenchless Crossings

The 220 kV circuit tie-ins for the EBO cross the M50. It is unlikely that this crossing can be completed via open trenching across the motorway. There is therefore a potential to use trenchless methods to complete this crossing.

While Horizontal Directional Drill (HDD) is the envisaged crossing methodology, a number of other trenchless methods may also be suitable and will be investigate for further detailed design during Step 4. These methodologies are:

- Horizontal Directional Drill (HDD)
- Micro tunnel Boring Machine
- Pipe Ramming

There are three different crossing configurations possible for this project. These are:

- Flat formation
  This formation requires 5 separate bores as each bore crossing will contain a single cable, and two will contain the communication cables. For safety, there is a separation of 5m between each bore. This formation thus requires a large amount of lateral space; however, the advantage is the bores can be relatively small. An example of this formation (not to scale) is shown in Figure 5-12.

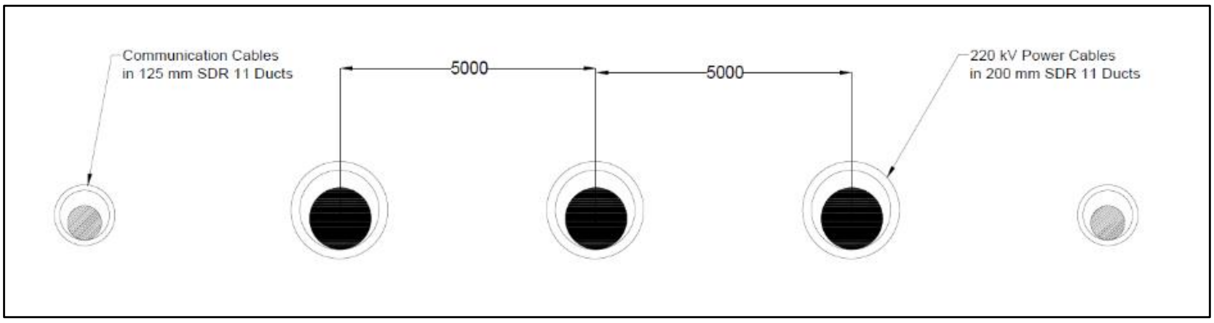


Figure 5-11: Crossing in flat formation (not to scale)

- Trefoil formation in an outer duct
  A second option is to use a trefoil formation within a protective outer duct. The advantage for this is that a single shot is required to make the crossing for the entire circuit. All power cables and communication cables are pulled through in a larger outer duct. This duct can be beneficial depending on the requirements for the crossing (detailed design and specific ground conditions required). The disadvantage of this is that a very large bore is required to pull the outer duct. This larger conduit, as well as the outer duct itself can add to the cost of the drill. An example of this formation is shown in Figure 5-13.

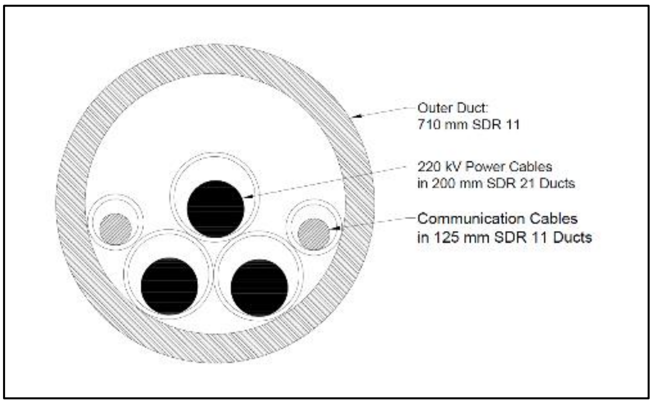


Figure 5-12: Crossing in trefoil with an outer duct

- Trefoil formation
  The third crossing methodology is in trefoil formation but without the outer duct. This is advantageous as it does not require the same large lateral space compared to flat formation, and as there is no outer duct, the bore size required is smaller than option 2. An example of this formation is shown in Figure 5-14.

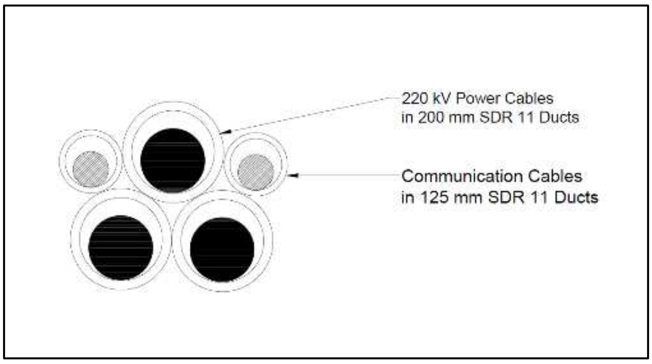


Figure 5-13: Crossing in trefoil without an outer duct

The crossing formation is envisaged at this stage to be trefoil formation without the outer duct, however this will be confirmed through detail design and site investigations in Step 4.

5.3.7 Traffic Management

Before works begin, traffic management planning will take place with the relevant local authorities. This will include establishing the requirement for and possibility of road closures and traffic diversions. The outcomes from these discussions may identify areas where night-time works are required or would minimise the impact on traffic, this is most likely to be required in the city centre or on busy roads on the outskirts of the city.

This planning ensures the safety of road users and those carrying out the works. During roadworks, local access to homes and businesses is maintained. Traffic is kept flowing as smoothly as possible and where possible, passing bays are provided to help keep it moving.

6 SUMMARY

This report has comprehensively assessed potential locations for the Dublin Central Grid Reinforcement project through a Multi-Criteria Analysis (MCA) process. This evaluation considered technical feasibility, deliverability, economic factors, socio-economic impacts, and environmental considerations across six potential locations. Following the MCA, Location 1 emerged as the Emerging Best Option (EBO) to progress to Step 4 for further assessment and analysis.

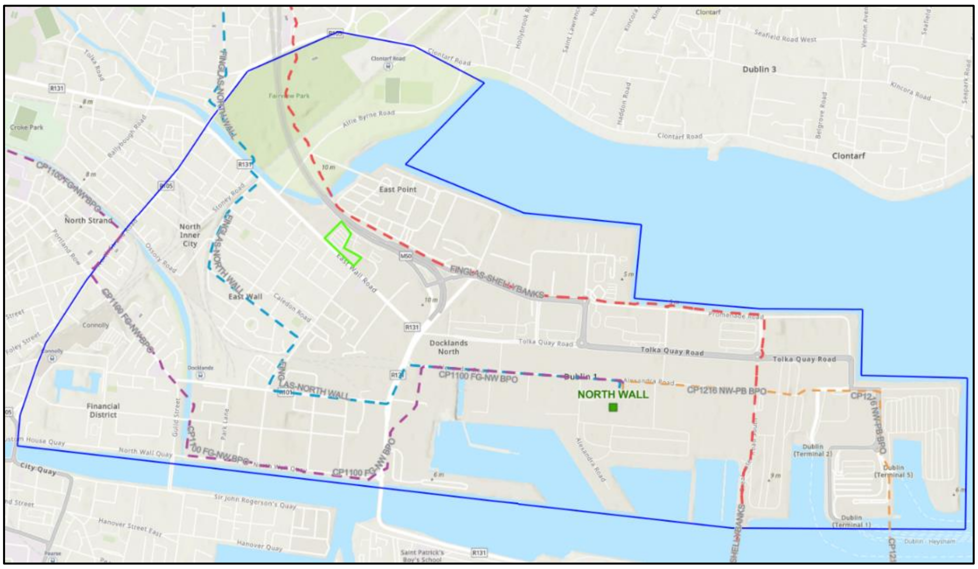


Figure 6-1: The Emerging Best Option to progress to Step 4 within the Study Area

This Step 3 also considered the technical feasibility of constructing the transmission substation at the identified Emerging Best Option. The assessment confirms, on the basis of the information currently available, that the construction is feasible however there are a number of items to be confirmed at the next step, including the exact number of circuits that can be accommodated.

Figure 6-2 shows the site layout of the Emerging Best Option.

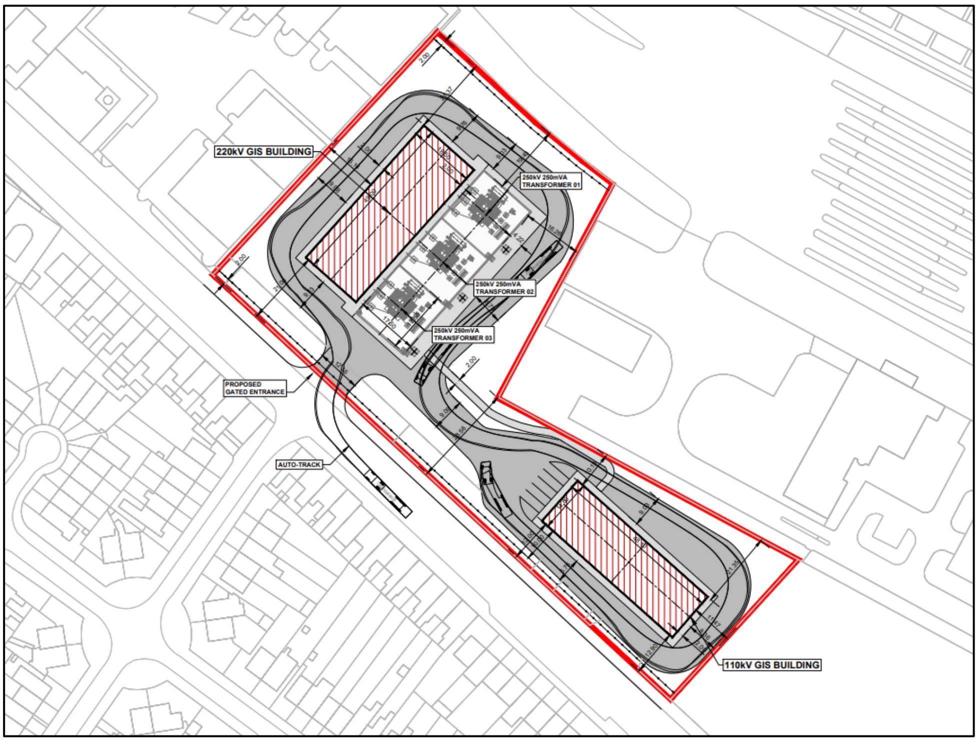


Figure 6-2: Master layout of Emerging Best Option

7 NEXT STEPS

This Step 3 (Preferred Options) Report will be published and presented to the public. Any feedback received will be considered in the project design moving forward.

This Step 3 Report will be accompanied by a social impact assessment (SIA) to identify the key stakeholders associated with the project, and a planning and consenting strategy to confirm the statutory consenting processes associated with the project.

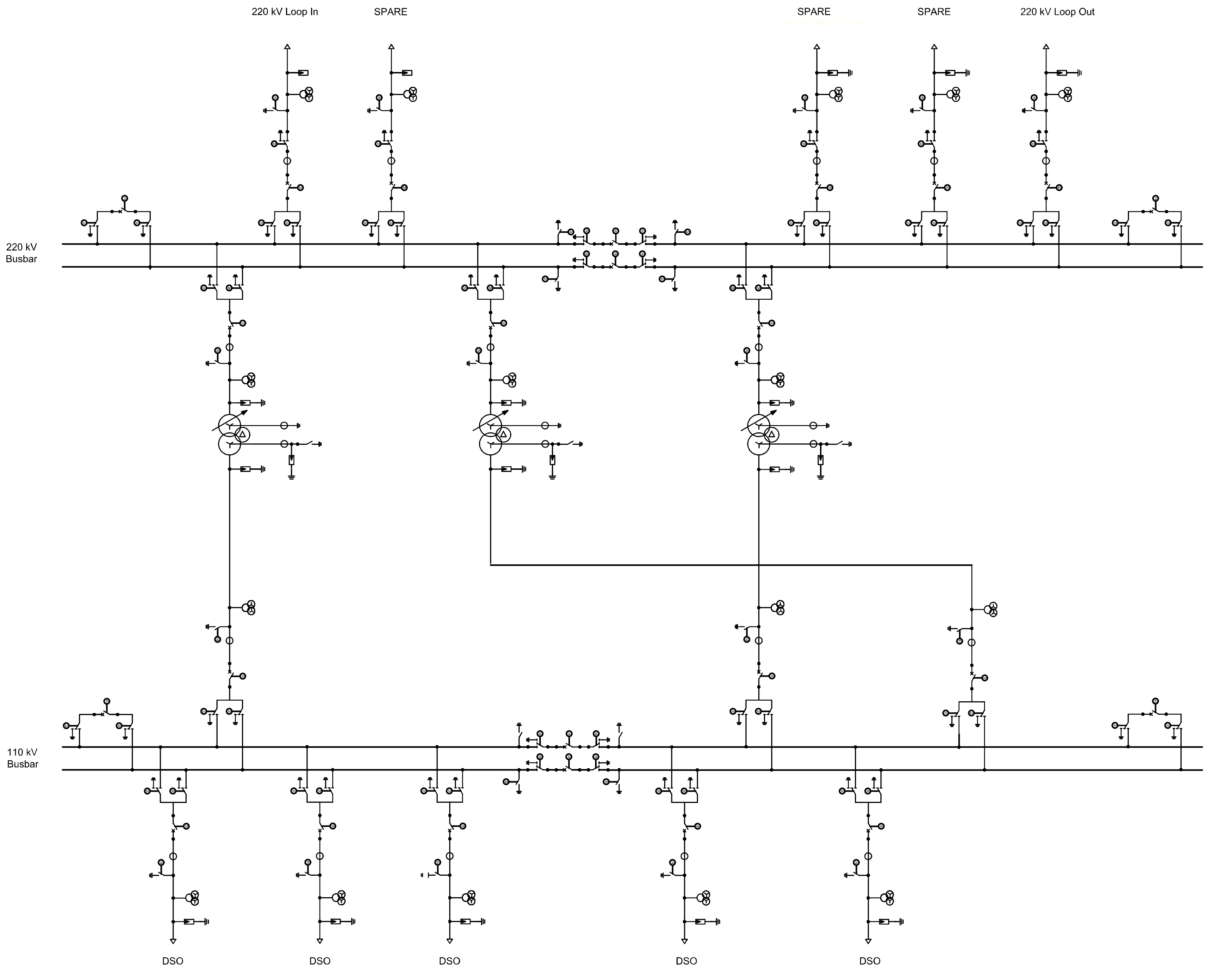
A scoping exercise to identify the investigations required to validate the desktop designs will also be prepared. The site investigations may include, but are not limited to, the following:

- Ground Penetrating Radar (PAS128)
- Slit trenches and H trenches
- Boreholes
- Testing for soil contamination
- Soil resistivity
- Ecological and environmental site investigations.

The Emerging Best Option (EBO) identified in this report will be taken forward to the next stage, Step 4, of this project. This stage includes the following:

- Social Impact Assessment
- Screening for Appropriate Assessment and Environmental Impact Assessment
- Step 4 Report
- Step 5 Report

APPENDIX A: SINGLE LINE DIAGRAM



NOTES:

LEGEND
CIRCUIT BREAKER
THREE POSITION EARTH SWITCH
EARTH SWITCH
CURRENT TRANSFORMER
VOLTAGE TRANSFORMER
SURGE ARRESTER
TRANSFORMER

REV.	STATUS	DATE	DRAWN	CHECKED	APPROVED	REVISION DESCRIPTION
A	FI	12/03/24	TP	DH	AB	For Approval

AB - As Built; FA - For Approval; FC - For Construction; FI - For Information

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POWERCOMM ENGINEERING

CLIENT:	EirGrid
CONSULTANT:	
SITE:	Dublin Central
PROJECT:	Dublin Central
DOCUMENT TITLE:	Single Line Drawing
PAGE TITLE:	
DRAWING NO.:	CP1273-PC-01-DW-SL-D-C-0001
PAGE:	1/1
SCALE:	NTS
FORMAT:	A2

APPENDIX B: AMPACITY CALCULATIONS

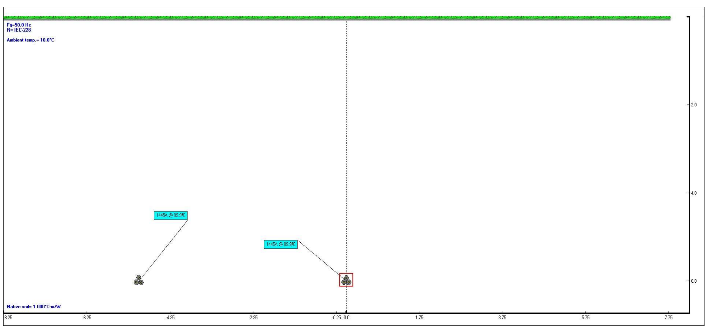
	Study Summary
CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario B
Date:	21/03/2024 10:58:01

General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Buried Ducts

Ambient Soil Temperature at Installation Depth	[°C]	10.0
Native Soil Thermal Resistivity	[K.m/W]	1.0
Consider Non-Isothermal Earth Surface		No



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [m]	Y coordinate [m]	Conductor temperature [°C]	Ampacity [A]
1	EIRGRID 220KV 2500 SQ CU	1		A	50.0	1.0	-0.06	6.04	89.9	1444.5
2	EIRGRID 220KV 2500 SQ CU	1		B	50.0	1.0	0.06	6.04	89.7	1444.5
3	EIRGRID 220KV 2500 SQ CU	1		C	50.0	1.0	0.0	5.93	89.6	1444.5
4	EIRGRID 220KV 2500 SQ CU	2		A	50.0	1.0	-5.06	6.04	89.7	1444.5
5	EIRGRID 220KV 2500 SQ CU	2		B	50.0	1.0	-4.94	6.04	89.9	1444.5
6	EIRGRID 220KV 2500 SQ CU	2		C	50.0	1.0	-5.0	5.93	89.6	1444.5

Steady State Summary

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario B
Date:	21/03/2024 10:58:01

Simulation Data

Installation type:	Buried Ducts
Steady State Option	Equally Loaded
Ambient temperature [°C]	10
Native Soil Thermal Resistivity [K.m/W]	1.0
Consider Non-Isothermal Earth Surface	No
Consider effect of soil dry out	No
Consider Electrical interaction between circuits	No
Induced current in metallic layers as a fraction of conductor current (applied to all single phase circuits)	0

Variable	Description	Unit	Cables					
Cable No.	Cable Index Number		1	2	3	4	5	6
General Input Data								
Cable ID	Cable Equipment ID		EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Circuit No.	Circuit No.		1	1	1	2	2	2
Phase	Cable Phase		A	B	C	A	B	C
Fq	Operating Frequency	[Hz]	50.0	50.0	50.0	50.0	50.0	50.0
x	X coordinate	[m]	-0.06	0.06	0.0	-5.06	-4.94	-5.0
y	Y coordinate	[m]	6.04	6.04	5.93	6.04	6.04	5.93
DLF	Daily Load Factor	[p.u.]	1.0	1.0	1.0	1.0	1.0	1.0
	Bonding Type		1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular
Ampacity								
I	Steady State Ampacity	[A]	1444.5	1444.5	1444.5	1444.5	1444.5	1444.5
Temperatures								
θc	Conductor temperature	[°C]	89.9	89.7	89.6	89.7	89.9	89.6
θs	Sheath/Shield temperature	[°C]	83.1	82.8	82.7	82.8	83.1	82.7
θa	Armour temperature	[°C]	n/a	n/a	n/a	n/a	n/a	n/a
θsurf	Cable surface temperature	[°C]	82.1	81.8	81.8	81.8	82.1	81.8
θduct	Duct surface temperature	[°C]	n/a	n/a	n/a	n/a	n/a	n/a
Resistances								
R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
R	AC Resistance of the Conductor at Operating Temperature	[Ω/km]	0.01055	0.01054	0.01054	0.01054	0.01055	0.01054
ys	Skin Effect Factor		0.10914	0.1093	0.10935	0.1093	0.10914	0.10935
yp	Proximity Effect Factor		0.04012	0.04017	0.04019	0.04017	0.04012	0.04019
Losses								
Wc	Conductor Losses	[W/m]	22.0132	21.99921	21.995	21.99922	22.01288	21.9949
Wd	Dielectric Losses	[W/m]	1.49477	1.49477	1.49477	1.49477	1.49477	1.49477
Ws	Metallic Screen Losses	[W/m]	2.57637	2.57854	2.57919	2.57854	2.57642	2.57921
Wa	Armor/Pipe Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0
Wt	Total Losses	[W/m]	26.08434	26.07251	26.06896	26.07253	26.08406	26.06887
λ_1	Screen Loss Factor		0.11704	0.11721	0.11726	0.11721	0.11704	0.11726
λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
Thermal resistances								
T1	Thermal resistance of insulation	[K.m/W]	0.30149	0.30149	0.30149	0.30149	0.30149	0.30149
T2	Thermal resistance of bedding/medium inside pipe-type	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a
T3	Thermal resistance of outer covering	[K.m/W]	0.03775	0.03775	0.03775	0.03775	0.03775	0.03775
T4	External thermal resistance	[K.m/W]	2.76374	2.75499	2.75244	2.75499	2.76376	2.75244
Others								
Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced Voltage (standing) on Sheath	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced Voltage (standing) on Concentric Wires	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced current on Metallic Screen	[A]	0.0	0.0	0.0	0.0	0.0	0.0

Cable Parameters under Normal Operation

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario B
Date:	21/03/2024 10:58:01

No.	Symbol	Description	Unit	Cable No.1	Cable No.2	Cable No.3	Cable No.4	Cable No.5	Cable No.6
1		Cable Equipment ID		EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Normal Operation IEC 60287-1-1									
Conductor AC Resistance									
2	R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
3	R'	DC Resistance of Conductor at Operating Temperature	[Ω/km]	0.00918	0.00917	0.00917	0.00917	0.00918	0.00917
4	dc	Conductor Diameter	[mm]	63.5	63.5	63.5	63.5	63.5	63.5
5	s	Distance Between Conductor Axes	[mm]	122.1	122.1	122.1	122.1	122.1	122.1
6	ks	Factor Used for xs Calculation (Skin Effect)		0.35	0.35	0.35	0.35	0.35	0.35
7	kp	Factor Used for xp Calculation (Proximity Effect)		0.2	0.2	0.2	0.2	0.2	0.2
8	xs	Component of Ys Calculation (Skin Effect)		2.18896	2.18986	2.19014	2.18986	2.18898	2.19014
9	xp	Component of Yp Calculation (Proximity Effect)		1.6547	1.65538	1.65559	1.65538	1.65471	1.65559
10	ys	Skin Effect Factor		0.10914	0.1093	0.10935	0.1093	0.10914	0.10935
11	yp	Proximity Effect Factor		0.04012	0.04017	0.04019	0.04017	0.04012	0.04019
12	R	AC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01055	0.01054	0.01054	0.01054	0.01055	0.01054
Dielectric Losses									
13	tanδ	Dielectric Loss Factor		0.001	0.001	0.001	0.001	0.001	0.001
14	ε	Insulation Relative Permitivity		2.5	2.5	2.5	2.5	2.5	2.5
15	C	Cable Capacitance	[μF/km]	0.295	0.295	0.295	0.295	0.295	0.295
16	U_0	Voltage	[kV]	127.01706	127.01706	127.01706	127.01706	127.01706	127.01706
17	Wd	Cable Dielectric Losses Per Phase	[W/m]	1.49477	1.49477	1.49477	1.49477	1.49477	1.49477
Circulating Loss Factor									
18	λ'_1	Screen Loss Factor Caused by Circulating Current		0.0	0.0	0.0	0.0	0.0	0.0
Eddy Loss Factor									
19	Rs	AC Resistance used for Eddy Loss Factor computation	[Ω/km]	0.51867	0.51823	0.5181	0.51823	0.51866	0.5181
20	d	Mean diameter used for Eddy Loss Factor computation	[mm]	109.3	109.3	109.3	109.3	109.3	109.3
21	ρs	Electrical Resistivity used for Eddy Loss Factor computation	[Ω.m]	0.0	0.0	0.0	0.0	0.0	0.0
22	Ds	External diameter used for Eddy Loss Factor computation	[mm]	109.5	109.5	109.5	109.5	109.5	109.5
23	ts	Thickness used for Eddy Loss Factor computation	[mm]	0.2	0.2	0.2	0.2	0.2	0.2
24	β_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		105.27683	105.32161	105.33508	105.32156	105.27786	105.33543
25	gs	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		1.00017	1.00017	1.00017	1.00017	1.00017	1.00017
27	m	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.06057	0.06062	0.06064	0.06062	0.06057	0.06064
28	λ_0	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.0022	0.0022	0.0022	0.0022	0.0022	0.0022
29	Δ_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.08338	0.08338	0.08338	0.08338	0.08338	0.08338
30	Δ_2	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.0	0.0	0.0	0.0	0.0	0.0
31	F	Milliken conductor Effect		1.0	1.0	1.0	1.0	1.0	1.0
32	Fpipe	Magnetic effect factor due to pipe		1.0	1.0	1.0	1.0	1.0	1.0
33	Farmour	Magnetic effect factor due to armour		1.0	1.0	1.0	1.0	1.0	1.0
34	λ''_1	Screen Loss Factor Caused by Eddy Current		0.11704	0.11721	0.11726	0.11721	0.11704	0.11726
Metallic Screen Loss factor									
35	λ_1	Screen Loss Factor		0.11704	0.11721	0.11726	0.11721	0.11704	0.11726
Armour and Pipe Loss Factor									
36	λ_2a	Armour Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
37	$\lambda_2$pipe	Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
39	λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
Normal Operation IEC 60287-2-1									
40	T_1	Thermal Resistance Between Conductor and Screen	[K.m/W]	0.30149	0.30149	0.30149	0.30149	0.30149	0.30149

41	t_1	Insulation Thickness Between Conductor and Screen	[mm]	22.8	22.8	22.8	22.8	22.8	22.8
42	ρTi	Thermal Resistivity of Insulation	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5
43	T_3	Thermal Resistance of Jacket/Pipe Coating	[K.m/W]	0.03775	0.03775	0.03775	0.03775	0.03775	0.03775
44	t_3	Thickness of Jacket/Pipe Coating	[mm]	4.0	4.0	4.0	4.0	4.0	4.0
45	ρTJ	Thermal Resistivity of Jacket/Pipe Coating	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5
Ducts Buried in the soil									
46	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	2.76374	2.75499	2.75244	2.75499	2.76376	2.75244
47	T_4	Total External Thermal Resistance	[K.m/W]	2.76374	2.75499	2.75244	2.75499	2.76376	2.75244
48	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	0.0	0.0	0.0	0.0	0.0	0.0
49	I	Cable Core Current Ampacity	[A]	1444.5	1444.5	1444.5	1444.5	1444.5	1444.5

	Study Summary
CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario D
Date:	21/03/2024 12:07:28

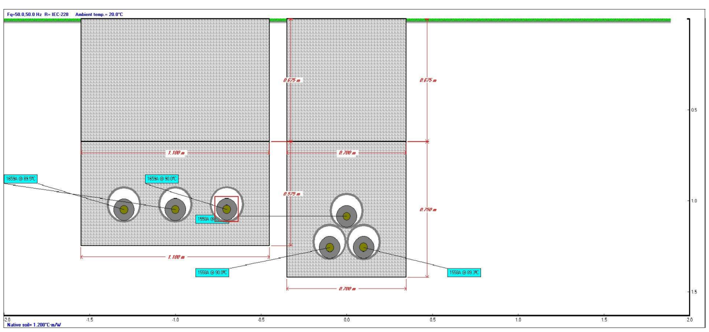
General Simulation Data

Steady State Option	Unequally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	20.0
Native Soil Thermal Resistivity	[K.m/W]	1.2
Consider Non-Isothermal Earth Surface		No

Layer Name	X [m]	Y [m]	Width [m]	Height [m]	Thermal Resistivity [K.m/W]
NSTD DB4	0.0	1.05	0.7	0.75	1.0
NSTD DB4	-1.0	0.338	1.1	0.675	1.0
NSTD DB3	-1.0	0.963	1.1	0.575	1.0
NSTD DB2	0.0	0.338	0.7	0.675	1.2



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [m]	Y coordinate [m]	Conductor temperature [°C]	Ampacity [A]
1	EIRGRID 220KV 2500 SQ CU	1		A	50.0	1.0	-0.1	1.26	90.0	1558.0
2	EIRGRID 220KV 2500 SQ CU	1		B	50.0	1.0	0.1	1.26	89.3	1558.0
3	EIRGRID 220KV 2500 SQ CU	1		C	50.0	1.0	0.0	1.08	88.9	1558.0
4	EIRGRID 220KV 2500 SQ CU	2		A	50.0	1.0	-1.3	1.05	82.8	1659.0
5	EIRGRID 220KV 2500 SQ CU	2		B	50.0	1.0	-1.0	1.05	89.5	1659.0
6	EIRGRID 220KV 2500 SQ CU	2		C	50.0	1.0	-0.7	1.05	90.0	1659.0

Steady State Summary

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario D
Date:	21/03/2024 12:07:28

Simulation Data

Installation type:	Multiple Ductbanks
Steady State Option	Unequally Loaded
Ambient temperature [°C]	20
Native Soil Thermal Resistivity [K.m/W]	1.2
Consider Non-Isothermal Earth Surface	No
Consider effect of soil dry out	No
Consider Electrical interaction between circuits	No
Induced current in metallic layers as a fraction of conductor current (applied to all single phase circuits)	0

Variable	Description	Unit	Cables					
Cable No.	Cable Index Number		1	2	3	4	5	6
General Input Data								
Cable ID	Cable Equipment ID		EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Circuit No.	Circuit No.		1	1	1	2	2	2
Phase	Cable Phase		A	B	C	A	B	C
Fq	Operating Frequency	[Hz]	50.0	50.0	50.0	50.0	50.0	50.0
x	X coordinate	[m]	-0.1	0.1	0.0	-1.3	-1.0	-0.7
y	Y coordinate	[m]	1.26	1.26	1.08	1.05	1.05	1.05
DLF	Daily Load Factor	[p.u.]	1.0	1.0	1.0	1.0	1.0	1.0
	Bonding Type		1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat
Ampacity								
I	Steady State Ampacity	[A]	1558.0	1558.0	1558.0	1659.0	1659.0	1659.0
Temperatures								
θc	Conductor temperature	[°C]	90.0	89.3	88.9	82.8	89.5	90.0
θs	Sheath/Shield temperature	[°C]	82.2	81.5	81.2	74.2	80.8	81.3
θa	Armour temperature	[°C]	n/a	n/a	n/a	n/a	n/a	n/a
θsurf	Cable surface temperature	[°C]	81.2	80.5	80.1	73.1	79.7	80.1
θduct	Duct surface temperature	[°C]	74.8	74.1	73.7	64.5	70.9	71.6
Resistances								
R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
R	AC Resistance of the Conductor at Operating Temperature	[Ω/km]	0.01032	0.0103	0.01029	0.01006	0.01023	0.01024
ys	Skin Effect Factor		0.1091	0.10954	0.10977	0.11367	0.10939	0.1091
yp	Proximity Effect Factor		0.01445	0.01451	0.01453	0.00678	0.00654	0.00652
Losses								
Wc	Conductor Losses	[W/m]	25.03896	24.9953	24.97246	27.68189	28.15666	28.19009
Wd	Dielectric Losses	[W/m]	1.49477	1.49477	1.49477	1.49477	1.49477	1.49477
Ws	Metallic Screen Losses	[W/m]	1.04912	1.05145	1.05267	0.25926	1.04679	0.26697
Wa	Armor/Pipe Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0
Wt	Total Losses	[W/m]	27.58285	27.54152	27.5199	29.43592	30.69821	29.95183
λ_1	Screen Loss Factor		0.0419	0.04207	0.04215	0.00937	0.03718	0.00947
λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
Thermal resistances								
T1	Thermal resistance of insulation	[K.m/W]	0.30149	0.30149	0.30149	0.30149	0.30149	0.30149
T2	Thermal resistance of bedding/medium inside pipe-type	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a
T3	Thermal resistance of outer covering	[K.m/W]	0.03775	0.03775	0.03775	0.03775	0.03775	0.03775
T4	External thermal resistance	[K.m/W]	0.72069	0.72169	0.71255	0.83593	0.81872	0.81075
Others								
Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	41.3	40.6	40.5	28.5	34.5	35.9
	Induced Voltage (standing) on Sheath	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced Voltage (standing) on Concentric Wires	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced current on Metallic Screen	[A]	0.0	0.0	0.0	0.0	0.0	0.0

Cable Parameters under Normal Operation

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario D
Date:	21/03/2024 12:07:28

No.	Symbol	Description	Unit	Cable No.1	Cable No.2	Cable No.3	Cable No.4	Cable No.5	Cable No.6
1		Cable Equipment ID		EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Normal Operation IEC 60287-1-1									
Conductor AC Resistance									
2	R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
3	R'	DC Resistance of Conductor at Operating Temperature	[Ω/km]	0.00918	0.00916	0.00915	0.00898	0.00917	0.00918
4	dc	Conductor Diameter	[mm]	63.5	63.5	63.5	63.5	63.5	63.5
5	s	Distance Between Conductor Axes	[mm]	201.99998	201.99998	201.99998	300.0	300.0	300.0
6	ks	Factor Used for xs Calculation (Skin Effect)		0.35	0.35	0.35	0.35	0.35	0.35
7	kp	Factor Used for xp Calculation (Proximity Effect)		0.2	0.2	0.2	0.2	0.2	0.2
8	xs	Component of Ys Calculation (Skin Effect)		2.18876	2.19115	2.1924	2.21353	2.19036	2.18876
9	xp	Component of Yp Calculation (Proximity Effect)		1.65455	1.65635	1.6573	1.67327	1.65576	1.65455
10	ys	Skin Effect Factor		0.1091	0.10954	0.10977	0.11367	0.10939	0.1091
11	yp	Proximity Effect Factor		0.01445	0.01451	0.01453	0.00678	0.00654	0.00652
12	R	AC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01032	0.0103	0.01029	0.01006	0.01023	0.01024
Dielectric Losses									
13	tanδ	Dielectric Loss Factor		0.001	0.001	0.001	0.001	0.001	0.001
14	ε	Insulation Relative Permitivity		2.5	2.5	2.5	2.5	2.5	2.5
15	C	Cable Capacitance	[μF/km]	0.295	0.295	0.295	0.295	0.295	0.295
16	U_0	Voltage	[kV]	127.01706	127.01706	127.01706	127.01706	127.01706	127.01706
17	Wd	Cable Dielectric Losses Per Phase	[W/m]	1.49477	1.49477	1.49477	1.49477	1.49477	1.49477
Circulating Loss Factor									
18	λ'_1	Screen Loss Factor Caused by Circulating Current		0.0	0.0	0.0	0.0	0.0	0.0
Eddy Loss Factor									
19	Rs	AC Resistance used for Eddy Loss Factor computation	[Ω/km]	0.51725	0.51609	0.51549	0.50389	0.51489	0.51567
20	d	Mean diameter used for Eddy Loss Factor computation	[mm]	109.3	109.3	109.3	109.3	109.3	109.3
21	ρs	Electrical Resistivity used for Eddy Loss Factor computation	[Ω.m]	0.0	0.0	0.0	0.0	0.0	0.0
22	Ds	External diameter used for Eddy Loss Factor computation	[mm]	109.5	109.5	109.5	109.5	109.5	109.5
23	ts	Thickness used for Eddy Loss Factor computation	[mm]	0.2	0.2	0.2	0.2	0.2	0.2
24	β_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		105.42177	105.53972	105.60161	106.81008	105.66267	105.58339
25	gs	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		1.00017	1.00017	1.00017	1.00017	1.00017	1.00017
27	m	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.06074	0.06087	0.06094	0.06235	0.06101	0.06092
28	λ_0	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.00081	0.00081	0.00081	0.00019	0.00074	0.00018
29	Δ_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.03515	0.03514	0.03514	-0.03036	0.00004	0.02164
30	Δ_2	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.0	0.0	0.0	0.0	0.0	0.0
31	F	Milliken conductor Effect		1.0	1.0	1.0	1.0	1.0	1.0
32	Fpipe	Magnetic effect factor due to pipe		1.0	1.0	1.0	1.0	1.0	1.0
33	Farmour	Magnetic effect factor due to armour		1.0	1.0	1.0	1.0	1.0	1.0
34	λ''_1	Screen Loss Factor Caused by Eddy Current		0.0419	0.04207	0.04215	0.00937	0.03718	0.00947
Metallic Screen Loss factor									
35	λ_1	Screen Loss Factor		0.0419	0.04207	0.04215	0.00937	0.03718	0.00947
Armour and Pipe Loss Factor									
36	λ_2a	Armour Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
37	$\lambda_2$pipe	Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
39	λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
Normal Operation IEC 60287-2-1									
40	T_1	Thermal Resistance Between Conductor and Screen	[K.m/W]	0.30149	0.30149	0.30149	0.30149	0.30149	0.30149

41	t_1	Insulation Thickness Between Conductor and Screen	[mm]	22.8	22.8	22.8	22.8	22.8	22.8
42	ρTi	Thermal Resistivity of Insulation	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5
43	T_3	Thermal Resistance of Jacket/Pipe Coating	[K.m/W]	0.03775	0.03775	0.03775	0.03775	0.03775	0.03775
44	t_3	Thickness of Jacket/Pipe Coating	[mm]	4.0	4.0	4.0	4.0	4.0	4.0
45	ρTJ	Thermal Resistivity of Jacket/Pipe Coating	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5
Cables Directly Buried									
46	L	Depth of Cable Axis	[m]	n/a	n/a	n/a	n/a	n/a	n/a
47	u	Coefficient Used in IEC 60287-2-1 Clause 2.2		n/a	n/a	n/a	n/a	n/a	n/a
48	T_4	Thermal Resistance of the Surrounding Medium	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a
49	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	n/a	n/a	n/a	n/a	n/a	n/a
50	I	Cable Core Current Ampacity	[A]	n/a	n/a	n/a	n/a	n/a	n/a
Cable in Ducts									
51	U	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		1.87	1.87	1.87	1.87	1.87	1.87
52	V	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.312	0.312	0.312	0.312	0.312	0.312
53	Y	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.0037	0.0037	0.0037	0.0037	0.0037	0.0037
54	θm	Mean Temperature of the Medium Filling the Space	[°C]	78.1	77.4	77.0	69.6	76.2	76.8
55	T_4'	Thermal Resistance of the Medium Inside the Duct/Pipe	[K.m/W]	0.22429	0.22514	0.22559	0.23505	0.22664	0.22591
56	Do	Outside Diameter of the Duct/Pipe	[mm]	200.0	200.0	200.0	200.0	200.0	200.0
57	Di	Inside Diameter of the Duct/Pipe	[mm]	180.0	180.0	180.0	180.0	180.0	180.0
58	ρT	Thermal Resistivity of the Duct/Pipe Material	[K.m/W]	0.5	0.5	0.5	3.5	3.5	3.5
59	T_4''	Thermal Resistance of the Duct/Pipe	[K.m/W]	0.00838	0.00838	0.00838	0.05869	0.05869	0.05869
60	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.48802	0.48817	0.47858	0.54219	0.53339	0.52615
Ducts Buried in the soil									
61	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.48802	0.48817	0.47858	0.54219	0.53339	0.52615
62	T_4	Total External Thermal Resistance	[K.m/W]	0.72069	0.72169	0.71255	0.83593	0.81872	0.81075
63	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	41.3	40.6	40.5	28.5	34.5	35.9
64	I	Cable Core Current Ampacity	[A]	1558.0	1558.0	1558.0	1659.0	1659.0	1659.0

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario E
Date:	21/03/2024 10:46:30

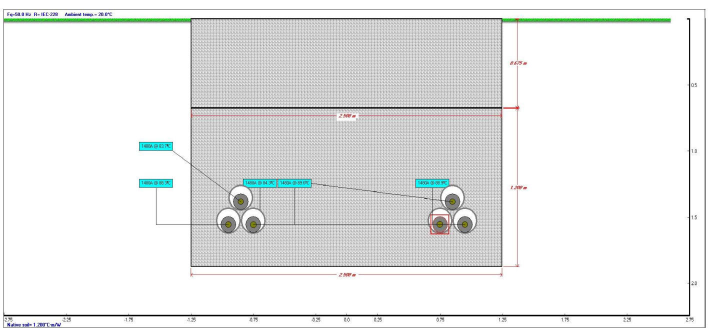
General Simulation Data

Steady State Option	Equally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	20.0
Native Soil Thermal Resistivity	[K.m/W]	1.2
Consider Non-Isothermal Earth Surface		No

Layer Name	X [m]	Y [m]	Width [m]	Height [m]	Thermal Resistivity [K.m/W]
NSTD DB4	0.0	1.276	2.5	1.2	1.0
NSTD DB2	0.0	0.338	2.5	0.675	1.2



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [m]	Y coordinate [m]	Conductor temperature [°C]	Ampacity [A]
1	EIRGRID 220KV 2500 SQ CU	1		A	50.0	1.0	0.75	1.56	90.0	1480.0
2	EIRGRID 220KV 2500 SQ CU	1		B	50.0	1.0	0.95	1.56	88.9	1480.0
3	EIRGRID 220KV 2500 SQ CU	1		C	50.0	1.0	0.85	1.38	84.3	1480.0
4	EIRGRID 220KV 2500 SQ CU	2		A	50.0	1.0	-0.95	1.56	88.3	1480.0
5	EIRGRID 220KV 2500 SQ CU	2		B	50.0	1.0	-0.75	1.56	89.6	1480.0
6	EIRGRID 220KV 2500 SQ CU	2		C	50.0	1.0	-0.85	1.38	83.7	1480.0

Steady State Summary

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario E
Date:	21/03/2024 10:46:30

Simulation Data

Installation type:	Multiple Ductbanks
Steady State Option	Equally Loaded
Ambient temperature [°C]	20
Native Soil Thermal Resistivity [K.m/W]	1.2
Consider Non-Isothermal Earth Surface	No
Consider effect of soil dry out	No
Consider Electrical interaction between circuits	No
Induced current in metallic layers as a fraction of conductor current (applied to all single phase circuits)	0

Variable	Description	Unit	Cables					
Cable No.	Cable Index Number		1	2	3	4	5	6
General Input Data								
Cable ID	Cable Equipment ID		EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Circuit No.	Circuit No.		1	1	1	2	2	2
Phase	Cable Phase		A	B	C	A	B	C
Fq	Operating Frequency	[Hz]	50.0	50.0	50.0	50.0	50.0	50.0
x	X coordinate	[m]	0.75	0.95	0.85	-0.95	-0.75	-0.85
y	Y coordinate	[m]	1.56	1.56	1.38	1.56	1.56	1.38
DLF	Daily Load Factor	[p.u.]	1.0	1.0	1.0	1.0	1.0	1.0
	Bonding Type		1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular
Ampacity								
I	Steady State Ampacity	[A]	1480.0	1480.0	1480.0	1480.0	1480.0	1480.0
Temperatures								
θc	Conductor temperature	[°C]	90.0	88.9	84.3	88.3	89.6	83.7
θs	Sheath/Shield temperature	[°C]	82.9	81.9	77.3	81.3	82.6	76.8
θa	Armour temperature	[°C]	n/a	n/a	n/a	n/a	n/a	n/a
θsurf	Cable surface temperature	[°C]	82.0	80.9	76.4	80.3	81.7	75.9
θduct	Duct surface temperature	[°C]	75.0	73.9	69.3	73.2	74.6	68.7
Resistances								
R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
R	AC Resistance of the Conductor at Operating Temperature	[Ω/km]	0.01031	0.01029	0.01017	0.01027	0.01031	0.01016
ys	Skin Effect Factor		0.10911	0.10979	0.1127	0.11018	0.10932	0.11305
yp	Proximity Effect Factor		0.01445	0.01454	0.0149	0.01459	0.01448	0.01494
Losses								
Wc	Conductor Losses	[W/m]	22.5943	22.53287	22.27654	22.49817	22.5755	22.24627
Wd	Dielectric Losses	[W/m]	1.49477	1.49477	1.49477	1.49477	1.49477	1.49477
Ws	Metallic Screen Losses	[W/m]	0.94458	0.94785	0.96175	0.9497	0.94557	0.96343
Wa	Armor/Pipe Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0
Wt	Total Losses	[W/m]	25.03364	24.97548	24.73306	24.94264	25.01584	24.70447
λ_1	Screen Loss Factor		0.04181	0.04207	0.04317	0.04221	0.04188	0.04331
λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
Thermal resistances								
T1	Thermal resistance of insulation	[K.m/W]	0.30149	0.30149	0.30149	0.30149	0.30149	0.30149
T2	Thermal resistance of bedding/medium inside pipe-type	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a
T3	Thermal resistance of outer covering	[K.m/W]	0.03775	0.03775	0.03775	0.03775	0.03775	0.03775
T4	External thermal resistance	[K.m/W]	2.47708	2.43943	2.28055	2.41817	2.46538	2.26147
Others								
Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced Voltage (standing) on Sheath	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced Voltage (standing) on Concentric Wires	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0
	Induced current on Metallic Screen	[A]	0.0	0.0	0.0	0.0	0.0	0.0

Cable Parameters under Normal Operation

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario E
Date:	21/03/2024 10:46:30

No.	Symbol	Description	Unit	Cable No.1	Cable No.2	Cable No.3	Cable No.4	Cable No.5	Cable No.6
1		Cable Equipment ID		EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Normal Operation IEC 60287-1-1									
Conductor AC Resistance									
2	R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
3	R'	DC Resistance of Conductor at Operating Temperature	[Ω/km]	0.00918	0.00915	0.00902	0.00913	0.00917	0.009
4	dc	Conductor Diameter	[mm]	63.5	63.5	63.5	63.5	63.5	63.5
5	s	Distance Between Conductor Axes	[mm]	202.00004	202.00004	202.00004	202.00004	202.00004	202.00004
6	ks	Factor Used for xs Calculation (Skin Effect)		0.35	0.35	0.35	0.35	0.35	0.35
7	kp	Factor Used for xp Calculation (Proximity Effect)		0.2	0.2	0.2	0.2	0.2	0.2
8	xs	Component of Ys Calculation (Skin Effect)		2.18883	2.19256	2.20833	2.19467	2.18997	2.21022
9	xp	Component of Yp Calculation (Proximity Effect)		1.6546	1.65742	1.66934	1.65901	1.65546	1.67077
10	ys	Skin Effect Factor		0.10911	0.10979	0.1127	0.11018	0.10932	0.11305
11	yp	Proximity Effect Factor		0.01445	0.01454	0.0149	0.01459	0.01448	0.01494
12	R	AC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01031	0.01029	0.01017	0.01027	0.01031	0.01016
Dielectric Losses									
13	tanδ	Dielectric Loss Factor		0.001	0.001	0.001	0.001	0.001	0.001
14	ε	Insulation Relative Permitivity		2.5	2.5	2.5	2.5	2.5	2.5
15	C	Cable Capacitance	[μF/km]	0.295	0.295	0.295	0.295	0.295	0.295
16	U_0	Voltage	[kV]	127.01706	127.01706	127.01706	127.01706	127.01706	127.01706
17	Wd	Cable Dielectric Losses Per Phase	[W/m]	1.49477	1.49477	1.49477	1.49477	1.49477	1.49477
Circulating Loss Factor									
18	λ'_1	Screen Loss Factor Caused by Circulating Current		0.0	0.0	0.0	0.0	0.0	0.0
Eddy Loss Factor									
19	Rs	AC Resistance used for Eddy Loss Factor computation	[Ω/km]	0.51844	0.51664	0.5091	0.51562	0.51789	0.5082
20	d	Mean diameter used for Eddy Loss Factor computation	[mm]	109.3	109.3	109.3	109.3	109.3	109.3
21	ρs	Electrical Resistivity used for Eddy Loss Factor computation	[Ω.m]	0.0	0.0	0.0	0.0	0.0	0.0
22	Ds	External diameter used for Eddy Loss Factor computation	[mm]	109.5	109.5	109.5	109.5	109.5	109.5
23	ts	Thickness used for Eddy Loss Factor computation	[mm]	0.2	0.2	0.2	0.2	0.2	0.2
24	β_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		105.30013	105.48393	106.26257	105.58824	105.35627	106.35577
25	gs	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		1.00017	1.00017	1.00017	1.00017	1.00017	1.00017
27	m	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.0606	0.06081	0.06171	0.06093	0.06066	0.06182
28	λ_0	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.0008	0.00081	0.00083	0.00081	0.00081	0.00084
29	Δ_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.03515	0.03514	0.03511	0.03514	0.03515	0.03511
30	Δ_2	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		0.0	0.0	0.0	0.0	0.0	0.0
31	F	Milliken conductor Effect		1.0	1.0	1.0	1.0	1.0	1.0
32	Fpipe	Magnetic effect factor due to pipe		1.0	1.0	1.0	1.0	1.0	1.0
33	Farmour	Magnetic effect factor due to armour		1.0	1.0	1.0	1.0	1.0	1.0
34	λ''_1	Screen Loss Factor Caused by Eddy Current		0.04181	0.04207	0.04317	0.04221	0.04188	0.04331
Metallic Screen Loss factor									
35	λ_1	Screen Loss Factor		0.04181	0.04207	0.04317	0.04221	0.04188	0.04331
Armour and Pipe Loss Factor									
36	λ_2a	Armour Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
37	$\lambda_2$pipe	Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
39	λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0
Normal Operation IEC 60287-2-1									
40	T_1	Thermal Resistance Between Conductor and Screen	[K.m/W]	0.30149	0.30149	0.30149	0.30149	0.30149	0.30149

41	t_1	Insulation Thickness Between Conductor and Screen	[mm]	22.8	22.8	22.8	22.8	22.8	22.8
42	ρTi	Thermal Resistivity of Insulation	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5
43	T_3	Thermal Resistance of Jacket/Pipe Coating	[K.m/W]	0.03775	0.03775	0.03775	0.03775	0.03775	0.03775
44	t_3	Thickness of Jacket/Pipe Coating	[mm]	4.0	4.0	4.0	4.0	4.0	4.0
45	ρTJ	Thermal Resistivity of Jacket/Pipe Coating	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5
Cables Directly Buried									
46	L	Depth of Cable Axis	[m]	n/a	n/a	n/a	n/a	n/a	n/a
47	u	Coefficient Used in IEC 60287-2-1 Clause 2.2		n/a	n/a	n/a	n/a	n/a	n/a
48	T_4	Thermal Resistance of the Surrounding Medium	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a
49	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	n/a	n/a	n/a	n/a	n/a	n/a
50	I	Cable Core Current Ampacity	[A]	n/a	n/a	n/a	n/a	n/a	n/a
Cable in Ducts									
51	U	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		1.87	1.87	1.87	1.87	1.87	1.87
52	V	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.312	0.312	0.312	0.312	0.312	0.312
53	Y	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.0037	0.0037	0.0037	0.0037	0.0037	0.0037
54	θm	Mean Temperature of the Medium Filling the Space	[°C]	79.2	78.1	73.6	77.5	78.9	73.0
55	T_4'	Thermal Resistance of the Medium Inside the Duct/Pipe	[K.m/W]	0.22294	0.22426	0.22994	0.22501	0.22334	0.23063
56	Do	Outside Diameter of the Duct/Pipe	[mm]	200.0	200.0	200.0	200.0	200.0	200.0
57	Di	Inside Diameter of the Duct/Pipe	[mm]	180.0	180.0	180.0	180.0	180.0	180.0
58	ρT	Thermal Resistivity of the Duct/Pipe Material	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5
59	T_4''	Thermal Resistance of the Duct/Pipe	[K.m/W]	0.05869	0.05869	0.05869	0.05869	0.05869	0.05869
60	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	2.19545	2.15648	1.99193	2.13447	2.18335	1.97215
Ducts Buried in the soil									
61	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	2.19545	2.15648	1.99193	2.13447	2.18335	1.97215
62	T_4	Total External Thermal Resistance	[K.m/W]	2.47708	2.43943	2.28055	2.41817	2.46538	2.26147
63	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	0.0	0.0	0.0	0.0	0.0	0.0
64	I	Cable Core Current Ampacity	[A]	1480.0	1480.0	1480.0	1480.0	1480.0	1480.0

Study Summary

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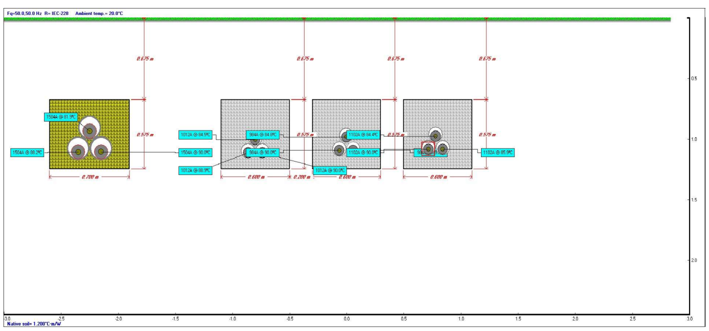
General Simulation Data

Steady State Option	Unequally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	20.0
Native Soil Thermal Resistivity	[K.m/W]	1.2
Consider Non-Isothermal Earth Surface		No

Layer Name	X [m]	Y [m]	Width [m]	Height [m]	Thermal Resistivity [K.m/W]
NSTD DB1	0.0	0.963	0.6	0.575	1.0
NSTD DB4	-2.25	0.963	0.7	0.575	1.0
NSTD DB3	0.8	0.963	0.6	0.575	1.0
NSTD DB2	-0.8	0.963	0.6	0.575	1.0



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [m]	Y coordinate [m]	Conductor temperature [°C]	Ampacity [A]
1	UBLIN CENTRA	1		A	50.0	1.0	-0.87	1.11	88.9	1012.0
2	UBLIN CENTRA	1		B	50.0	1.0	-0.73	1.11	90.0	1012.0
3	UBLIN CENTRA	1		C	50.0	1.0	-0.8	1.0	84.5	1012.0
4	UBLIN CENTRA	2		A	50.0	1.0	-0.07	1.09	90.0	983.9
5	UBLIN CENTRA	2		B	50.0	1.0	0.06	1.09	89.8	983.9
6	UBLIN CENTRA	2		C	50.0	1.0	0.0	0.98	84.8	983.9
7	UBLIN CENTRA	3		A	50.0	1.0	0.72	1.09	90.0	1102.4
8	UBLIN CENTRA	3		B	50.0	1.0	0.88	1.09	85.9	1102.4
9	UBLIN CENTRA	3		C	50.0	1.0	0.78	0.98	84.4	1102.4
10	ID 220KV 2500	4		A	50.0	1.0	-2.35	1.11	88.2	1504.4
11	ID 220KV 2500	4		B	50.0	1.0	-2.15	1.11	90.0	1504.4
12	ID 220KV 2500	4		C	50.0	1.0	-2.25	0.93	81.9	1504.4

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Steady State Summary

Simulation Data

Installation type:	Multiple Ductbanks
Steady State Option	Unequally Loaded
Ambient temperature [°C]	20
Native Soil Thermal Resistivity [K.m/W]	1.2
Consider Non-Isothermal Earth Surface	No
Consider effect of soil dry out	No
Consider Electrical interaction between circuits	No
Induced current in metallic layers as a fraction of conductor current (applied to all single phase circuits)	0

Variable	Description	Unit	Cables											
Cable No.	Cable Index Number		1	2	3	4	5	6	7	8	9	10	11	12
General Input Data														
Cable ID	Cable Equipment ID		DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Circuit No.	Circuit No.		1	1	1	2	2	2	3	3	3	4	4	4
Phase	Cable Phase		A	B	C	A	B	C	A	B	C	A	B	C
Fq	Operating Frequency	[Hz]	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
x	X coordinate	[m]	-0.87	-0.73	-0.8	-0.07	0.06	0.0	0.72	0.88	0.78	-2.35	-2.15	-2.25
y	Y coordinate	[m]	1.11	1.11	1.0	1.09	1.09	0.98	1.09	1.09	0.98	1.11	1.11	0.93
DLF	Daily Load Factor	[p.u.]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Bonding Type		1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular
Ampacity														
I	Steady State Ampacity	[A]	1012.0	1012.0	1012.0	983.9	983.9	983.9	1102.4	1102.4	1102.4	1504.4	1504.4	1504.4
Temperatures														
θc	Conductor temperature	[°C]	88.9	90.0	84.5	90.0	89.8	84.8	90.0	85.9	84.4	88.2	90.0	81.9
θs	Sheath/Shield temperature	[°C]	84.2	85.3	79.9	85.5	85.3	80.4	84.4	80.4	78.9	81.0	82.7	74.8
θa	Armour temperature	[°C]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
θsurf	Cable surface temperature	[°C]	83.3	84.4	79.0	84.7	84.4	79.6	83.4	79.4	77.8	80.0	81.8	73.8
θduct	Duct surface temperature	[°C]	77.7	78.8	73.3	79.4	79.2	74.3	76.8	72.7	71.2	72.7	74.5	66.4
Resistances														
R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0072	0.0072	0.0072
R	AC Resistance of the Conductor at Operating Temperature	[Ω/km]	0.01671	0.01675	0.01654	0.01677	0.01676	0.01657	0.01666	0.0165	0.01644	0.01027	0.01032	0.01011
ys	Skin Effect Factor		0.13659	0.13576	0.13992	0.13576	0.13593	0.13967	0.13574	0.13882	0.14004	0.11022	0.1091	0.11422
yp	Proximity Effect Factor		0.02717	0.02702	0.02777	0.02789	0.02793	0.02862	0.02035	0.02076	0.02093	0.01467	0.01454	0.01517
Losses														
Wc	Conductor Losses	[W/m]	17.11435	17.15901	16.94134	16.2304	16.22169	16.03701	20.24277	20.04961	19.97537	23.24236	23.34684	22.8825
Wd	Dielectric Losses	[W/m]	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	1.49477	1.49477	1.49477
Ws	Metallic Screen Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.98793	0.98232	1.00779
Wa	Armor/Pipe Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wt	Total Losses	[W/m]	17.53946	17.58412	17.36646	16.65551	16.6468	16.46213	20.66789	20.47472	20.40049	25.72505	25.82392	25.38506
λ_1	Screen Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04251	0.04207	0.04404
λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal resistances														
T1	Thermal resistance of insulation	[K.m/W]	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.30149	0.30149	0.30149
T2	Thermal resistance of bedding/medium inside pipe-type	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
T3	Thermal resistance of outer covering	[K.m/W]	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.03775	0.03775	0.03775
T4	External thermal resistance	[K.m/W]	0.98641	0.98395	1.0115	0.98021	0.97881	1.01016	0.97624	0.98036	0.98949	0.89114	0.88378	0.88042
Others														
Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	46.0	47.1	41.4	48.3	48.1	42.9	43.2	39.3	37.7	37.1	38.9	31.5
	Induced Voltage (standing) on Sheath	[V/km]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0	0.0	0.0
	Induced Voltage (standing) on Concentric Wires	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Induced current on Metallic Screen	[A]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cable Parameters under Normal Operation

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No.	Symbol	Description	Unit	Cable No.1	Cable No.2	Cable No.3	Cable No.4	Cable No.5	Cable No.6	Cable No.7	Cable No.8	Cable No.9	Cable No.10	Cable No.11	Cable No.12
1		Cable Equipment ID		DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU	EIRGRID 220KV 2500 SQ CU
Normal Operation IEC 60287-1-1															
Conductor AC Resistance															
2	R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0072	0.0072	0.0072
3	R'	DC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01436	0.01441	0.01417	0.01441	0.0144	0.01418	0.01441	0.01423	0.01416	0.00913	0.00918	0.00895
4	dc	Conductor Diameter	[mm]	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	63.5	63.5	63.5
5	s	Distance Between Conductor Axes	[mm]	129.0052	129.0052	129.0052	126.99998	126.99998	126.99998	148.44398	148.44398	148.44398	201.42263	201.42263	201.42263
6	ks	Factor Used for xs Calculation (Skin Effect)		0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.35	0.35	0.35
7	kp	Factor Used for xp Calculation (Proximity Effect)		0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.2	0.2	0.2
8	xs	Component of Ys Calculation (Skin Effect)		2.32942	2.3254	2.34523	2.3254	2.32623	2.34404	2.32533	2.34003	2.34577	2.1949	2.18875	2.21651
9	xp	Component of Yp Calculation (Proximity Effect)		1.79951	1.7964	1.81172	1.7964	1.79704	1.8108	1.79634	1.8077	1.81213	1.65919	1.65454	1.67552
10	ys	Skin Effect Factor		0.13659	0.13576	0.13992	0.13576	0.13593	0.13967	0.13574	0.13882	0.14004	0.11022	0.1091	0.11422
11	yp	Proximity Effect Factor		0.02717	0.02702	0.02777	0.02789	0.02793	0.02862	0.02035	0.02076	0.02093	0.01467	0.01454	0.01517
12	R	AC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01671	0.01675	0.01654	0.01677	0.01676	0.01657	0.01666	0.0165	0.01644	0.01027	0.01032	0.01011
Dielectric Losses															
13	tanδ	Dielectric Loss Factor		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
14	ε	Insulation Relative Permitivity		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
15	C	Cable Capacitance	[μF/km]	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.295	0.295	0.295
16	U_0	Voltage	[kV]	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	127.01706	127.01706	127.01706
17	Wd	Cable Dielectric Losses Per Phase	[W/m]	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	1.49477	1.49477	1.49477
Circulating Loss Factor															
18	λ'_1	Screen Loss Factor Caused by Circulating Current		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eddy Loss Factor															
19	Rs	AC Resistance used for Eddy Loss Factor computation	[Ω/km]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.51513	0.5181	0.50488
20	d	Mean diameter used for Eddy Loss Factor computation	[mm]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	109.3	109.3	109.3
21	ρs	Electrical Resistivity used for Eddy Loss Factor computation	[Ω.m]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0	0.0	0.0
22	Ds	External diameter used for Eddy Loss Factor computation	[mm]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	109.5	109.5	109.5
23	ts	Thickness used for Eddy Loss Factor computation	[mm]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.2	0.2	0.2
24	β_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	105.63801	105.33469	106.70525
25	gs	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.00017	1.00017	1.00017
27	m	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.06099	0.06064	0.06222
28	λ_0	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00082	0.00081	0.00085
29	Δ_1	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.03531	0.03532	0.03526
30	Δ_2	Coefficient used in IEC 60287-1-1 Clause 2.3.6.1		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0	0.0	0.0
31	F	Milliken conductor Effect		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.0	1.0	1.0
32	Fpipe	Magnetic effect factor due to pipe		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.0	1.0	1.0
33	Farmour	Magnetic effect factor due to armour		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.0	1.0	1.0
34	λ''_1	Screen Loss Factor Caused by Eddy Current		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04251	0.04207	0.04404
Metallic Screen Loss factor															
35	λ_1	Screen Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04251	0.04207	0.04404
Armour and Pipe Loss Factor															
36	λ_2a	Armour Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	$\lambda_2$pipe	Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Normal Operation IEC 60287-2-1															
40	T_1	Thermal Resistance Between Conductor and Screen	[K.m/W]	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.30149	0.30149	0.30149
41	t_1	Insulation Thickness Between Conductor and Screen	[mm]	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	22.8	22.8	22.8
42	ρTi	Thermal Resistivity of Insulation	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
43	T_3	Thermal Resistance of Jacket/Pipe Coating	[K.m/W]	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.03775	0.03775	0.03775
44	t_3	Thickness of Jacket/Pipe Coating	[mm]	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
45	ρTJ	Thermal Resistivity of Jacket/Pipe Coating	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Cables Directly Buried															
46	L	Depth of Cable Axis	[m]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
47	u	Coefficient Used in IEC 60287-2-1 Clause 2.2		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
48	T_4	Thermal Resistance of the Surrounding Medium	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
49	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
50	I	Cable Core Current Ampacity	[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cable in Ducts															
51	U	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
52	V	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312
53	Y	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037
54	θm	Mean Temperature of the Medium Filling the Space	[°C]	80.7	81.9	76.4	82.3	82.1	77.2	80.4	76.4	74.8	77.1	78.9	70.9
55	T_4'	Thermal Resistance of the Medium Inside the Duct/Pipe	[K.m/W]	0.28595	0.28433	0.29243	0.28369	0.28403	0.29127	0.28643	0.2925	0.2949	0.22552	0.22333	0.2334
56	Do	Outside Diameter of the Duct/Pipe	[mm]	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	200.0	200.0	200.0
57	Di	Inside Diameter of the Duct/Pipe	[mm]	118.0	118.0	118.0	118.0	118.0	118.0	118.0	118.0	118.0	180.0	180.0	180.0
58	ρT	Thermal Resistivity of the Duct/Pipe Material	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
59	T_4''	Thermal Resistance of the Duct/Pipe	[K.m/W]	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.05869	0.05869	0.05869
60	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.66836	0.66752	0.68697	0.66441	0.66268	0.68679	0.65771	0.65576	0.66248	0.60693	0.60176	0.58832
Ducts Buried in the soil															
61	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.66836	0.66752	0.68697	0.66441	0.66268	0.68679	0.65771	0.65576	0.66248	0.60693	0.60176	0.58832
62	T_4	Total External Thermal Resistance	[K.m/W]	0.98641	0.98395	1.0115	0.98021	0.97881	1.01016	0.97624	0.98036	0.98949	0.89114	0.88378	0.88042
63	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	46.0	47.1	41.4	48.3	48.1	42.9	43.2	39.3	37.7	37.1	38.9	31.5

64	I	Cable Core Current Ampacity	[A]	1012.0	1012.0	1012.0	983.9	983.9	983.9	1102.4	1102.4	1102.4	1504.4	1504.4	1504.4

Study Summary

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario H
Date:	21/03/2024 14:22:51

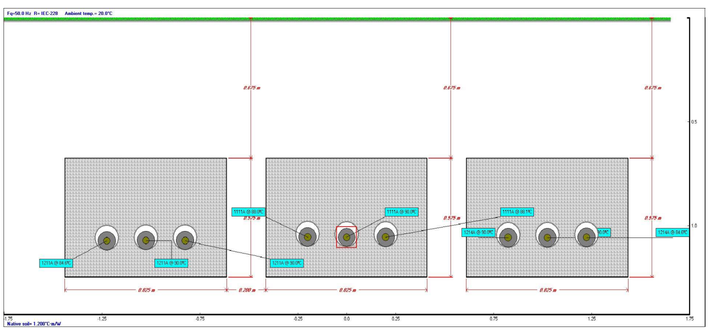
General Simulation Data

Steady State Option	Unequally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	20.0
Native Soil Thermal Resistivity	[K.m/W]	1.2
Consider Non-Isothermal Earth Surface		No

Layer Name	X [m]	Y [m]	Width [m]	Height [m]	Thermal Resistivity [K.m/W]
NSTD DB1	0.0	0.963	0.825	0.575	1.0
NSTD DB3	1.025	0.963	0.825	0.575	1.0
NSTD DB2	-1.025	0.963	0.825	0.575	1.0



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [m]	Y coordinate [m]	Conductor temperature [°C]	Ampacity [A]
1	DUBLIN CENTRAL	1		A	50.0	1.0	-1.23	1.07	84.6	1210.6
2	DUBLIN CENTRAL	1		B	50.0	1.0	-1.03	1.07	90.0	1210.6
3	DUBLIN CENTRAL	1		C	50.0	1.0	-0.83	1.07	90.0	1210.6
4	DUBLIN CENTRAL	2		A	50.0	1.0	-0.2	1.05	88.0	1111.5
5	DUBLIN CENTRAL	2		B	50.0	1.0	0.0	1.05	90.0	1111.5
6	DUBLIN CENTRAL	2		C	50.0	1.0	0.2	1.05	88.1	1111.5
7	DUBLIN CENTRAL	3		A	50.0	1.0	0.83	1.06	90.0	1213.6
8	DUBLIN CENTRAL	3		B	50.0	1.0	1.03	1.06	90.0	1213.6
9	DUBLIN CENTRAL	3		C	50.0	1.0	1.23	1.06	84.6	1213.6

Steady State Summary

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario H
Date:	21/03/2024 14:22:51

Simulation Data

Installation type:	Multiple Ductbanks
Steady State Option	Unequally Loaded
Ambient temperature [°C]	20
Native Soil Thermal Resistivity [K.m/W]	1.2
Consider Non-Isothermal Earth Surface	No
Consider effect of soil dry out	No
Consider Electrical interaction between circuits	No
Induced current in metallic layers as a fraction of conductor current (applied to all single phase circuits)	0

Variable	Description	Unit	Cables								
Cable No.	Cable Index Number		1	2	3	4	5	6	7	8	9
General Input Data											
Cable ID	Cable Equipment ID		DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL
Circuit No.	Circuit No.		1	1	1	2	2	2	3	3	3
Phase	Cable Phase		A	B	C	A	B	C	A	B	C
Fq	Operating Frequency	[Hz]	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
x	X coordinate	[m]	-1.23	-1.03	-0.83	-0.2	0.0	0.2	0.83	1.03	1.23
y	Y coordinate	[m]	1.07	1.07	1.07	1.05	1.05	1.05	1.06	1.06	1.06
DLF	Daily Load Factor	[p.u.]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Bonding Type		1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat	1 Conductor Crossbonded Flat
Ampacity											
I	Steady State Ampacity	[A]	1210.6	1210.6	1210.6	1111.5	1111.5	1111.5	1213.6	1213.6	1213.6
Temperatures											
θc	Conductor temperature	[°C]	84.6	90.0	90.0	88.0	90.0	88.1	90.0	90.0	84.6
θs	Sheath/Shield temperature	[°C]	78.1	83.3	83.3	82.4	84.4	82.5	83.3	83.3	78.0
θa	Armour temperature	[°C]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
θsurf	Cable surface temperature	[°C]	76.8	82.1	82.1	81.4	83.3	81.4	82.0	82.1	76.8
θduct	Duct surface temperature	[°C]	68.8	74.2	74.1	74.7	76.7	74.7	74.1	74.1	68.7
Resistances											
R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
R	AC Resistance of the Conductor at Operating Temperature	[Ω/km]	0.01631	0.01653	0.01652	0.01645	0.01653	0.01645	0.01652	0.01653	0.01631
ys	Skin Effect Factor		0.13983	0.13575	0.13577	0.13725	0.13574	0.13721	0.13577	0.13574	0.13984
yp	Proximity Effect Factor		0.01147	0.01117	0.01117	0.01128	0.01116	0.01127	0.01117	0.01116	0.01147
Losses											
Wc	Conductor Losses	[W/m]	23.91137	24.22029	24.21864	20.31781	20.41532	20.32032	24.33656	24.33895	24.02724
Wd	Dielectric Losses	[W/m]	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512
Ws	Metallic Screen Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wa	Armor/Pipe Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wt	Total Losses	[W/m]	24.33649	24.64541	24.64376	20.74292	20.84044	20.74544	24.76168	24.76406	24.45235
λ_1	Screen Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal resistances											
T1	Thermal resistance of insulation	[K.m/W]	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195
T2	Thermal resistance of bedding/medium inside pipe-type	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
T3	Thermal resistance of outer covering	[K.m/W]	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144
T4	External thermal resistance	[K.m/W]	0.96475	0.9582	0.95307	0.94893	0.95219	0.94943	0.95171	0.9564	0.9624
Others											
Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	33.3	38.5	38.6	41.7	43.5	41.7	38.4	38.4	33.2
	Induced Voltage (standing) on Concentric Wires	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Induced current on Metallic Screen	[A]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cable Parameters under Normal Operation

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario H
Date:	21/03/2024 14:22:51

No.	Symbol	Description	Unit	Cable No.1	Cable No.2	Cable No.3	Cable No.4	Cable No.5	Cable No.6	Cable No.7	Cable No.8	Cable No.9
1		Cable Equipment ID		DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL
Normal Operation IEC 60287-1-1												
Conductor AC Resistance												
2	R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
3	R'	DC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01417	0.01441	0.01441	0.01432	0.01441	0.01432	0.01441	0.01441	0.01417
4	dc	Conductor Diameter	[mm]	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3
5	s	Distance Between Conductor Axes	[mm]	200.0	200.0	200.0	200.0	200.0	200.0	200.00005	200.00005	200.00005
6	ks	Factor Used for xs Calculation (Skin Effect)		0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
7	kp	Factor Used for xp Calculation (Proximity Effect)		0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
8	xs	Component of Ys Calculation (Skin Effect)		2.34482	2.32538	2.32548	2.33254	2.32533	2.33236	2.32548	2.32533	2.34485
9	xp	Component of Yp Calculation (Proximity Effect)		1.8114	1.79638	1.79646	1.80192	1.79634	1.80177	1.79646	1.79634	1.81143
10	ys	Skin Effect Factor		0.13983	0.13575	0.13577	0.13725	0.13574	0.13721	0.13577	0.13574	0.13984
11	yp	Proximity Effect Factor		0.01147	0.01117	0.01117	0.01128	0.01116	0.01127	0.01117	0.01116	0.01147
12	R	AC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01631	0.01653	0.01652	0.01645	0.01653	0.01645	0.01652	0.01653	0.01631
Dielectric Losses												
13	tanδ	Dielectric Loss Factor		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
14	ε	Insulation Relative Permitivity		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
15	C	Cable Capacitance	[μF/km]	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336
16	U_0	Voltage	[kV]	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853
17	Wd	Cable Dielectric Losses Per Phase	[W/m]	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512
Circulating Loss Factor												
18	λ'_1	Screen Loss Factor Caused by Circulating Current		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eddy Loss Factor												
19	λ''_1	Screen Loss Factor Caused by Eddy Current		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Metallic Screen Loss factor												
20	λ_1	Screen Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Armour and Pipe Loss Factor												
21	λ_2a	Armour Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	$\lambda_2$pipe	Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Normal Operation IEC 60287-2-1												
25	T_1	Thermal Resistance Between Conductor and Screen	[K.m/W]	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195
26	t_1	Insulation Thickness Between Conductor and Screen	[mm]	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
27	ρTi	Thermal Resistivity of Insulation	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
28	T_3	Thermal Resistance of Jacket/Pipe Coating	[K.m/W]	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144
29	t_3	Thickness of Jacket/Pipe Coating	[mm]	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
30	ρTJ	Thermal Resistivity of Jacket/Pipe Coating	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Cables Directly Buried												
31	L	Depth of Cable Axis	[m]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
32	u	Coefficient Used in IEC 60287-2-1 Clause 2.2		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
33	T_4	Thermal Resistance of the Surrounding Medium	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
34	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
35	I	Cable Core Current Ampacity	[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cable in Ducts												
36	U	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
37	V	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312
38	Y	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037
39	θm	Mean Temperature of the Medium Filling the Space	[°C]	73.2	78.5	78.5	78.4	80.3	78.4	78.4	78.5	73.1
40	T_4'	Thermal Resistance of the Medium Inside the Duct/Pipe	[K.m/W]	0.29746	0.28926	0.2893	0.28951	0.28655	0.28943	0.28938	0.28932	0.29757
41	Do	Outside Diameter of the Duct/Pipe	[mm]	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
42	Di	Inside Diameter of the Duct/Pipe	[mm]	118.0	118.0	118.0	118.0	118.0	118.0	118.0	118.0	118.0
43	ρT	Thermal Resistivity of the Duct/Pipe Material	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
44	T_4''	Thermal Resistance of the Duct/Pipe	[K.m/W]	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321
45	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.63519	0.63684	0.63167	0.62732	0.63354	0.6279	0.63022	0.63498	0.63273
Ducts Buried in the soil												
46	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.63519	0.63684	0.63167	0.62732	0.63354	0.6279	0.63022	0.63498	0.63273
47	T_4	Total External Thermal Resistance	[K.m/W]	0.96475	0.9582	0.95307	0.94893	0.95219	0.94943	0.95171	0.9564	0.9624
48	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	33.3	38.5	38.6	41.7	43.5	41.7	38.4	38.4	33.2

49	I	Cable Core Current Ampacity	[A]	1210.6	1210.6	1210.6	1111.5	1111.5	1111.5	1213.6	1213.6	1213.6

	Study Summary
CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario I
Date:	21/03/2024 14:16:15

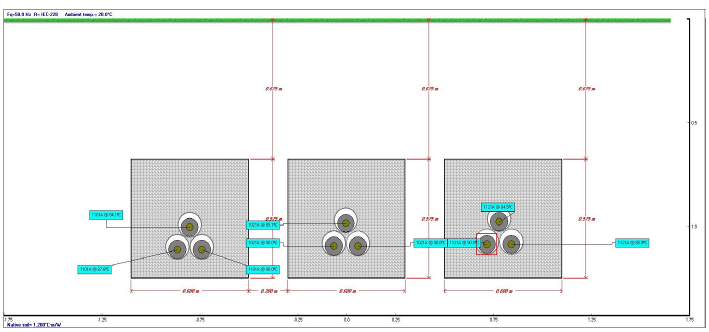
General Simulation Data

Steady State Option	Unequally Loaded
Consider Electrical interaction between circuits	No
Induced currents in metallic layers as a fraction of conductor current (applied to all single phase circuits) :	0.0
Conductor Resistances Computation Option:	IEC-228

Installation Type:Multiple Ductbanks/Backfills

Ambient Soil Temperature at Installation Depth	[°C]	20.0
Native Soil Thermal Resistivity	[K.m/W]	1.2
Consider Non-Isothermal Earth Surface		No

Layer Name	X [m]	Y [m]	Width [m]	Height [m]	Thermal Resistivity [K.m/W]
NSTD DB1	0.0	0.963	0.6	0.575	1.0
NSTD DB3	0.8	0.963	0.6	0.575	1.0
NSTD DB2	-0.8	0.963	0.6	0.575	1.0



Results Summary

Cable No.	Cable ID	Circuit No.	Feeder ID	Cable Phase	Cable Frequency	Daily Load Factor	X coordinate [m]	Y coordinate [m]	Conductor temperature [°C]	Ampacity [A]
1	DUBLIN CENTRAL	1		A	50.0	1.0	-0.87	1.11	87.6	1101.2
2	DUBLIN CENTRAL	1		B	50.0	1.0	-0.73	1.11	90.0	1101.2
3	DUBLIN CENTRAL	1		C	50.0	1.0	-0.8	1.0	84.1	1101.2
4	DUBLIN CENTRAL	2		A	50.0	1.0	-0.07	1.09	90.0	1021.0
5	DUBLIN CENTRAL	2		B	50.0	1.0	0.06	1.09	90.0	1021.0
6	DUBLIN CENTRAL	2		C	50.0	1.0	0.0	0.98	85.1	1021.0
7	DUBLIN CENTRAL	3		A	50.0	1.0	0.72	1.09	90.0	1121.1
8	DUBLIN CENTRAL	3		B	50.0	1.0	0.88	1.09	85.9	1121.1
9	DUBLIN CENTRAL	3		C	50.0	1.0	0.78	0.98	84.5	1121.1

	Steady State Summary
CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario I
Date:	21/03/2024 14:16:15

Simulation Data

Installation type:	Multiple Ductbanks
Steady State Option	Unequally Loaded
Ambient temperature [°C]	20
Native Soil Thermal Resistivity [K.m/W]	1.2
Consider Non-Isothermal Earth Surface	No
Consider effect of soil dry out	No
Consider Electrical interaction between circuits	No
Induced current in metallic layers as a fraction of conductor current (applied to all single phase circuits)	0

Variable	Description	Unit	Cables								
Cable No.	Cable Index Number		1	2	3	4	5	6	7	8	9
General Input Data											
Cable ID	Cable Equipment ID		DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL
Circuit No.	Circuit No.		1	1	1	2	2	2	3	3	3
Phase	Cable Phase		A	B	C	A	B	C	A	B	C
Fq	Operating Frequency	[Hz]	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
x	X coordinate	[m]	-0.87	-0.73	-0.8	-0.07	0.06	0.0	0.72	0.88	0.78
y	Y coordinate	[m]	1.11	1.11	1.0	1.09	1.09	0.98	1.09	1.09	0.98
DLF	Daily Load Factor	[p.u.]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Bonding Type		1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular	1 Conductor Crossbonded Triangular
Ampacity											
I	Steady State Ampacity	[A]	1101.2	1101.2	1101.2	1021.0	1021.0	1021.0	1121.1	1121.1	1121.1
Temperatures											
θc	Conductor temperature	[°C]	87.6	90.0	84.1	90.0	90.0	85.1	90.0	85.9	84.5
θs	Sheath/Shield temperature	[°C]	82.1	84.4	78.6	85.2	85.2	80.3	84.3	80.2	78.8
θa	Armour temperature	[°C]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
θsurf	Cable surface temperature	[°C]	81.0	83.3	77.5	84.2	84.3	79.4	83.2	79.1	77.7
θduct	Duct surface temperature	[°C]	74.4	76.7	70.8	78.6	78.6	73.7	76.3	72.3	70.8
Resistances											
R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
R	AC Resistance of the Conductor at Operating Temperature	[Ω/km]	0.01666	0.01675	0.01652	0.01677	0.01677	0.01658	0.01666	0.0165	0.01644
ys	Skin Effect Factor		0.13753	0.13575	0.14027	0.13576	0.13575	0.13947	0.13574	0.13884	0.13995
yp	Proximity Effect Factor		0.02734	0.02702	0.02783	0.0279	0.02789	0.02858	0.02035	0.02077	0.02092
Losses											
Wc	Conductor Losses	[W/m]	20.20563	20.31715	20.03805	17.4787	17.47961	17.28102	20.93667	20.73555	20.66515
Wd	Dielectric Losses	[W/m]	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512
Ws	Metallic Screen Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wa	Armor/Pipe Losses	[W/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wt	Total Losses	[W/m]	20.63075	20.74226	20.46316	17.90382	17.90472	17.70614	21.36179	21.16067	21.09027
λ_1	Screen Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thermal resistances											
T1	Thermal resistance of insulation	[K.m/W]	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195
T2	Thermal resistance of bedding/medium inside pipe-type	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
T3	Thermal resistance of outer covering	[K.m/W]	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144
T4	External thermal resistance	[K.m/W]	0.9929	0.98838	1.01622	0.98313	0.98103	1.01187	0.97881	0.98159	0.99031
Others											
Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	40.5	42.8	36.7	46.6	46.7	41.5	42.2	38.4	36.8
	Induced Voltage (standing) on Concentric Wires	[V/km]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Induced current on Metallic Screen	[A]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cable Parameters under Normal Operation

CYMCAP Version	7.2 Revision 3
Study:	DUBLIN CENTRAL
Execution:	Scenario I
Date:	21/03/2024 14:16:15

No.	Symbol	Description	Unit	Cable No.1	Cable No.2	Cable No.3	Cable No.4	Cable No.5	Cable No.6	Cable No.7	Cable No.8	Cable No.9
1		Cable Equipment ID		DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL	DUBLIN CENTRAL
Normal Operation IEC 60287-1-1												
Conductor AC Resistance												
2	R_0	DC Resistance of the conductor at 20°C	[Ω/km]	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113	0.0113
3	R'	DC Resistance of Conductor at Operating Temperature	[Ω/km]	0.0143	0.01441	0.01415	0.01441	0.01441	0.01419	0.01441	0.01423	0.01416
4	dc	Conductor Diameter	[mm]	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3
5	s	Distance Between Conductor Axes	[mm]	129.0052	129.0052	129.0052	126.99998	126.99998	126.99998	148.44398	148.44398	148.44398
6	ks	Factor Used for xs Calculation (Skin Effect)		0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
7	kp	Factor Used for xp Calculation (Proximity Effect)		0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
8	xs	Component of Ys Calculation (Skin Effect)		2.3339	2.32539	2.34689	2.32544	2.32536	2.34311	2.32532	2.34013	2.34539
9	xp	Component of Yp Calculation (Proximity Effect)		1.80296	1.79639	1.813	1.79643	1.79636	1.81008	1.79634	1.80778	1.81184
10	ys	Skin Effect Factor		0.13753	0.13575	0.14027	0.13576	0.13575	0.13947	0.13574	0.13884	0.13995
11	yp	Proximity Effect Factor		0.02734	0.02702	0.02783	0.0279	0.02789	0.02858	0.02035	0.02077	0.02092
12	R	AC Resistance of Conductor at Operating Temperature	[Ω/km]	0.01666	0.01675	0.01652	0.01677	0.01677	0.01658	0.01666	0.0165	0.01644
Dielectric Losses												
13	tanδ	Dielectric Loss Factor		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
14	ε	Insulation Relative Permitivity		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
15	C	Cable Capacitance	[μF/km]	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.336
16	U_0	Voltage	[kV]	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853	63.50853
17	Wd	Cable Dielectric Losses Per Phase	[W/m]	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512	0.42512
Circulating Loss Factor												
18	λ'_1	Screen Loss Factor Caused by Circulating Current		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eddy Loss Factor												
19	λ''_1	Screen Loss Factor Caused by Eddy Current		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Metallic Screen Loss factor												
20	λ_1	Screen Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Armour and Pipe Loss Factor												
21	λ_2a	Armour Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	$\lambda_2$pipe	Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	λ_2	Armour Loss Factor + Pipe Loss Factor		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Normal Operation IEC 60287-2-1												
25	T_1	Thermal Resistance Between Conductor and Screen	[K.m/W]	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195	0.27195
26	t_1	Insulation Thickness Between Conductor and Screen	[mm]	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
27	ρTi	Thermal Resistivity of Insulation	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
28	T_3	Thermal Resistance of Jacket/Pipe Coating	[K.m/W]	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144	0.05144
29	t_3	Thickness of Jacket/Pipe Coating	[mm]	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
30	ρTJ	Thermal Resistivity of Jacket/Pipe Coating	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Cables Directly Buried												
31	L	Depth of Cable Axis	[m]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
32	u	Coefficient Used in IEC 60287-2-1 Clause 2.2		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
33	T_4	Thermal Resistance of the Surrounding Medium	[K.m/W]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
34	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
35	I	Cable Core Current Ampacity	[A]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cable in Ducts												
36	U	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
37	V	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312
38	Y	Coefficient Used in IEC 60287-2-1 Clause 2.2.7.1		0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037
39	θm	Mean Temperature of the Medium Filling the Space	[°C]	78.0	80.4	74.5	81.7	81.7	76.8	80.1	76.0	74.6
40	T_4'	Thermal Resistance of the Medium Inside the Duct/Pipe	[K.m/W]	0.29	0.2865	0.29543	0.28456	0.28453	0.29178	0.28691	0.29304	0.29525
41	Do	Outside Diameter of the Duct/Pipe	[mm]	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
42	Di	Inside Diameter of the Duct/Pipe	[mm]	118.0	118.0	118.0	118.0	118.0	118.0	118.0	118.0	118.0
43	ρT	Thermal Resistivity of the Duct/Pipe Material	[K.m/W]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
44	T_4''	Thermal Resistance of the Duct/Pipe	[K.m/W]	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321	0.0321
45	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.6708	0.66977	0.68869	0.66647	0.6644	0.68798	0.6598	0.65644	0.66296
Ducts Buried in the soil												
46	T_4'''	Thermal Resistance of the Surrounding Medium	[K.m/W]	0.6708	0.66977	0.68869	0.66647	0.6644	0.68798	0.6598	0.65644	0.66296
47	T_4	Total External Thermal Resistance	[K.m/W]	0.9929	0.98838	1.01622	0.98313	0.98103	1.01187	0.97881	0.98159	0.99031
48	Δθint	Temperature Rise at the Surface of the Cable Due to Other Surrounding Elements	[°C]	40.5	42.8	36.7	46.6	46.7	41.5	42.2	38.4	36.8

49	I	Cable Core Current Ampacity	[A]	1101.2	1101.2	1101.2	1021.0	1021.0	1021.0	1121.1	1121.1	1121.1

APPENDIX C: MASTER LAYOUT

Client

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Powering Up Dublin

General Notes
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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	27.03.24	EM / DC	ISSUE FOR REVIEW & COMMENT	DC

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Scale: 1:500 @ A1
Created on: 27/03/2024
Sheets: 1 of 1

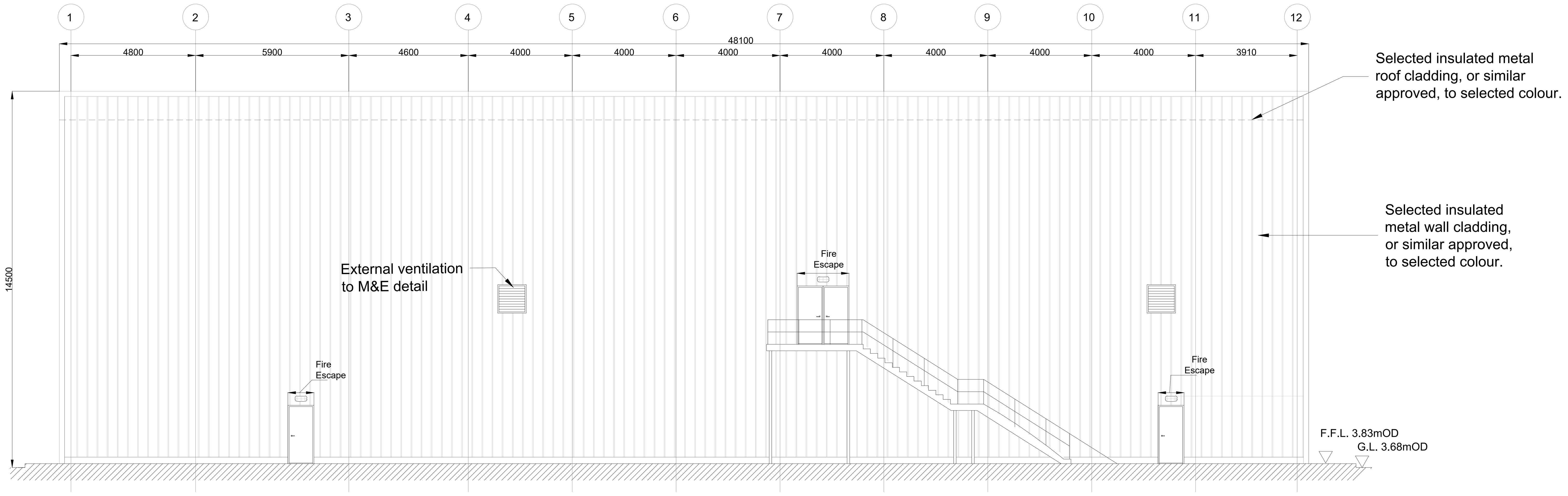
Project: **DUBLIN CENTRAL BULK SUPPLY POINT PROJECT**

Title: SUBSTATION COMPOUND
SITE LAYOUT PLAN
MASTER LAYOUT

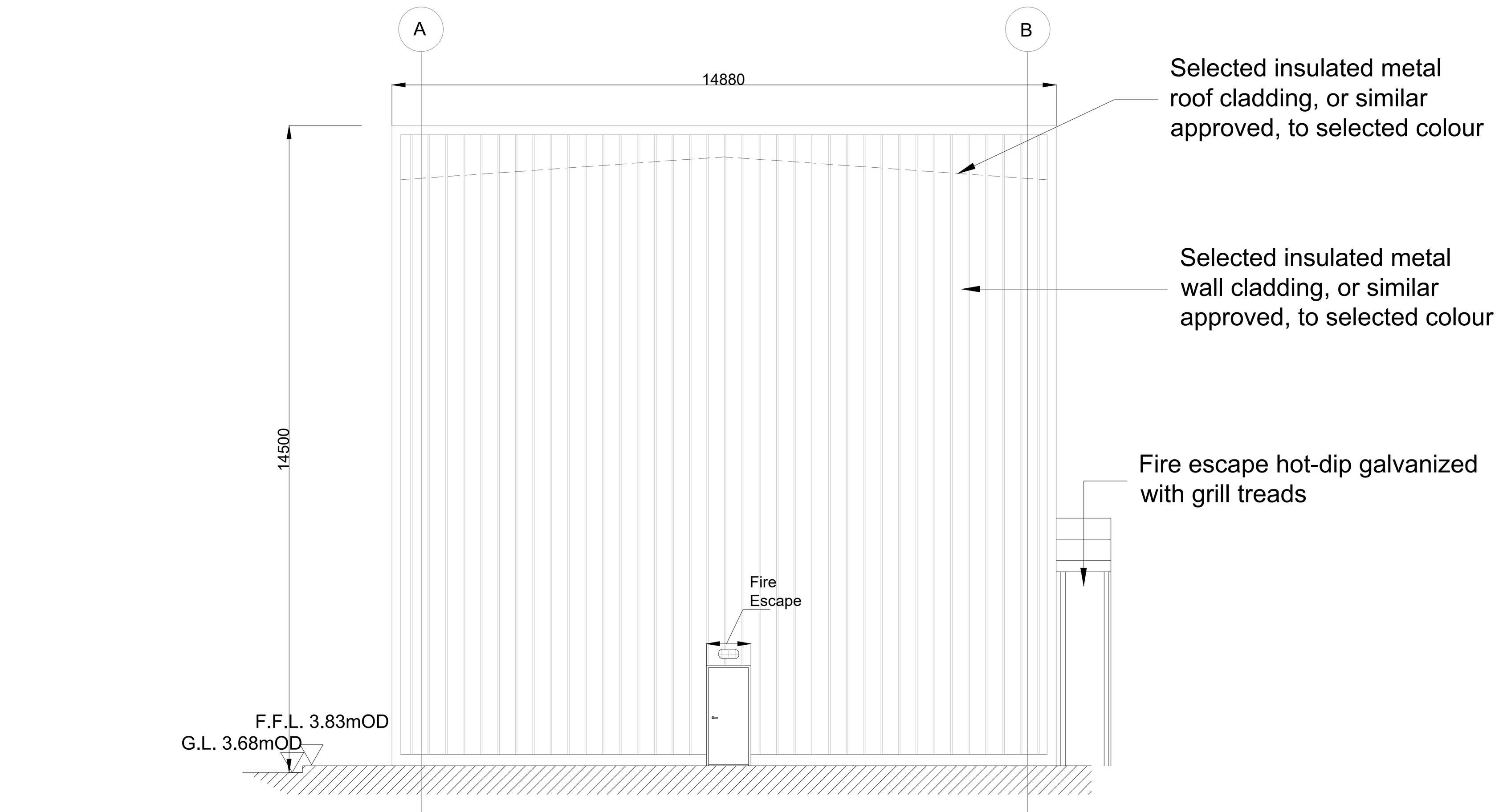
Drawing Number: CP1273-RPS-01-DW-XX-D-C-0002
Status: S3
Rev: P01

M:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-SL-D-C-0002 Substation Compound Site Layout Plan-Master Layout.dwg

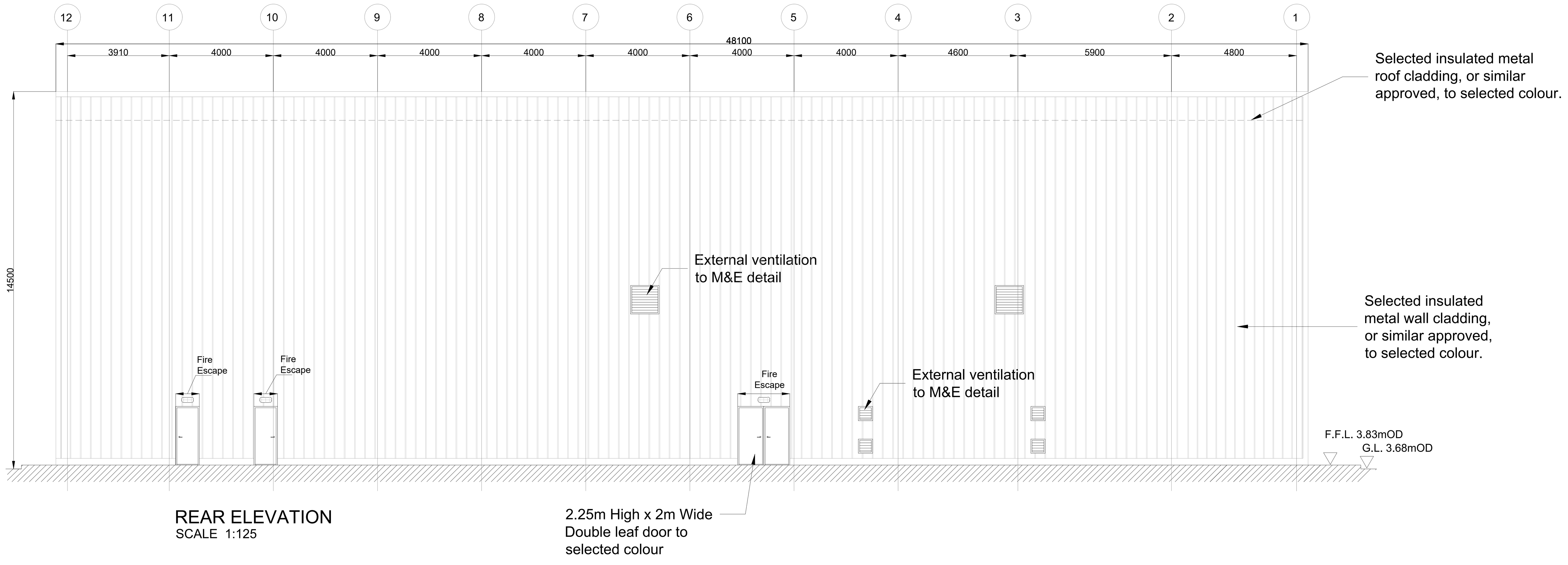
APPENDIX D: MASTER ELEVATIONS



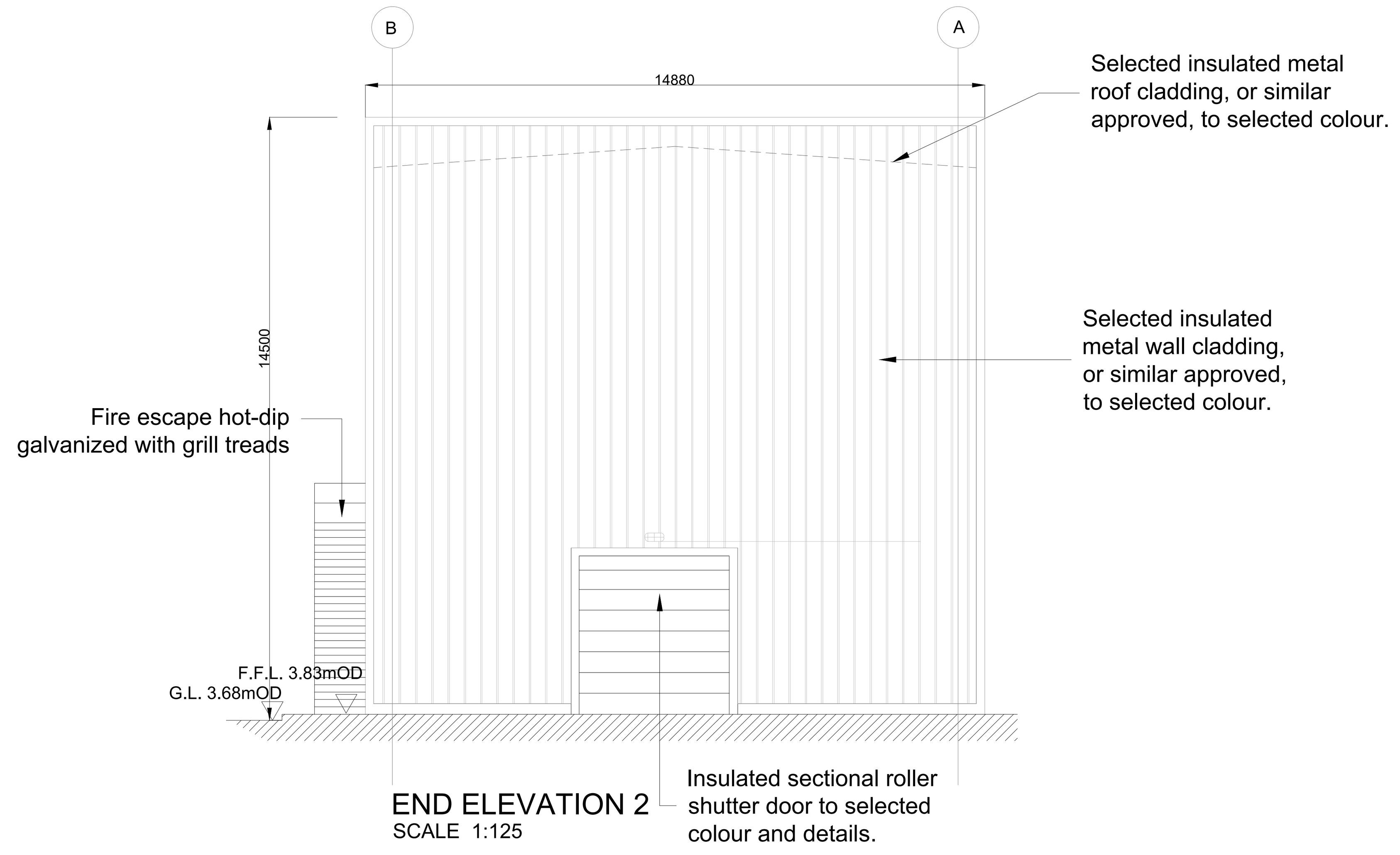
FRONT ELEVATION
SCALE 1:125



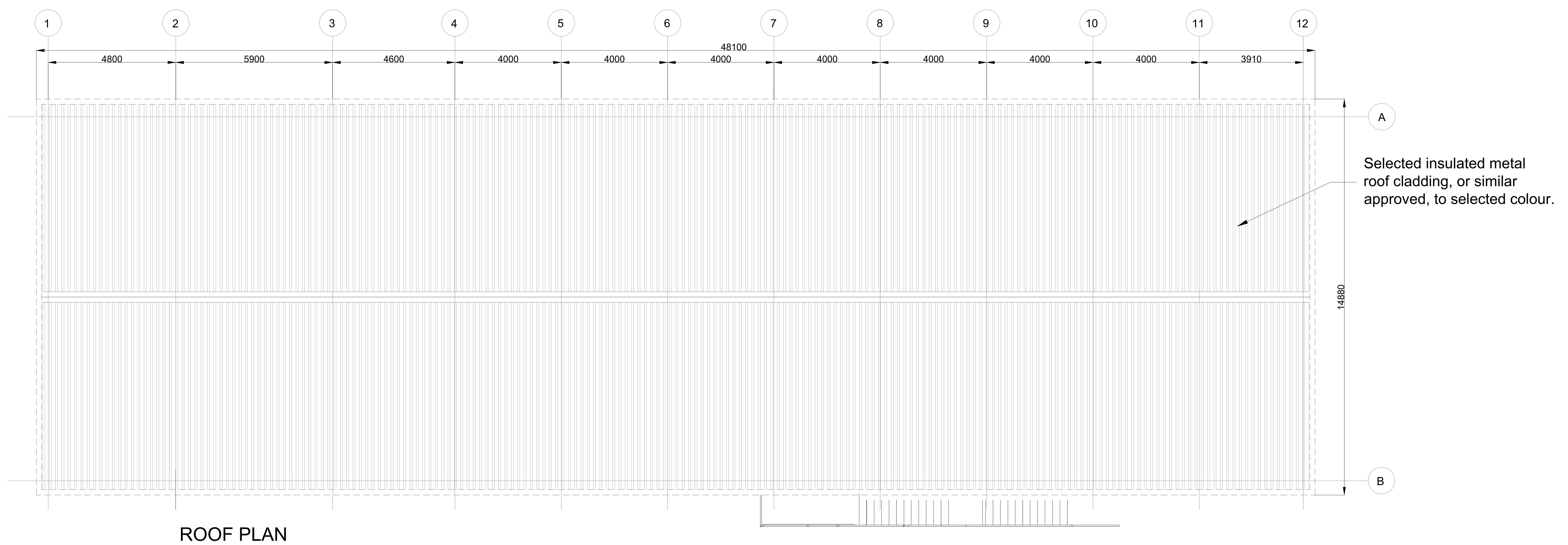
END ELEVATION 1
SCALE 1:125



REAR ELEVATION
SCALE 1:125



END ELEVATION 2
SCALE 1:125



ROOF PLAN
SCALE 1:125

NOTES

1. DESIGN IS FOR PLANNING PURPOSES ONLY.
2. DRAFT FOR CLIENT COMMENT AND IS NOT TO BE USED FOR CONSTRUCTION.
3. REQUIREMENT FOR LOUVERED VENTS IN SWITCH ROOM TBC BASED ON SWITCHGEAR MANUFACTURER REQUIREMENTS.
4. FLOOD LEVEL TO BE CONSIDERED TO ASCERTAIN THE GROUND LEVELS.

Client

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General Notes

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	27/03/24	EM DC	ISSUE FOR DISCUSSION & REVIEW	DC

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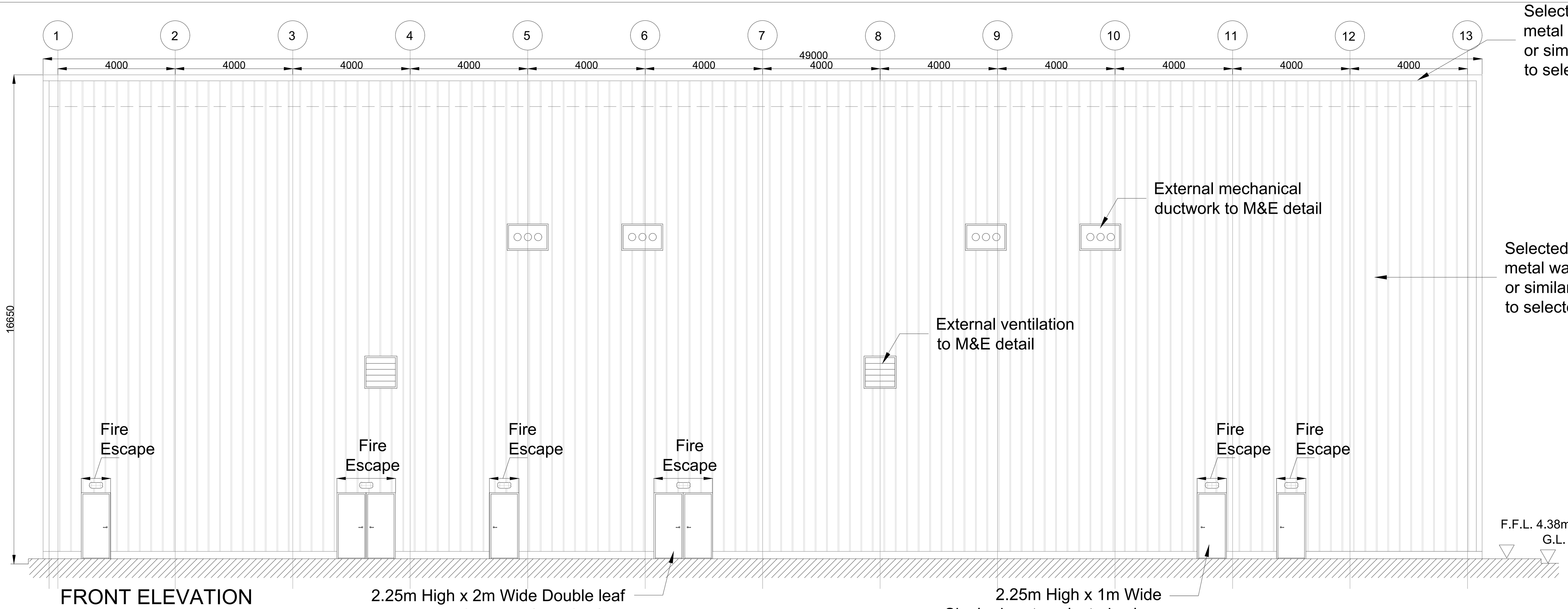
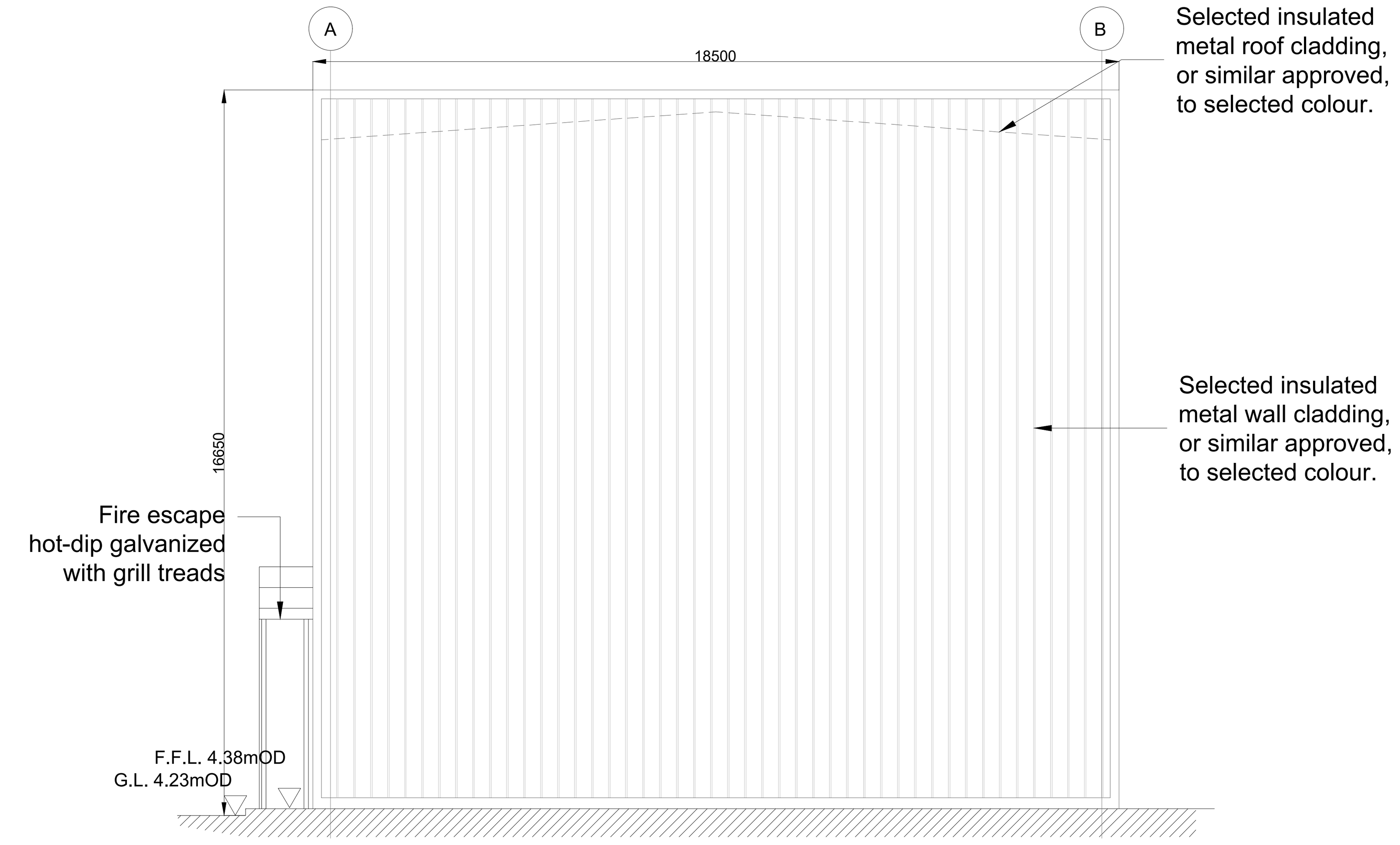
Scale	1:125 @ A1
Created on	27/03/2024
Sheets	1 of 1
Project	DUBLIN CENTRAL BULK SUPPLY POINT PROJECT
Title	110 KV GIS BUILDING ELEVATIONS
Drawing Number	CP1273-RPS-01-DW-XX-D-C-0004
Status	S3
Rev	P01

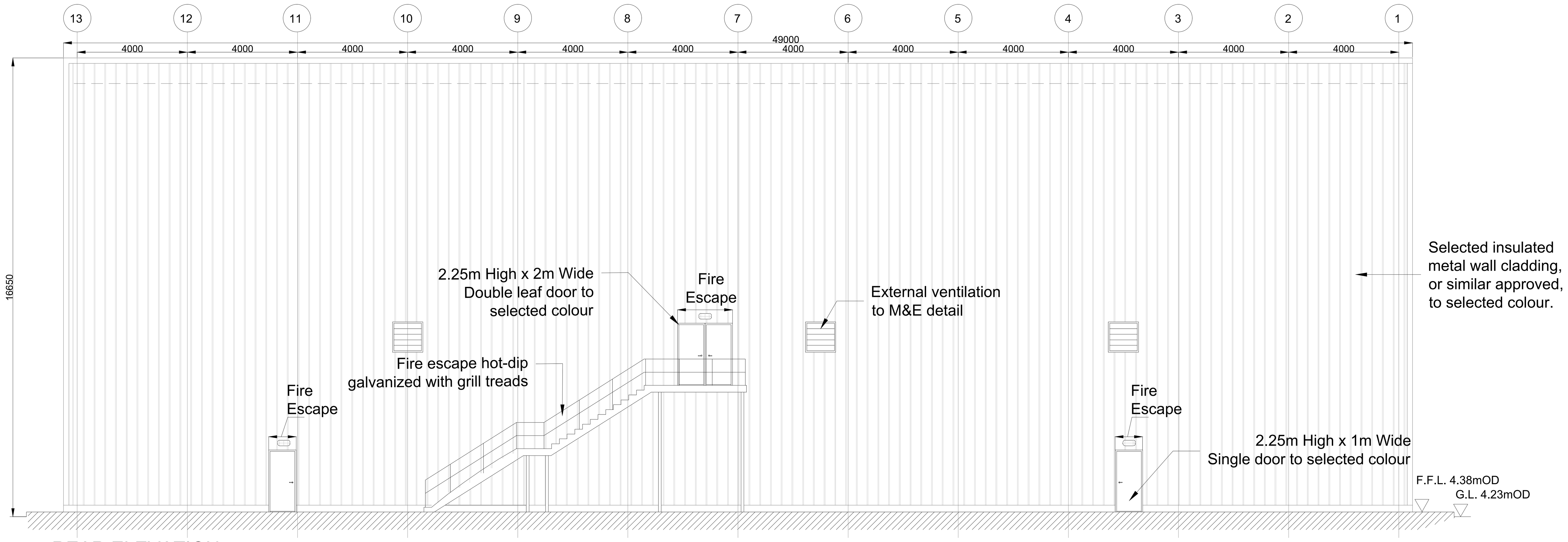
M:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-SL-D-C-0004 110KV GIS Building Elevations.dwg



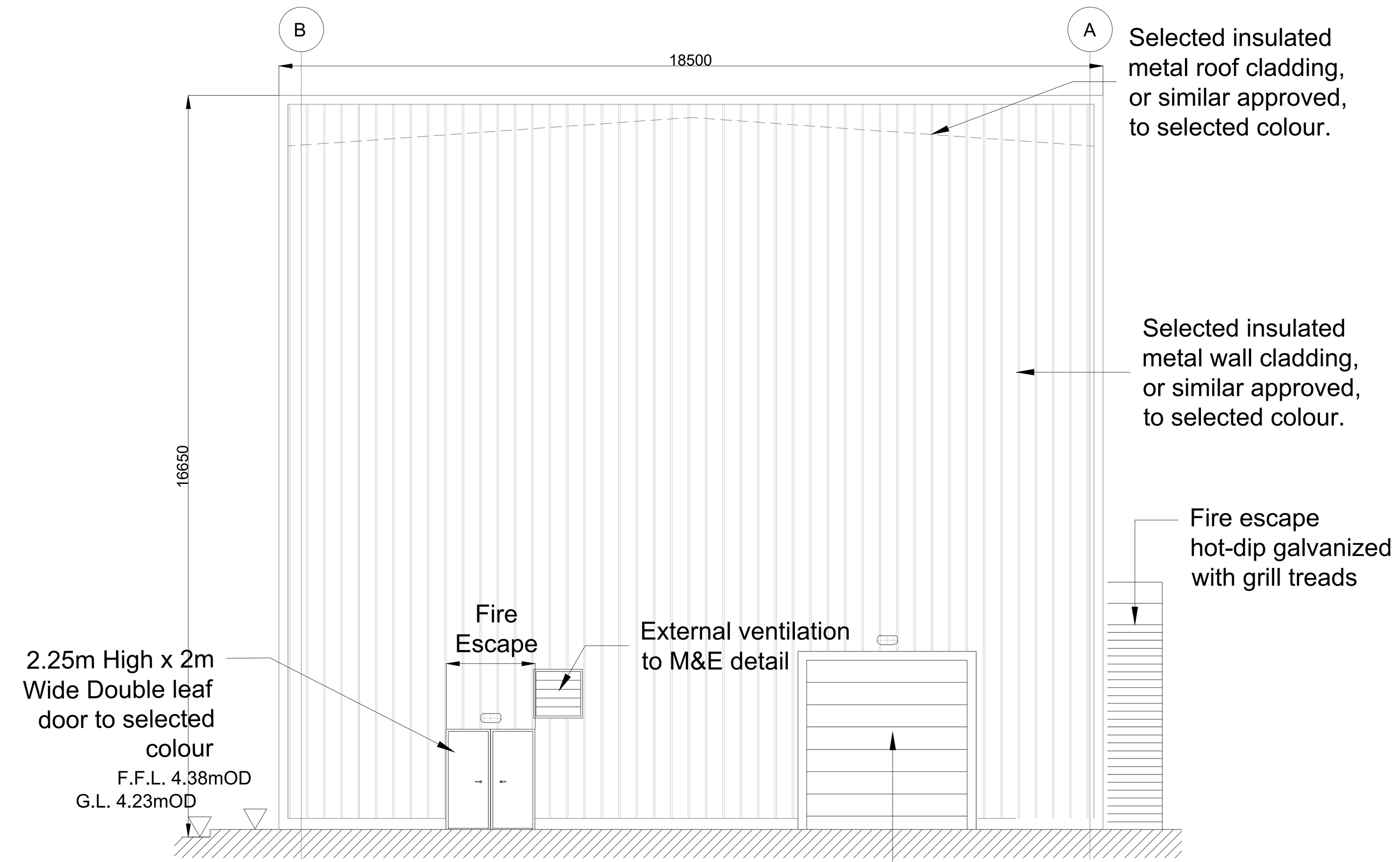
FRONT ELEVATION
SCALE 1:125



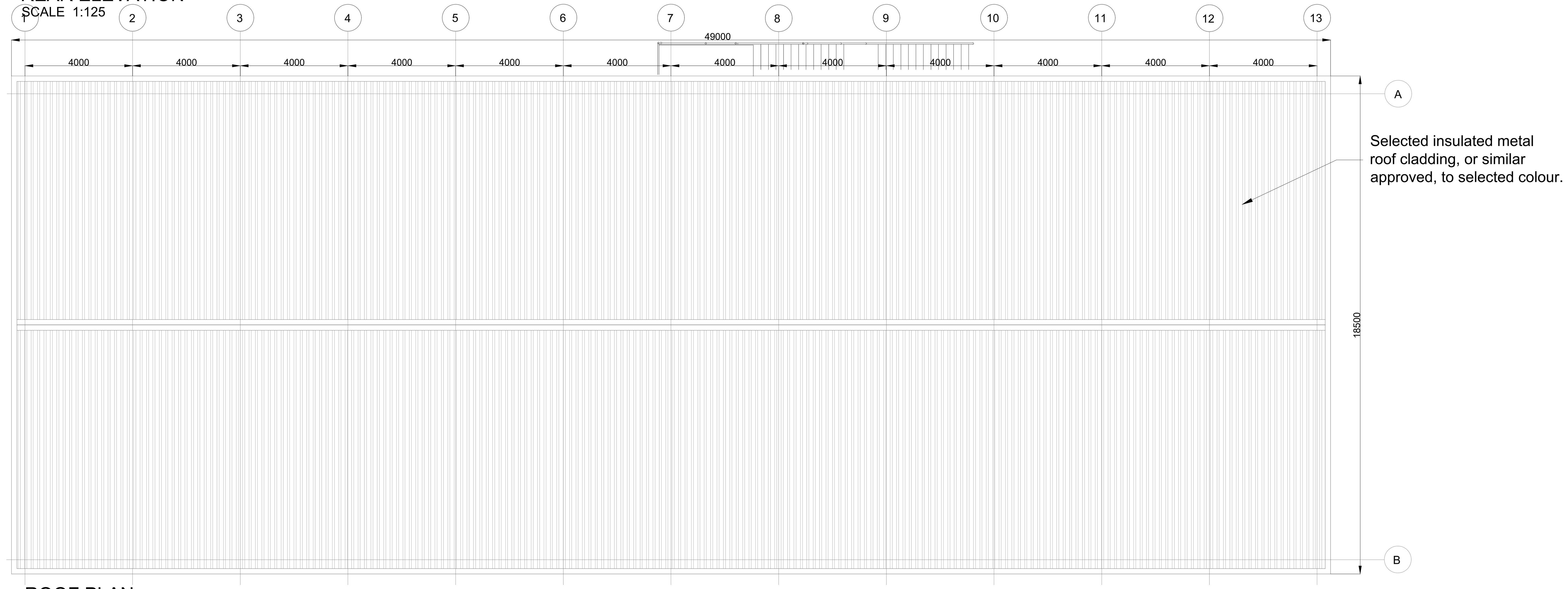
END ELEVATION 1
SCALE 1:125



REAR ELEVATION
SCALE 1:125



END ELEVATION 2
SCALE 1:125



ROOF PLAN
SCALE 1:125

NOTES

1. Units in millimeters (mm).
2. DESIGN IS FOR PLANNING PURPOSES ONLY.
3. DRAFT FOR CLIENT COMMENT AND IS NOT TO BE USED FOR CONSTRUCTION.
4. REQUIREMENT FOR LOUVERED VENTS IN SWITCH ROOM TBC BASED ON SWITCHGEAR MANUFACTURER REQUIREMENTS.
5. FLOOD LEVEL TO BE CONSIDERED TO ASCERTAIN THE GROUND LEVELS.

Client

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(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.
(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	27/03/24	EM / DC	ISSUE FOR REVIEW & COMMENT	DC

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Scale: 1:125 @ A1
Created on: 27/03/2024
Sheets: 1 of 1

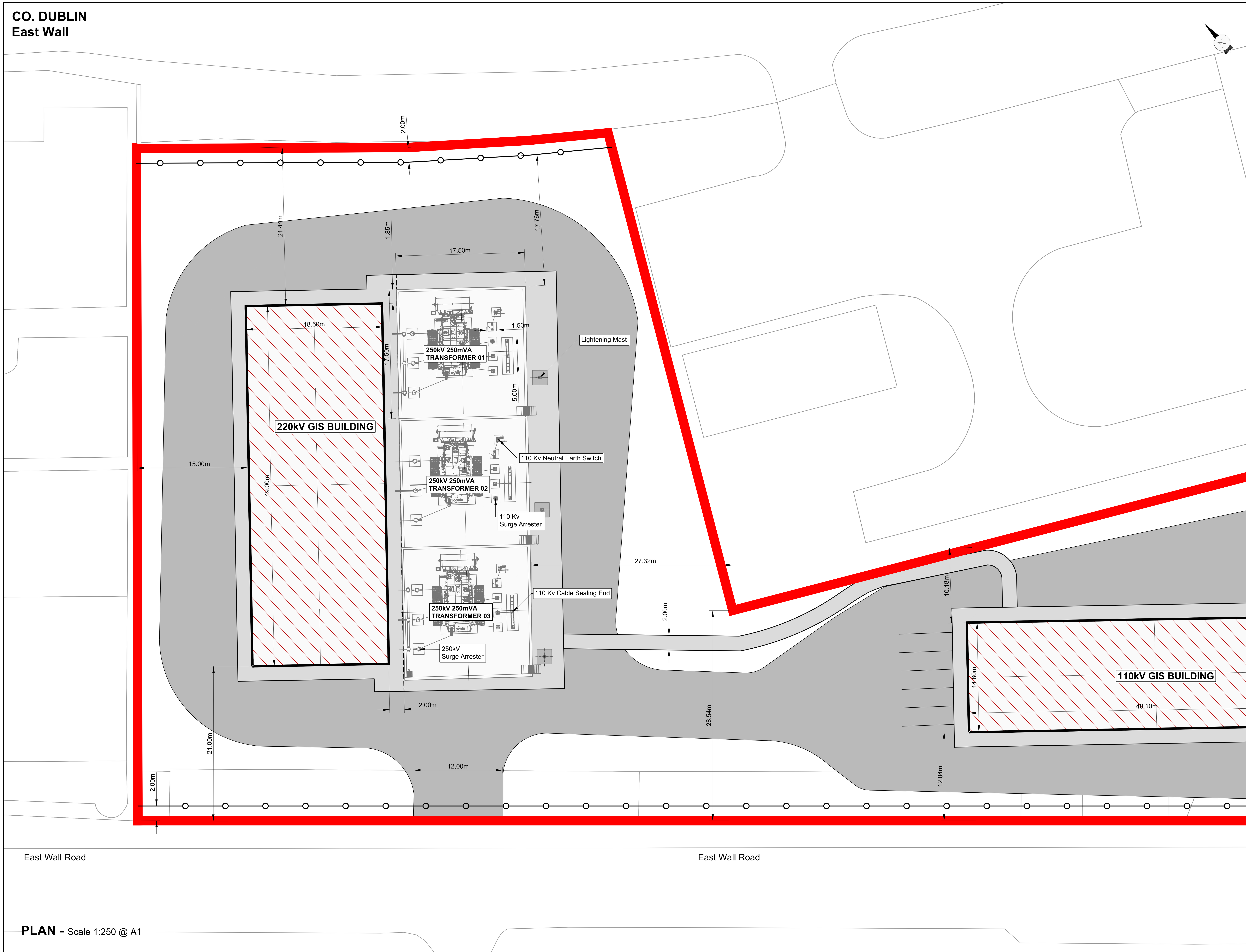
Project: DUBLIN CENTRAL BULK SUPPLY POINT PROJECT
Title: 220 KV GIS BUILDING ELEVATIONS

Drawing Number: CP1273-RPS-01-DW-XX-D-C-0005
Status: S3
Rev: P01

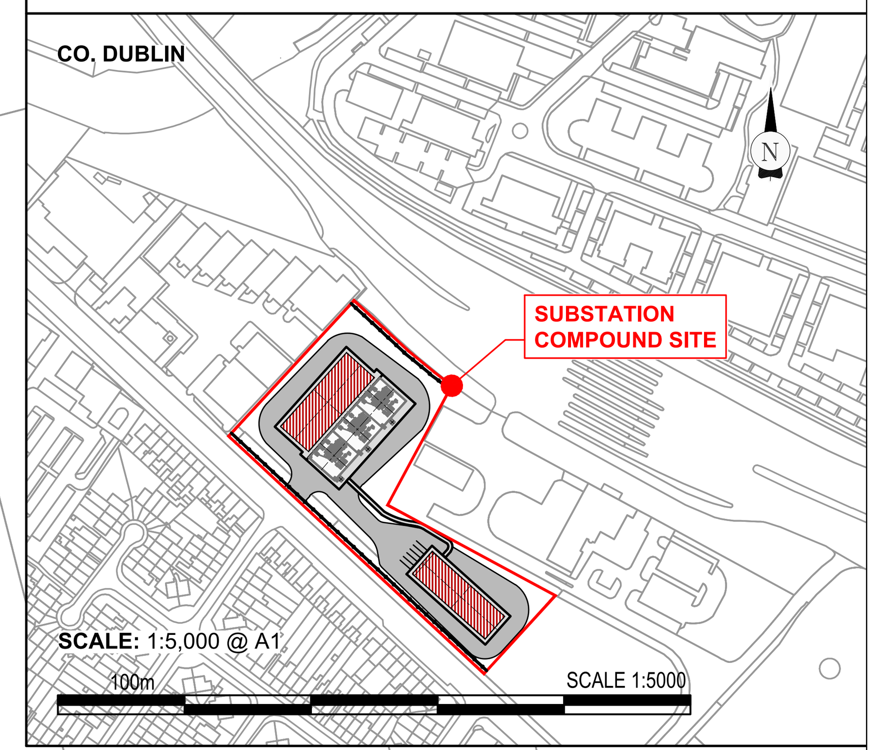
M:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-SL-D-C-0005 220KV GIS Building Elevations.dwg

APPENDIX E: PRIMARY PLANT VIEW

CO. DUBLIN
East Wall



KEY PLAN:



PLAN - Scale 1:250 @ A1

5m
SCALE 1:250

Client

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General Notes

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	27/03/2024	DB / DC	ISSUE FOR REVIEW & COMMENT	DC

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Scale: 1:250 @ A1
Created on: 27/03/2024
Sheets: 1 of 1

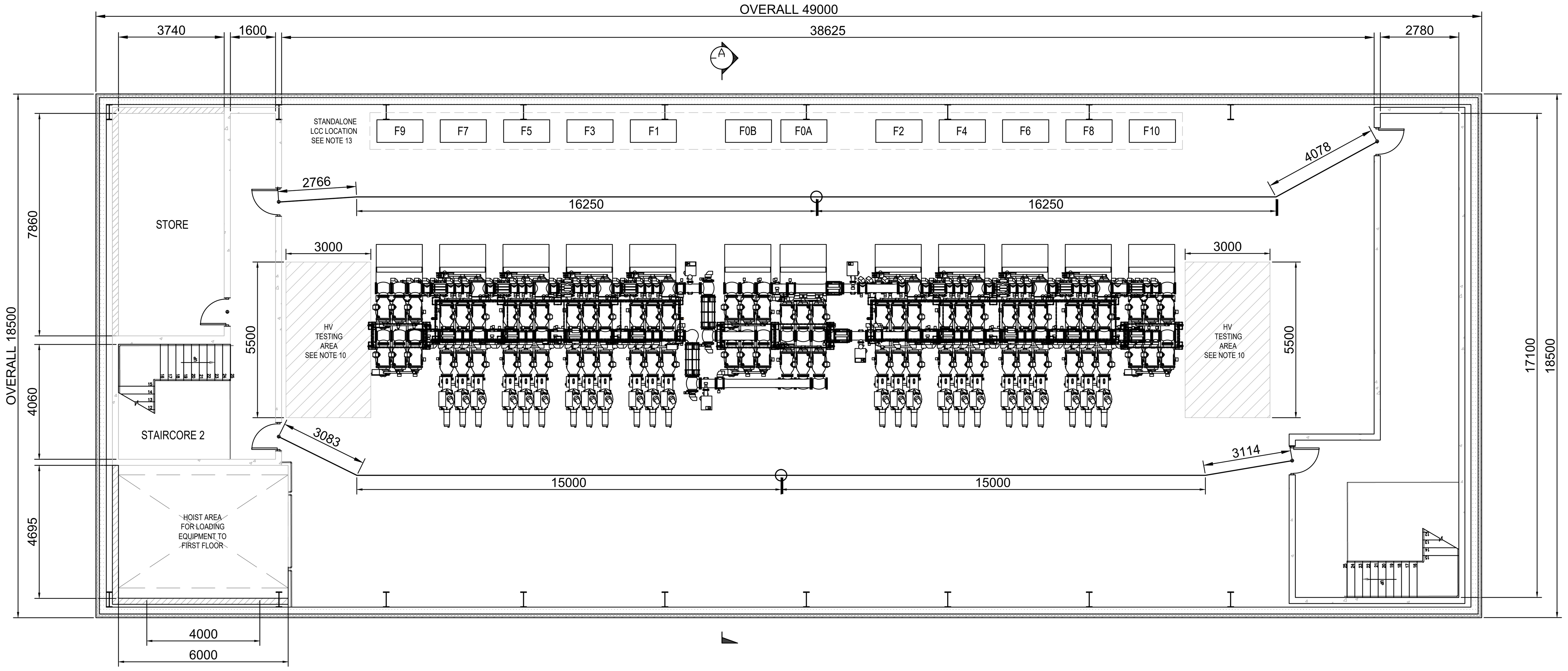
Project: DUBLIN CENTRAL BULK SUPPLY POINT PROJECT

Title: SUBSTATION COMPOUND - EQUIPMENT LAYOUT PLAN

Drawing Number: CP1273-RPS-01-DW-XX-D-C-0009
Status: S3
Rev: P01

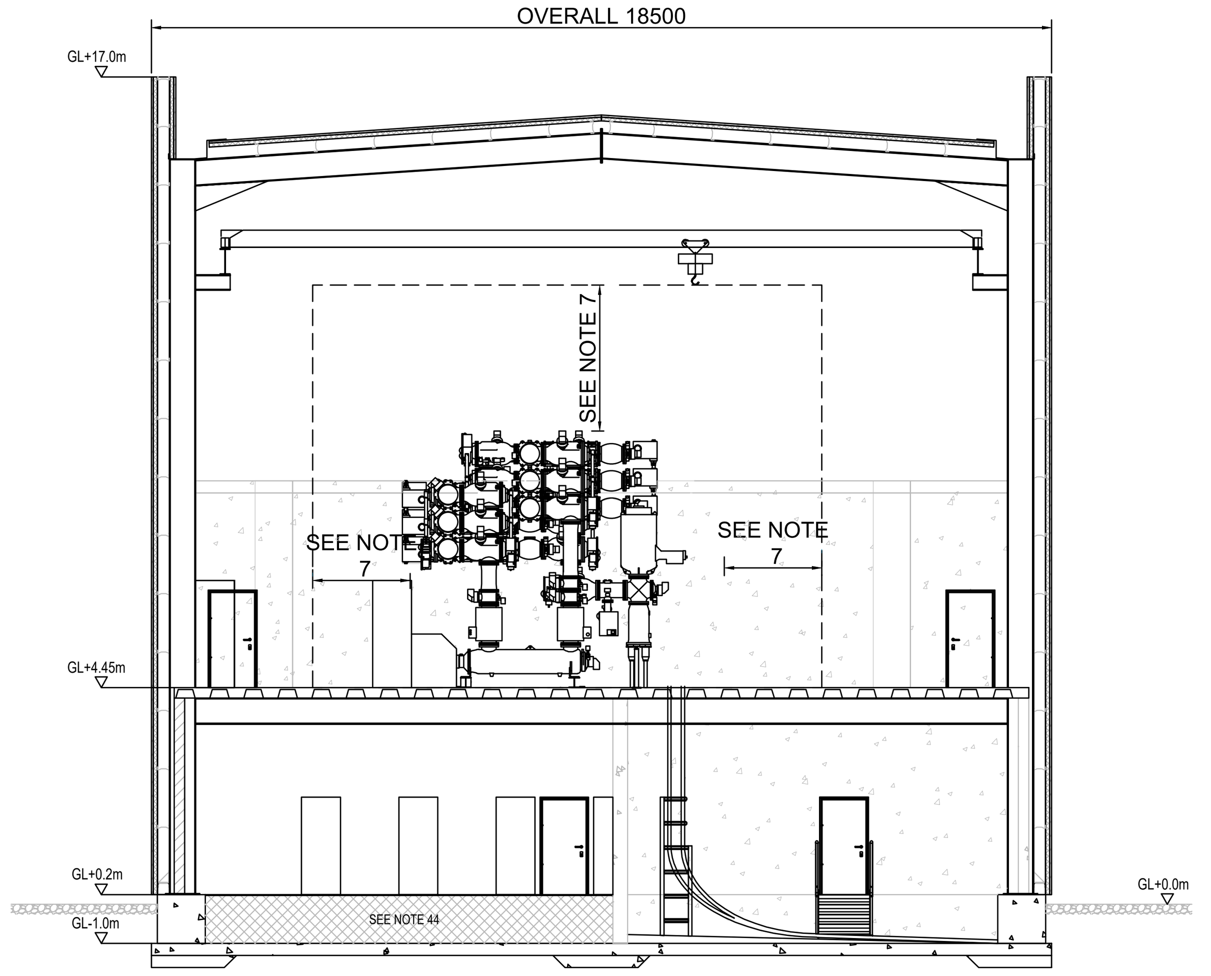
M:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-SL-D-C-0003 Substation Compound Equipment Layout Plan.dwg

APPENDIX F: CONTROL BUILDING LAYOUT



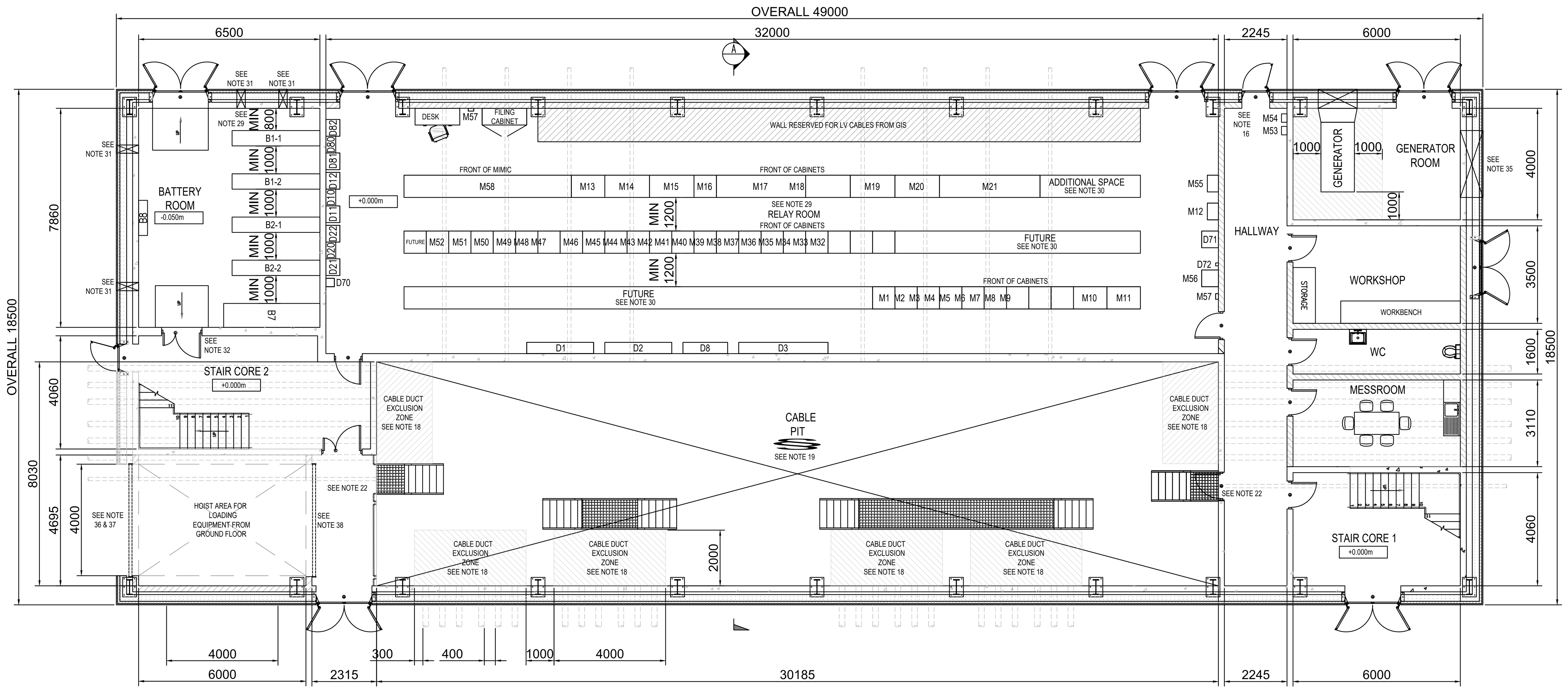
PLAN - FIRST FLOOR

SCALE: NTS



ELEVATION - SECTION A-A

SCALE: NTS



PLAN - GROUND FLOOR

SCALE: NTS

CABINET DESIGNATION	DESCRIPTION	DIMENSIONS
B1-1	220V DC BATTERY 1, STAND 1	3150x550
B1-2	220V DC BATTERY 1, STAND 2	3150x550
B2-1	220V DC BATTERY 2, STAND 1	3150x550
B2-2	220V DC BATTERY 2, STAND 2	3150x550
B7	48V DC TELECOMS BATTERY	3450x860
B8	48V DC STATION BATTERY	1260x320
D1	220V DC DISTRIBUTION BOARD 1	2400x400
D2	220V DC DISTRIBUTION BOARD 2	2400x400
D8	48V DC DISTRIBUTION BOARD	1600x400
D3	AC DISTRIBUTION BOARD	3200x400
D10	220V BATTERY No 1 CHARGER CHANGE VER SWIOCH & FUSE BOX	600x350
D11	220V BATTERY No 1: CHARGER 1 & BATTERY SUPERVISION	600x500
D12	220V BATTERY No 1: CHARGER 2 & BATTERY SUPERVISION	600x500
D20	220V BATTERY No 2 CHARGER CHANGE OVER SWITCH & FUSE BOX	600x350
D21	220V BATTERY No 2: CHARGER 1 & BATTERY SUPERVISION	600x500
D22	220V BATTERY No 2: CHARGER 2 & BATTERY SUPERVISION	600x500
D80	24/48V BATTERY: CHARGER CHANGE OVER SWITCH & FUSE BOX	600x350
D81	24/48V BATTERY: CHARGER 1 & BATTERY SUPERVISION	600x500
D82	24/48V BATTERY: CHARGER 2 & BATTERY SUPERVISION	600x500
D70	48V TELECOMS CONNECTION/FUSE BOX	
D71	48V SMPS (TELECOMS)	600x600
D72	TELECOMS ISOLATION SWITCH	100x100
M1	OPMUX 1	800x800
M2	OPMUX 2	800x800
M3	OPMUX 3	800x800
M4	ODF	800x800
M5	IP SERVICES	800x800
M6	48V DC (TELECOMS) DISTRIBUTION BOARD	600X600
M7	MAIN DISTRIBUTION FRAME	800x800
M8	NCC RTU 1 (INCL.GPS CLOCK)	800x800
M9	NCC RTU 2 (INCL.GPS CLOCK)	800x800
M10	TELEMETERING 1	1200x800
M11	TELEMETERING 2	1200x800
M12	DCC RTU	600x400
M13	SYNCHRONISING PANEL	1200x800
M14	EVENT RECORDER/AAP 1	1600x800
M15	EVENT RECORDER/AAP 2	1600x800
M16	BATTERY SUPERVISION	800x800
M17	SIGNAL INTERPOSING	3200x800
M18	BUSBAR PROTECTION 1	1600x800
M19	BUSBAR PROTECTION 2	1600x800
M20	BUSBAR PROTECTION 3	1600x800
M21	CUSTOMER INTERFACE	3200x800
M32	F9 COUPLER PROTECTION	800x800
M33	F7 PROTECTON	800x800
M34	F7 PROTECTION	800x800
M35	F5 PROTECTION	800x800
M36	F5 PROTECTION	800x800
M37	F3 PROTECTION	800x800
M38	F3 PROTECTION	800x800
M39	F1 PROTECTION	800x800
M40	F1 PROTECTION	800x800
M41	F0A SECTIONALISER PROTECTION	800x800
M42	F0B SECTIONALISER PROTECTION	800x800
M43	F2 PROTECTION	800x800
M44	F2 PROTECTION	800x800
M45	F4 PROTECTION	800x800
M46	F4 PROTECTION	800x800
M47	F6 PROTECTION	800x800
M48	F6 PROTECTION	800x800
M49	F8 PROTECTION	800x800
M50	F8 PROTECTION	800x800
M51	F10 COUPLER PROTECTION	800x800
M52	REMOTE INTERROGATION/DISTURBANCE RECORDER	800x800
M53	INTRUDER ALARM PANEL	
M54	FIRE ALARM PANEL	
M55	ETIE	600x400
M56	EIRGRID ENERGY METERING	800x800
M57	TELEPHONE POINTS (2No.)	
M58	MIMIC	6000x800

GENERAL

NOTE 1:
THIS DRAWING IS PRODUCED FOR INFORMATION PURPOSES ONLY ALL DIMENSIONS, REFERENCES (EG. LIGHTNING MAST LOCATIONS ETC). GIVEN ARE INDICATIVE AND SHOULD NOT BE USED AS PART OF A DETAILED DESIGN

NOTE 2:
THIS IS A CONCEPTUAL DESIGN DETAILED DESIGN IS REQUIRED PENDING CONFIRMATION OF SPECIFIC EQUIPMENT SUPPLIER AND SITE DETAILS

NOTE 3:
BUILDING HAS BEEN SPECIFICALLY DESIGNED T0 ACCOMMODATE 2 NO TRANSFORMER BAYS (CABLE CONNECTION) AND 6NO. FEEDER BAYS (CABLE CONNECTION).

NOTE 4:
WHERE THERE IS MORE THAN ONE MINIMUM DISTANCE STATED FOR A SPECIFIC AREA THE LARGEST MINIMUM DISTANCE SHOULD BE ADHERED TO

NOTE 5:
FIRE AND ATEX ZONES NOT SHOWN, THIS SHOULD BE CONSIDERED DURING DETAILED CUSTOMER DESIGN

NOTE 6:
CIVIL CALCULATIONS ARE TO BE CARRIED OUT AT THE DETAIL DESIGN STAGE AND TAKE INTO ACCOUNT SPECIFIC, EXISTING SITE GROUND CONDITIONS

SWITCH GEAR

NOTE 7 (AS ILLUSTRATED ON DRAWING) :
THE SWITCHGEAR SHOWN ON THIS DRAWING IS INDICATIVE ONLY DIMENSIONS OF THE OVERALL BUILDING SHALL BE DESIGNED TO SUIT MANUFACTURER SPECIFIC DIMENSIONS ENVELOPE AROUND THE SWITCHGEAR SHALL BE WITH MANUFACTURER RECOMMENDATIONS FOR ON-GOING OPERATION, MAINTENANCE AND REPLACEMENT OF HV PLANT

NOTE 8:
REQUIREMENT FOR GIS OVERPRESSURE VENTS TO BE CONFIRMED BY GIS SUPPLIER.

NOTE 9:
ALL OPES IN GIS ROOM FOR LV AND HV CABLES TO BE FIRE SEALED

NOTE 10 (AS ILLUSTRATED ON DRAWING) :
MINIMUM CLEAR AREA ON BOTH SIDES OF THE GIS FOR THE HV TEST EQUIPMENT IS 3000mm

NOTE 11:
LV CABLE ROUTING FOR FUTURE SWITCHGEAR BAYS SHALL BE CONSIDERED AS PART OF THE DETAILED DESIGN DIFFERENCES IN LENGTH BETWEEN THE RELAY ROOM AND THE SWITCHGEAR HALL MUST BE NOTED AT THE DETAIL DESIGN PHASE, WITH LV CABLING ROUTED ACCORDINGLY

NOTE 12:
SPECIFIC SWITCHROOM FLOOR REQUIREMENTS ARE TO SUIT THE MANUFACTURER'S SPECIFICATIONS AND ARE TO BE EVALUATED AT THE DETAIL DESIGN STAGE

NOTE 13:
BOTH OPTIONS OF LCC , INTEGRATED AND STANDALONE, HAVE BEEN SHOWN FOR INFORMATIONAL PURPOSES

NOTE 14:
HIGH FREQUENCY MESH IS TO BE LAID WITHIN THE GIS FLOOR AND SUIT SWITCHGEAR MANUFACTURER REQUIREMENTS FOR FURTHER DETAILS ON EIRGRID EARTHING REQUIREMENTS, REFER TO EIRGRID'S FUNCTIONAL SPECIFICATION XDS-GFS-12-001.

NOTE 15:
GIS ACCESS PLATFORMS SHOWN ARE INDICATIVE ONLY AND SHALL BE EVALUATED AT THE DETAIL DESIGN PHASE

HALLWAY

NOTE 16 (AS ILLUSTRATED ON DRAWING) :
FIRE AND ALARM PANELS TO BE LOCATED IN THE VICINITY OF THE MAIN ENTRANCE.

CABLE PITS

NOTE 17:
THE MAXIMUM LENGTH OF A CABLE THAT CAN BE PUSHED INTO THE CABLE ROOM IS 100m ROUTE LENGTH

NOTE 18 (AS ILLUSTRATED ON DRAWING) :
BUILDING DESIGNER AND CABLE DESIGNER SHALL CO-ORDINATE WORKS TO ENSURE THERE ARE NO OBSTRUCTIONS LOCATED 2m DIRECTLY IN FRONT OF THE CABLE DUCTS AND 300mm TO THE SIDE OF THE CABLE DUCT WHERE THE DUCT ENTERS THE CABLE ROOM

NOTE 19 (AS ILLUSTRATED ON DRAWING) :
ADEQUATE AREA TO BE PROVIDED IN THE VICINITY OF THE GIS BUILDING TO ALLOW SPACE FOR SETTING UP THE EQUIPMENT NEEDED FOR CABLE PULLING OPERATIONS THIS AREA IS APPROX. 12m X 12m FOR EACH CABLE CIRCUIT, CABLE DESIGNER TO CONSIDER.

NOTE 20:
AN OPENING MUST BE PROVIDED FOR EACH CIRCUIT TO ALLOW FOR SUITABLE CABLE PULLING DUCTS

NOTE 21:
CABLE SUPPORT STEELWORK TO BE PROVIDED BY THE CONTRACTOR WALL TO BE CAPABLE OF SUPPORTING HV CABLES, RING CT's etc

NOTE 22 AS ILLUSTRATED ON DRAWING:
AN OPENING SHALL BE PROVIDED UNDER THE STAIRS FOR CABLE PULLING

NOTE 23:
SUITABLE ANCHOR POINTS SHALL BE INSTALLED FOR CABLE PULLING

NOTE 24 (AS ILLUSTRATED ON DRAWING) :
INDICATIVE MODULAR/RELOCATABLE WALKWAY BRIDGES HAVE BEEN SHOWN WITHIN THE CABLE PIT AND ARE INTENDED T PROVIDE AN UNIMPEDED ROUTE OF ESCAPE FROM THE PIT IN THE EVENT OF AN EMERGENCY BRIDGES ARE TO CONSTRUCTED WITH A NON-METALLIC MATERIAL, i e GLASS REINFORCED PLASTIC.

NOTE 25:
CABLE PIT ENTRY DUCTS LOCATIONS ARE INDICATIVE ONLY DUCTING SHALL BE FACILITATED TO SUIT THE ULTIMATE DEVELOPMENT OF THE STATION TO REDUCE THE POSSIBILITY OF WATER INGRESS

NOTE 26:
RISK ASSESSMENT TO BE CARRIED OUT AT DETAIL DESIGN STAGE TO EVALUATE THE REQUIREMENT FOR FORCED VENTILATION WITHIN CABLE PIT

NOTE 27:
LINK BOXES LOCATED IN THE CABLE BASEMENTS SHALL BE READILY ACCESSIBLE FOR OPERATIONS STAFF FOR MAINTENANCE PURPOSES WITH SAFETY SIGNAGE AS OUTLINE IN THE EIRGRID CABLE SPECIFICATIONS

NOTE 28:
TELECOMMUNICATION DUCTS SHALL BE ROUTED DIRECTLY TO THE RELAY ROOM AS PER ESB TELECOMS REQUIREMENTS

BATTERY ROOM

NOTE 29 (AS ILLUSTRATED ON DRAWING) :
MINIMUM CLEAR DISTANCE BETWEEN 220V BATTERY STANDS AND WALLS IS 800mm .

NOTE 30:
BATTERIES SHOULD BE LOCATED AWAY FROM THE WALL TO ENSURE ACCESS TO ALL BATTERY CELLS FOR MAINTENANCE BATTERIES SHOULD NOT BE LOCATED IN FRONT OF AIR VENTS

NOTE 31 (AS ILLUSTRATED ON DRAWING) :
SCREENED VENTS (2 HIGH LEVEL AND 2 LOW LEVEL) ARE TO BE INSTALLED IN THE BATTERY ROOM AS PER IEC 62485-2 ON ADJACENT EXTERNAL WALL MINIMUM VENT DIMENSIONS: 900 x 225mm

NOTE 32 AS ILLUSTRATED ON DRAWING :
ACCESS DOOR TO STAIRCORE 2 FROM HOIST AREA, AND ADDITIONAL DOUBLE DOOR EXIT IN BATTERY ROOM TO BE SIZED APPROPRIATELY SIZE REQUIREMENT TBC IN LINE WITH FIRE REGULATIONS

NOTE 33:
BATTERY ROOM FLOOR IS TO BE FITTED WITH NON-SLIP, ACID RESISTANT VINYL AS PER THE REQUIREMENTS OF XDS-GFS-13-001-R2

NOTE 34:
DETAIL DESIGN IS TO CARRY OUT APPROPRIATE RISK ASSESSMENT & VENTILATION CALCULATIONS TO EVALUATE BATTERY ROOM VENT REQUIREMENTS

GENERATOR ROOM

NOTE 35 (AS ILLUSTRATED ON DRAWING) :
MINIMUM DIESEL GENERATOR LOUVRE DIMENSIONS 1200 x 1200mm

HOIST AREA

NOTE 36 (AS ILLUSTRATED ON DRAWING) :
EQUIPMENT ACCESS DOOR TO BE SIZED SUCH THAT A STANDARD ESB TRUCK CAN BE REVERSED IN THE HOIST AREA (MIN 4000mm WIDTH)

NOTE 37 (AS ILLUSTRATED ON DRAWING) :
ROLLER SHUTTER DOOR EXTENDS TO CEILING LEVEL OF THE GROUND FLOOR OF THE GIS BUILDING

NOTE 38 (AS ILLUSTRATED ON DRAWING) :
ROLLER SHUTTER DOOR TO BE INSTALLED BETWEEN THE HOIST AREA AND THE CABLE PIT AND IS INTENDED TO PREVENT VERTICAL FIRE TRAVEL BETWEEN THE FIRST AND SECOND FLOORS OF THE BUILDING, INLINE WITH FIRE REGULATIONS

RELAY ROOM

NOTE 39 (AS ILLUSTRATED ON DRAWING) :
RELAY ROOM MUST BE SIZED APPROPRIATELY TO ALLOW FOR ULTIMATE DEVELOPMENT OF STATION

NOTE 40 (AS ILLUSTRATED ON DRAWING) :
SPACE SHOULD BE CONSIDERED FOR ADDITIONAL TELECOMS AND PROTECTION PANELS

NOTE 41:
INDICATIVE CABLE ACCESS SHOWN

NOTE 42:
A TELECOMS EARTH BAR SHALL BE INSTALLED IN CLOSE PROXIMITY TO THE DCC RTU

NOTE 43:
NO ELECTRICAL EQUIPMENT (INCL.BATTERIES) SHALL BE INSTALLED DIRECTLY IN FRONT OF VENTS

NOTE 44 (AS ILLUSTRATED ON DRAWING) :
RELAY ROOM FLOOR CONSTRUCTION TO SUIT ROOM REQUIREMENTS

ROOF ACCESS

NOTE 45:
ROOF ACCESS IS TO BE EVALUATED AT THE DETAIL DESIGN STAGE BY CONDUCTING A RISK ASSESSMENT

M:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-SL-D-C-0008 Control Building Layout 220KV.dwg

Client

EirGrid

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(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.

(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	27.03.24	EM	DC	ISSUE FOR REVIEW & COMMENT	DC

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Scale: NTS @ A1

Project: **DUBLIN CENTRAL BULK SUPPLY POINT**

Created on: 27/03/2024

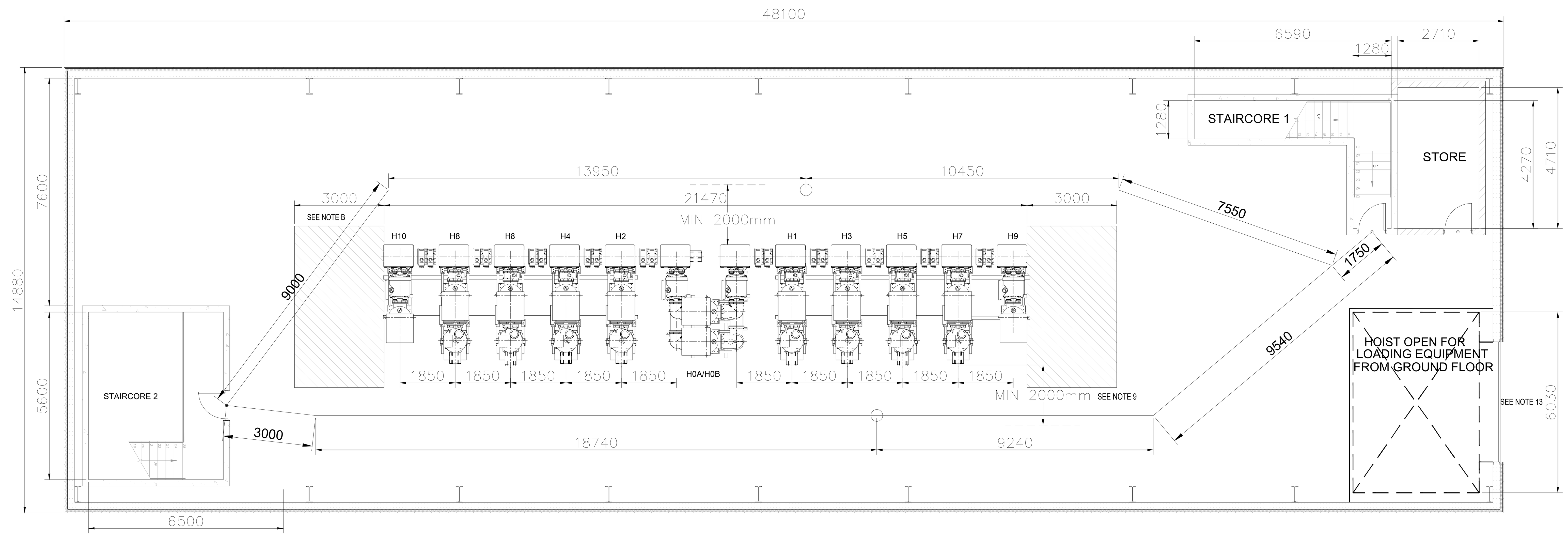
Title: 220 KV GIS PLAN LAYOUT

Sheets: 1 of 1

Drawing Number: CP1274-RPS-02-DW-XX-D-C-0008

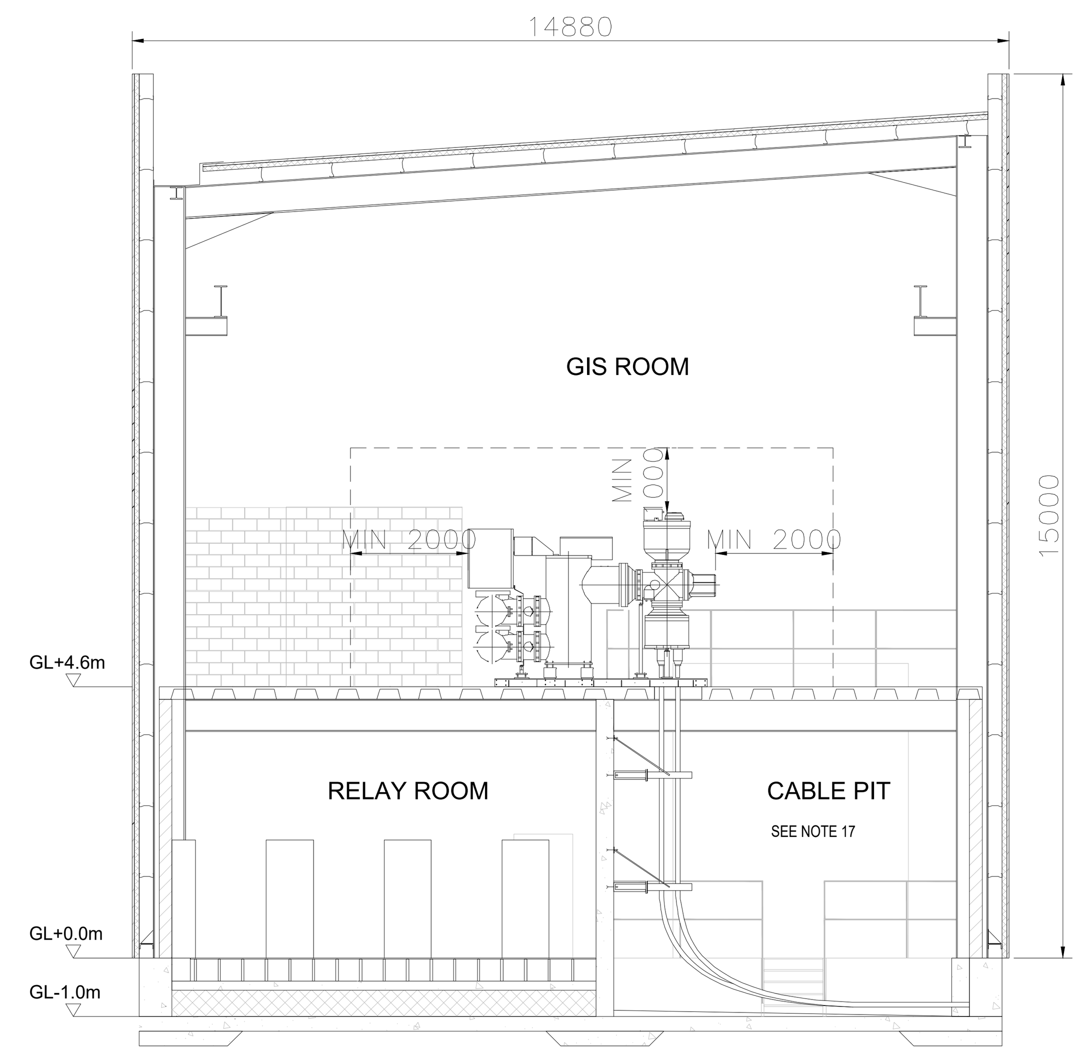
Status: S3

Rev: P01



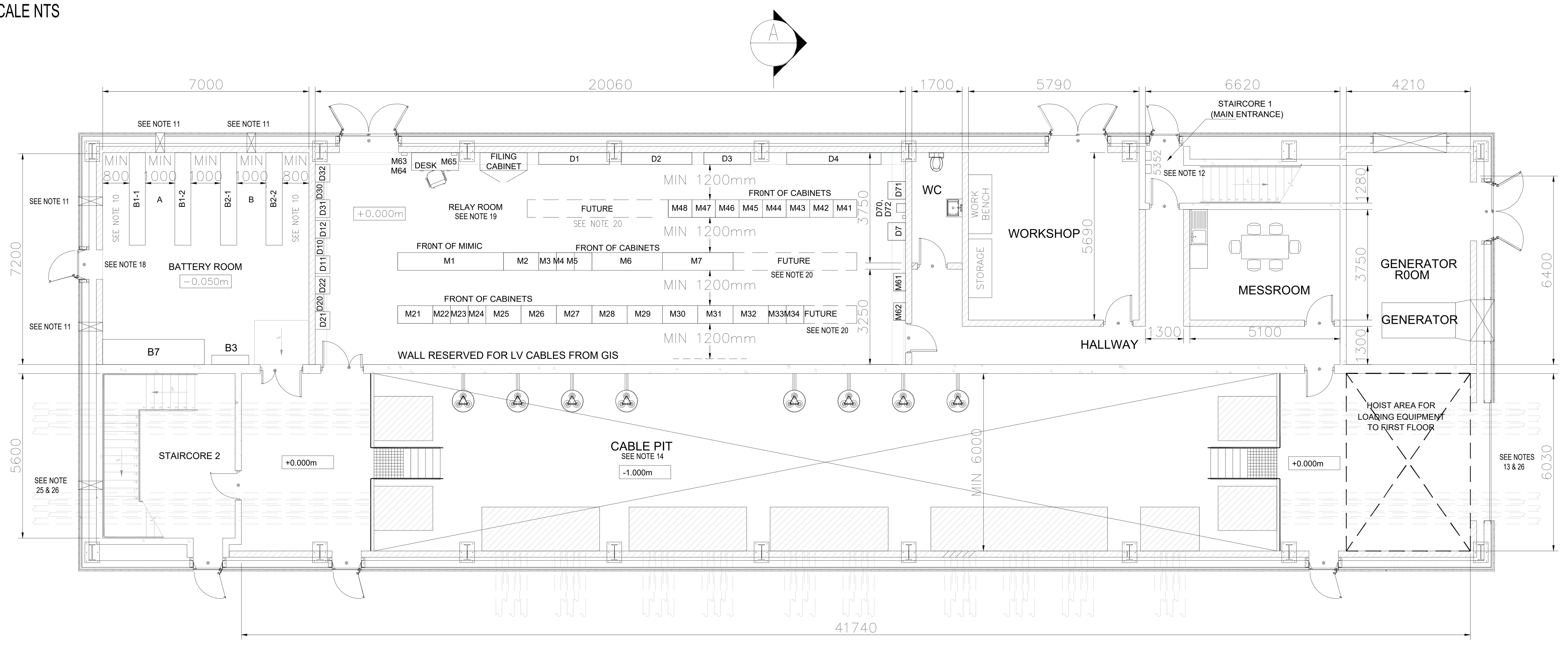
PLAN - FIRST FLOOR

SCALE NTS



SECTION

NTS



PLAN - GROUND FLOOR

SCALE NTS

LIST OF CABINETS

CABINET DESIGNATION	DESCRIPTION	DIMENSIONS
B1-1	220V DC BATTERY 1 STAND 1	3150x550
B1-2	220V DC BATTERY 1 STAND 2	3150x550
B2-1	220V DC BATTERY 2 STAND 1	3150x550
B2-2	220V DC BATTERY 2 STAND 2	3150x550
B3	24V DC STATION BATTERY	3450x880
B7	48V OC TELECOMS BATTERY	1260x320
D1	220V DC DISTRIBUTION BOARD 1	2400x400
D2	220V DC DISTRIBUTION BOARD 2	2400x400
D3	24/48V DC DISTRIBUTION BOARD	1600x400
D4	AC DISTRIBUTION BOARD	3200x400
D7	48V (TELECOMS) DISTRIBUTION	600x600
D10	220V BATTERY No 1 CHARGER CHANGEOVER SWITCH & FUSE BOX	600x300
D11	220V BATTERY Na 1: CHARGER 1 & BATTERY SUPERVISION	600x600
D12	220V BATTERY No 1: CHARGER 2 & BATTERY SUPERVISION	600x600
D20	220V BATTERY No 2 CHARGER CHANGEOVER SWITCH & FUSE BOX	600x300
D21	220V BATTERY Na2: CHARGER 1 & BATTERY SUPERVISION	600x600
D22	220V BATTERY No 2: CHARGER 2 & BATTERY SUPERVISION	600x600
D30	24/48V BATTERY: CHARGER CHANGEOVER SWITCH & FUSE BOX	600x300
D31	24/48V BATTERY: CHARGER 1 & BATTERY SUPERVISION	600x600
D32	24/48V BATTERY: CHARGER 2 & BATTERY SUPERVISION	600x600
D70	48V TELECOMS CONNECTION/FUSE BOX	
D71	48V SMPS (TELECOMS)	600x600
D72	TELECOMS ISOLATION SWITCH	100x100
M1	MIMIC	3800x800
M2	SYNCHRONISING PANEL	1200x800
M3	EVENT RECORDER/AAP	600x600
M4	BACKUP AAP	600x600
M5	BATTERY SUPERVISION	600x600
M6	SIGNAL INTERPOSING	2400x800
M7	CUSTOMER INTERFACE	2400x800
M21	BUSBAR PROTECTION	1200x800
M22	REMOTE INTERROGATION/DISTURBANCE RECORDER	600x600
M23	H10 COUPLER PROTECTION	600x600
M24	H9 COUPLER PROTECTION	600x600
M25	H8 BAY PROTECTION	1200x800
M26	H7 BAY PROTECTION	1200x800
M27	H6 BAY PROTECTION	1200x800
M28	H5 BAY PROTECTION	1200x800
M29	H4 BAY PROTECTION	1200x800
M30	H3 BAY PROTECTION	1200x800
M31	H2 BAY PROTECTION	1200x800
M32	H1 BAY PROTECTION	1200x800
M33	H0B SECTIONALISER PROTECTION	600x600
M34	H0A SECTIONALISER PROTECTION	600x600
M41	OPMUX 1	800x600
M42	OPMUX 2	800x600
M43	ODF	800 600
M44	IP SERVICES	800x600
M45	MAIN DISTRIBUTION FRAME	800x600
M46	NCC RTU (INCL.GPS CLOCK)	800 600
M47	TELEMETERING	800x600
M48	EIRGRID ENERGY METERING	800 600
M61	DCC RTU SEE NOTE 22	600x400
M62	ETIE	600x400
M63	INTRUDER ALARM PANEL	
M64	FIRE ALARM PANEL	
M65	TELEPHONE POINTS (2No)	

NOTE 1:
THIS DRAWING IS PRODUCED FOR INFORMATION PURPOSES ONLY ALL DIMENSIONS, REFERENCES (EG LIGHTNING MAST LOCATIONS ETC.) GIVEN ARE INDICATIVE AND SHOULD NOT BE USED AS PART OF A DETAILED DESIGN.

NOTE 2:
THIS IS A CONCEPTUAL DESIGN DETAILED DESIGN IS REQUIRED PENDING CONFIRMATION OF SPECIFIC EQUIPMENT SUPPLIER AND SITE DETAILS.

NOTE 3:
BUILDING HAS BEEN SPECIFICALLY DESIGNED TO ACCOMMODATE 4NO. TRANSFORMER BAYS (CABLE CONNECTION) AND 4NO. FEEDER BAYS (CABLE CONNECTION).

NOTE 4:
SWITCHGEAR SHOWN ON THIS DRAWING IS INDICATIVE ONLY

NOTE 5:
REQUIREMENT FOR GIS OVERPRESSURE VENTS TO BE CONFIRMED BY GIS SUPPLIER

NOTE 6:
WHERE THERE IS MORE THAN ONE MINIMUM DISTANCE STATED FOR A SPECIFIC AREA THE LARGEST MINIMUM DISTANCE SHOULD BE ADHERED TO.

NOTE 7:
ALL OPES IN GIS ROOM FOR LV AND HV CABLE TO BE FIRE SEALED.

NOTE 8:
THE MAXIMUM LENGTH OF A CABLE THAT CAN BE PUSHED INTO THE CABLE ROOM IS 100m ROUTE LENGTH.

NOTE 9 (AS ILLUSTRATED ON DRAWING):
MINIMUM CLEAR AREA ON BOTH SIDES OF HE GIS FOR THE HV TEST EQUIPMENT IS 3000mm.

NOTE 10 (AS ILLUSTRATED ON DRAWING):
MINIMUM CLEAR DISTANCE BETWEEN 220V BATTERY STANDS AND WALLS IS 800mm.

NOTE 11 (AS ILLUSTRATED ON DRAWING) :
SCREENED VENTS (2 HIGH LEVEL AND 2 LOW LEVEL) ARE TO BE INSTALLED IN THE BATTERY ROOM AS PER IEC 62485-2 ON ADJACENT EXTERNAL WALL.

NOTE 12 (AS ILLUSTRATED ON DRAWING):
FIRE AND ALARM PANELS TO BE LOCATED IN THE VICINITY OF THE MAIN ENTRANCE.

NOTE 13 (AS ILLUSTRATED ON DRAWING):
EQUIPMENT ACCESS DOOR TO BE SIZED SUCH THAT A STANDARD ESB TRUCK CAN BE REVERSED IN THE HOIST AREA (MIN 4000mm WIDTH).

NOTE 14 (AS ILLUSTRATED ON DRAWING):
THERE ARE TO BE NO OBSTRUCTIONS LOCATED 2m DIRECTLY IN FRONT OF THE CABLE DUCTS AND 300mm TO THE SIDE OF THE CABLE DUCT WHERE THE DUCT ENTERS THE CABLE ROOM

NOTE 15:
ADEQUATE AREA TO BE PROVIDED IN THE VICINITY OF THE GIS BUILDING TO ALLOW SPACE FOR SETTING UP THE EQUIPMENT NEEDED FOR CABLE PULLING OPERATION THIS AREA IS APPROX.12m X 12m FOR EACH CABLE CIRCUIT CABLE DESIGNER TO ADVISE.

NOTE 16:
AN OPENING MUST BE PROVIDED FOR EACH CIRCUIT TO ALLOW FOR SUITABLE CABLE PULLING DUCTS .

NOTE 17 (AS ILLUSTRATED ON DRAWING) :
CABLE SUPPORT STEELWORK TO BE PROVIDED BY THE CONTRACTOR WALL TO BE CAPABLE OF SUPPORTING HV CABLES, RING CT's etc.

NOTE 18 (AS ILLUSTRATED ON DRAWING):
ADDITIONAL EXIT DOOR IN BATTERY ROOM, REQUIREMENT TBC IN LINE WITH FIRE REGULATIONS.

NOTE 19 (AS ILLUSTRATED ON DRAWING):
RELAY ROOM MUST BE SIZED APPROPRIATELY TO ALLOW FOR ULTIMATE DEVELOPMENT OF STATION.

NOTE 20 (AS ILLUSTRATED ON DRAWING) :
SPACE SHOULD BE PROVIDED FOR FUTURE TELECOMS AND PROTECTION PANELS.

NOTE 21:
INDICATIVE CABLE ACCESS SHOWN

NOTE 22:
A TELECOMS EARTH BAR SHALL BE INSTALLED IN CLOSE PROXIMITY TO THE DCC RTU.

NOTE 23:
ONLY SINGLE ROW BATTERY STANDS MAY BE LOCATED AGAINST A WALL

NOTE 24:
NO ELECTRICAL EQUIPMENT (INCL BATTERIES) SHALL BE INSTALLED DIRECTLY IN FRONT OF VENTS .

NOTE 25 (AS ILLUSTRATED ON DRAWING):
AN OPENING SHALL BE PROVIDED UNDER THE STAIRS FOR CABLE PULLING

NOTE 26 (AS ILLUSTRATED ON DRAWING):
SUITABLE ANCHOR POINTS SHALL BE INSTALLED FOR CABLE PULLING

NOTE 27:
FIRE AND ATEX ZONES NOT SHOWN, THIS SHOULD BE CONSIDERED DURING DETAILED CUSTOMER DESIGN

M:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-SL-D-C-0007 Control Building Layout 110KV.dwg

Client

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	27/03/24	EM	DC	ISSUE FOR REVIEW & COMMENT	DC

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Scale	NTS @ A1
Created on	27/03/2024
Sheets	1 of 1
Project	DUBLIN CENTRAL BULK SUPPLY POINT PROJECT
Title	110 KV GIS PLAN LAYOUT
Drawing Number	CP1274-RPS-02-DW-XX-D-C-0007
Status	S3
Rev	P01

APPENDIX G: CABLE ARRANGEMENTS

Client

EirGrid
Powering Up Dublin

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(ii) DO NOT SCALE, use figured dimensions only.

(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing.

(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.

(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	27/03/2024	DB	DC	ISSUE FOR REVIEW & COMMENT	DC

rps A TETRA TECH COMPANY — POWERCOMM GROUP

Scale: 1:250 @ A1
Created on: 27/03/2024
Sheets: 1 of 1

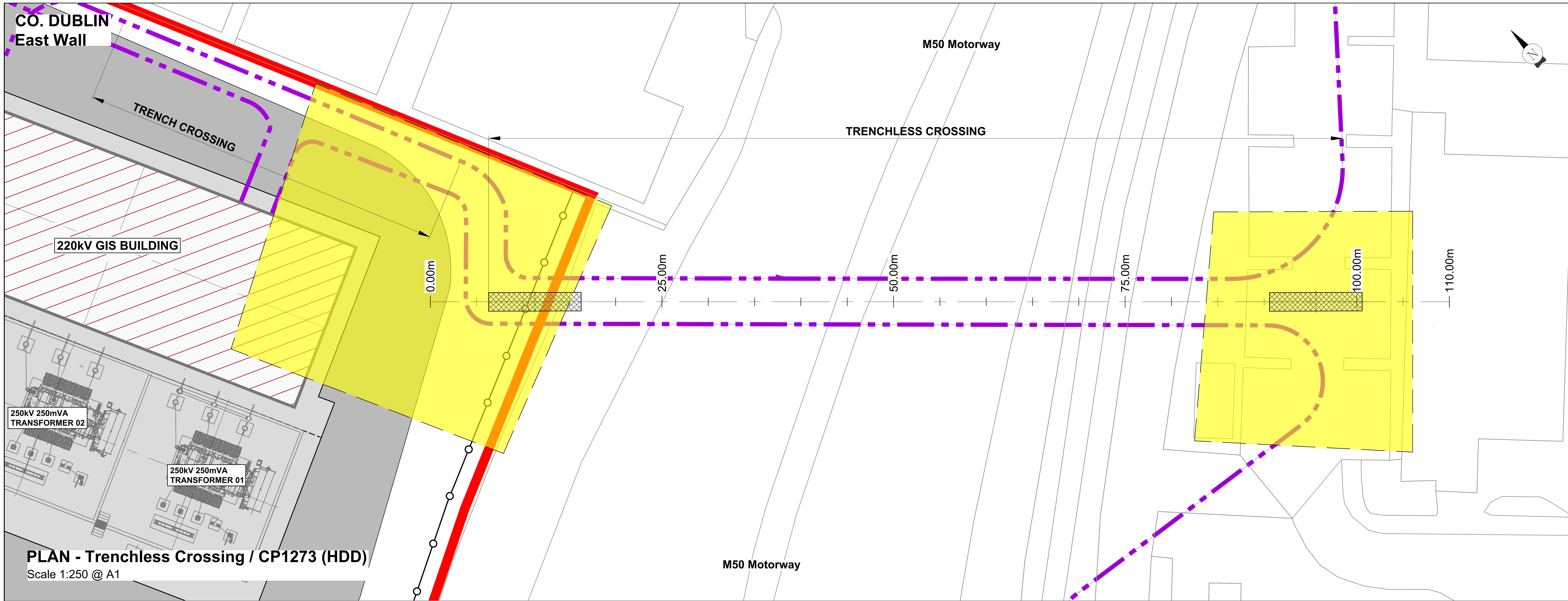
Project: **DUBLIN CENTRAL BULK SUPPLY POINT PROJECT**

Title: SUBSTATION COMPOUND - CABLE ARRANGEMENT

Drawing Number: CP1273-RPS-01-DW-XX-D-C-0009
Status: S3
Rev: P01

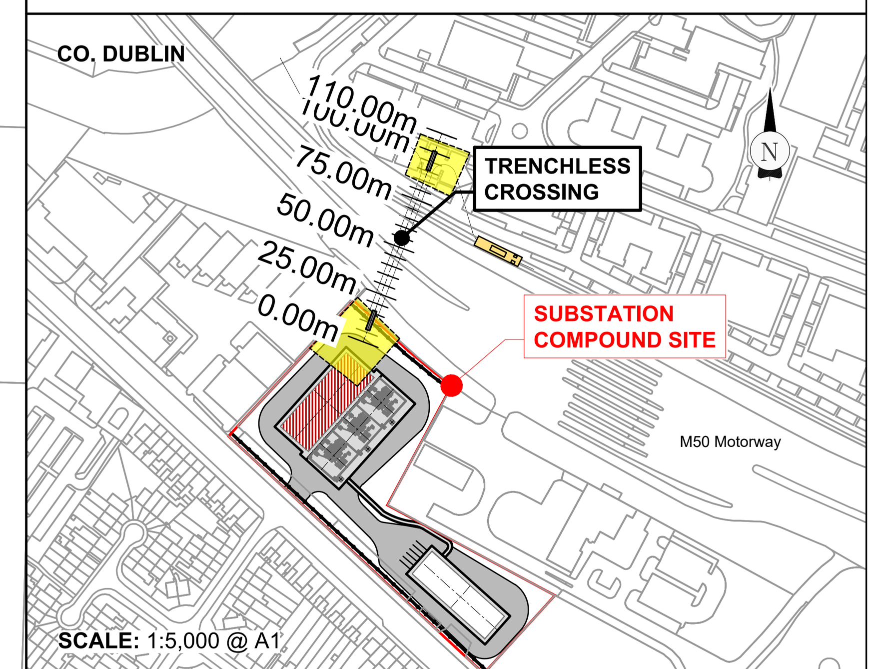
R:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-NC-D-C-0009 Cable Arrangement.dwg

APPENDIX H: HDD CROSSING



PLAN - Trenchless Crossing / CP1273 (HDD)
Scale 1:250 @ A1

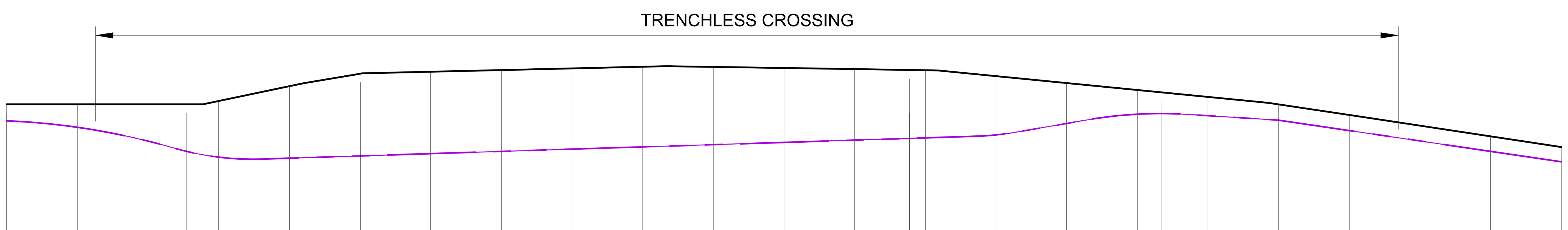
KEY PLAN:



SCALE: 1:5,000 @ A1

LEGEND - Site Compound

- Compound Boundary
- 220kV Tie-In to Finglas / Shellybanks
- Proposed Pathway
- Proposed Internal Road
- Proposed Internal Fence
- Proposed Working Area - Type 01
- Proposed Working Area - Type 02



Compound Site | Grass Verge | **M50 Motorway** | Grass Verge / Footpath | Commercial Area

DATUM:
-10.00m AOD

EXISTING GROUND LEVELS (m)	4.000	4.000	4.000	4.233	5.289	6.171	6.312	6.428	6.544	6.659	6.650	6.573	6.494	6.415	6.000	5.508	5.016	4.524	3.996	3.247	2.491	1.734	0.976
TOP OF DUCT LEVELS (m)	2.809	2.350	1.372	0.237	0.165	0.325	0.485	0.645	0.804	0.964	1.124	1.283	1.443	1.603	1.812	2.623	3.279	3.172	2.856	2.120	1.384	0.649	-0.087
COVER DEPTH / DIFFERENCE (m)	1.191	1.650	2.628	3.996	5.123	5.846	5.828	5.784	5.740	5.695	5.527	5.290	5.051	4.812	4.188	2.885	1.737	1.352	1.141	1.127	1.107	1.085	1.064
CHAINAGE (m)	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00

CP1273 - PROFILE VIEW 01 (HDD)
Scale: Horiz. 1:250, Vert. 1:250 @ A1

LONG SECTION - Trenchless Crossing
Trenchless Crossing / CP1273 (HDD)

Client
EirGrid
Powering Up Dublin

General Notes
(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	27/03/24	DB / DC	ISSUE FOR REVIEW & COMMENT	DC

rps
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POWERCOMM GROUP

Scale	1:1000 @ A1
Created on	27/03/2024
Sheets	1 of 1
Project	DUBLIN CENTRAL BULK SUPPLY POINT PROJECT
Title	TRENCHLESS CROSSING - (220kV SUBSTATION) Plan & Long Section
Drawing Number	CP1273-RPS-01-DW-NC-D-C-0010
Status	S3
Rev	P01

R:\IE000451A - Dublin Bulk Supply Point\8.0 Drawings\DR\CP1273-RPS-01-DW-NC-D-C-0010 M50 Trenchless Crossing.dwg

APPENDIX I: CONDUCTOR DATASHEETS

20004748 QM08
20001785 QM08
20001785 UM
20001785 BSOH

ISO 9001
ISO 14001
OHSAS 18001

Contract No.	Ref. No.
User / Customer	Page No. : 1 of 5
Project Title : 220kV Cable & Accessories	
Contractor	
Document Title	

Specification

For

220kV Al 2500SQ / 24.5mm XLPE / Al wire screen shield Cable

Rev. No.	Date	Descriptions	Prepared By	Reviewed By	Approved By

1. Scope

This specification covers the construction, dimensions, packing and tests requirements of 220kV single core aluminum conductor, cross-linked polyethylene(XLPE) insulated, aluminum wire screened, laminated aluminum foil and black HDPE oversheathed power cable.

2. Reference standards

■ IEC 60228 : Conductors of insulated cables
■ IEC 62067 : Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um = 170 kV) up to 500 kV (Um = 550 kV) - Test methods and requirements

3. Construction and Material

Construction of the cable shall meet the requirements specified in the attached table and as follows.

3.1 Conductor

The conductor shall consist of Milliken construction from the aluminum wires in accordance with IEC 60228(class 2). The conductor shall be water sealed by additional water swellable tape(s) between the conductor strands.

3.2 Conductor binder

Semi-conducting tape(s) shall be applied between the conductor and the conductor screen.

3.3 Conductor screen

The conductor screen shall consist of an extruded layer of semi-conducting thermosetting compound.

3.4 Insulation

The insulation shall consist of an extruded layer of cross-linked polyethylene (XLPE) over the conductor screen.
The minimum thickness at any point shall be not less than 90% of the nominal thickness specified in the attached table.

3.5 Insulation screen

Over the insulation, semi-conducting thermosetting compound shall be extruded as insulation screen and shall be firmly bonded to the insulation.
The conductor shield, insulation and insulation screen shall be extruded simultaneously by dry curing process

3.6 Longitudinal water barrier

Semi-conducting swellable tape(s) shall be applied over the insulation screen to prevent longitudinal water penetration.

3.7 Metallic screen

The metallic screen consisting of aluminum wires shall be helically applied with suitable lay length and a narrow aluminum tape shall be applied directly over the aluminum wires with suitable gap in an opposite layer of the aluminum wires.

3.8 Longitudinal water barrier

Semi-conducting swellable tape(s) shall be applied over the metallic screen with suitable overlap to prevent longitudinal water penetration.

3.9 Radial water barrier

The laminated aluminum foil shall be applied longitudinally over the semi-conducting swellable tape to prevent radial water penetration.

3.10 Oversheath

The oversheath shall be an extruded layer of black HDPE compound.
The minimum average thickness shall not be less than the nominal thickness specified in the attached table and the minimum thickness at any point shall not be less than 85% - 0.1mm of the nominal thickness specified in the attached table.
The semi-conducting layer (graphite coating) shall be applied over the oversheath to serve as an electrode for voltage test on the oversheath.

4. Cable Marking

The following description shall be embossed along two lines on the outer sheath throughout the entire length of the cable. The gap between the end of one set of embossed characters and the beginning of another shall not be greater than 150mm.

1) Electric Cable
2) Rated voltage, 220,000 Volts
3) Customer's name, ESB
4) Specification number, 18091
5) Conductor size, 2500 ㎟
6) Designation, XLPE
7) Manufacturer's name,
8) Year of manufacture

Ex) Electric Cable 220,000Volts ESB 18091 (Al)2500 ㎟ XLPE Continuously increasing

meter marking shall be provided on the oversheath at an interval of 1 meter.

5. Sealing and Drumming

Immediately after the works tests, both ends of the cable length shall be sealed by means of metal cap and pulling eye fitted over the end. The complete cable shall be wound on non-returnable metallic drum. All cable drums shall be arranged to take a round spindle and lagged with closely fitting steel sheets.

6. Tests

The following tests shall be carried out at manufacturer's works according to the procedure of IEC 62067.

6.1 Routine Tests

1) A.C Voltage test
2) Partial discharge test
3) Electrical test on oversheath

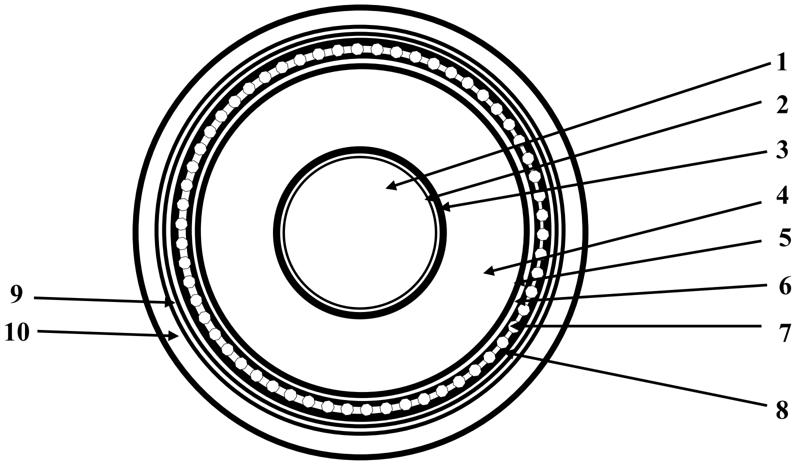
6.2 Sample Tests

1) Conductor examination and check of dimensions
2) Measurement of electrical D.C. resistance of conductor
3) Hot set test on XLPE insulation
4) Measurement of capacitance

Attached Table

Characteristics & Cross- sectional drawing

Scale : Not to scale



No	Description	Unit	Particulars
0	**Rated voltage**	kV	220
1	**Conductor**		Aluminum wires
	- nominal cross- sectional area	㎟	2500
	- shape		Milliken
	- overall diameter of conductor(nom.)	㎜	63.0
2	**Conductor binder**	-	Semi-conducting tape(s)
3	**Conductor screen**		Semi-conducting thermosetting compound
	- average thickness	㎜	1.2
	- minimum thickness at any point	㎜	0.8
4	**Insulation**		Cross-linked polyethylene(XLPE)
	- nominal thickness	㎜	24.5
5	**Insulation screen**		Semi-conducting thermosetting compound
	- average thickness	㎜	1.0
	- minimum thickness at any point	㎜	0.8
6	**Longitudinal water barrier**	-	Semi-conducting water swellable tape(s)
7	**Metallic screen**		Aluminum wires
	- No. / dia. of wires	EA/㎜	93 x 2.3
8	**Longitudinal water barrier**	-	Semi-conducting water swellable tape(s)
9	**Radial water barrier**	-	Aluminum laminated foil
	- nominal thickness	㎜	0.35
10	**Oversheath**		Black HDPE compound with graphite coating
	- nominal thickness	㎜	4.0
11	**Overall diameter(approx.)**	㎜	136
12	**Weight of cable(approx.)**	kg/m	17.3
13	**D.C. resistance of conductor at 20℃**	㎌/km	0.0127
14	**Electrostatic capacitance(nom.)**	Ω/㎞	0.254

TECHNICAL SCHEDULE TS – 9

220 kV XLPE Land Cable – 2.500mm² Al XLPE Physical Characteristics

Note: All dimensions to be filled in where applicable.

Item	Query	Unit	Reply
1	Conductor:		
	(a) Material Grade		Aluminum
	(b) Type e.g. round, etc.		Compacted
	(c) Design e.g. stranded, segmental and enamelled etc.		Segmental
	(d) Nominal diameter	mm	63
	(e) Cross-sectional area	mm^2	2500
	(f) Method of water blocking		Swelling tape
2	Inner Semi-conducting Layer:		
	(a) Material		Semi-conducting thermosetting compound
	(b) Nominal Thickness	mm	1.2(avg.)
	(c) Minimum Thickness	mm	0.8
3	Insulation:		
	(a) Material Grade		XLPE
	(b) Nominal thickness	mm	24.5
	(c) Minimum thickness		22.05
	(d) Ovality of insulation $\leq$ 10%	mm	$\leq$ 10%(eccentricity)
4	Outer Semi-conducting Layer:		
	(a) Material Grade		Semi-conducting thermosetting compound
	(b) Nominal thickness	mm	1.0(avg.)
	(c) Minimum thickness	mm	0.8
5	Nominal diameter over core screen	mm	approx. 119.0
	Roundness of cable core ; maximum ovality < 0.9 mm	mm	$\leq$ 2.0mm (Dmax – Dmin)
6	Radial thickness of insulation incl. semi-conducting layers		
	(a) Nominal	mm	27.3
	(b) Minimum	mm	23.65
7	Bedding Layer/'Water Barrier		
	(a) Material		Semi-conducting swellable tape
	(b) Thickness	mm	nom. 0.3
	(c) OD of bedding layer	mm	approx, 119.8
	(d) Method of electrical connection between 4 and 8		Semi-conducting swellable tape
	(e) Method of water blocking		Semi-conducting swellable tape
8	Metallic Sheath:		
	(a) Material		Aluminium
	(b) Type, corrugated or smooth		N/A
	(c) Nominal thickness	mm	2.3(Diameter of wire)
	(d) Mean diameter	mm	approx. 122.1
	(e) Cross-sectional area	mm^2	approx. 386.4
	(f) Diameter over crest of corrugations	mm	N/A
	(g) OD of sheath if not corrugated	mm	Approx. 124.4
	(h) Diameter and no. of extra copper wires required to ensure short circuit performance of cable meets Specification 18080 (if needed)		2.3 x 93(Aluminum wires)
9	Outer MDPE/HDPE Sheath		
	(a) Material		HDPE
	(b) Nominal thickness	mm	4.0
	(c) Minimum thickness	mm	3.3
	(d) Shore D hardness		60
	(e) Shrinkage %		N/A
10	Nominal diameter of completed cable including thickness of any conductive outer layer	mm	approx. 136
11	Conductive Outer Layer		
	(a) Material Grade		Graphite coating
	(b) Thickness	mm	0.01
	Extruded Layer Surface resistivity	KOhm/m	N/A

	Graphite Layer Surface Resistivity Coefficient of static and dynamic friction of cable based on sidewall force equal to cable weight/m for straight line pull in HDPE pipe (a) for graphite layer (b) extruded outer conductive layer Coefficient of static and dynamic friction based on 5000N/m sidewall force in HDPE pipe (a) for graphite layer (b) for extruded outer conductive layer	KOhm/m	max. 150kΩ/m (Without Lub) 0.35 (Without Lub) 0.4 (Without Lub) 0.35 (Without Lub) 0.4
12	(a) Normal length per drum	m	600
	(b) Maximum length per drum	m	1100
13	(a) Normal gross weight of loaded drum	kg	approx. 13,800
	(b) Maximum gross weight of loaded drum	kg	approx. 24,000
14	Maximum drum dimensions width/height	m/m	approx, 3.6 / 4.4
15	Minimum radius of bend around which cable can be pulled (a) Laid Direct (b) In ducts (c) Cable placed in position with former (d) Cable placed in position without former	kN m m m m	 2.8 2.8 2.5 2.8
16	Permissible pulling force allowed on conductors during installation	kN	98
17	Maximum permissible sidewall forces	kN	9.8 kN/m

TECHNICAL SCHEDULE TS – 10

220 kV XLPE Land Cable – 2.500mm² Al XLPE Electrical Characteristics

Item	Query	Unit	Reply
1	Maximum AC/DC resistance of conductor at 20°C	Ω/km	DC : 0.0127
2	Maximum AC resistance of conductor at 90°C	Ω/km	0.0167
3	Minimum insulation resistance	MΩ/km	2100MΩ·km
4	Maximum phase inductance	mH/km	0.421
5	Maximum phase capacitance	μF/km	0.275
6	Maximum charging current per phase	A/km	11.0
7	Zero phase sequence impedance for 3-phase cable (R_0+jX_0)	Ω/km	0.10721+j0.06461
8	Maximum permissible continuous temperature of conductor/sheath	°C/°C	90/80
9	Maximum permissible continuous current rating when installed per Appendix A of specification for all bonding situations outlined there	A	1436.7A (For Summer) 1537.7A (For Winter)
10	Maximum AC/DC metallic sheath resistance (inclusive of any screen wires) at 20°C	Ω/km	0.07429
11	Losses: (a) Conductor losses per phase at current in item 9 (b) Dielectric losses per phase at U_O (c) Sheath loss per phase at current in item 9 (d) Total losses per phase	 W/m W/m W/m W/m	At summer 34.464 1.28 0.443 36.188
12	Maximum/expected dielectric loss angle at U_O and a conductor temperature of: 20°C 40°C 60°C Maximum operating temperature +5°C	 % % % %	 0.1 0.08 0.07 0.05
13	Maximum/expected dielectric loss at 20°C and: 0.5 U_O	 %	 0.08

	1.0 U_O	%	0.1
	1.5 U_O	%	0.12
	2.0 U_O	%	0.15
14	Thermal resistance between conductor and metallic sheath	K m/W	0.376
15	Thermal resistivity of:		
	Insulation and semi-conducting layers	K m/W	3.5
	MDPE/HDPE Outer Sheath	K m/W	3.5
16	Design 1.2/50 μs impulse stress for 550kV at conductor/core screen	kV/mm	57.0 / 33.0
17	Design AC stress for U_o at conductor/core screen	kV/mm	6.9 / 4.0
18	Average design AC stress across insulation	kV/mm	5.2
19	Minimum 50% flashover voltage of sealing end for a 1.2/50mS wave (nominal), positive/negative	kV	1480(for outdoor sealing end)
20	Surface leakage distance of sealing end porcelain (outdoor). Minimum = 5,000mm	mm	Min. 8900 (In case of polymer insulator)
21	Relative permittivity of dielectric		2.5
22	Cable screening factor when cable is buried in ground with resistivity:		
	1,000 Ω m		N/A
	100 Ω m		N/A
23	Permissible Metallic Sheath(including any screen wires) fault current for the following fault duration times		Metallic screen(Aluminum wires)
	0.1s	A	122400
	0.2s	A	87300
	0.5s	A	56100
	1.0s	A	40400
	3.0s	A	24400
24	Permissible main conductor 1s short time fault current and corresponding conductor temperature	A/°C	230.3kA / 250'C
25	Permissible steady overload and conductor temperature for 0.5/1/2/4 hours, based on installation conditions in Appendix A, after prior continuous loading of:		**0.5 / 1 / 2 / 4**
	50% of current in Item 9	%	300 / 300 / 250 / 250
	75% of current in Item 9	%	300 / 260 / 208 / 179
	90% of current in Item 9	%	279 / 221 / 181 / 159
26	(a) Is the cable design fully in accordance with the specification?		Refer to Deviation Sheet
	(b) If not, list all deviations.		

We confirm that we have read and understand the requirements of Technical Schedules TS-9 and TS-10 and we confirm our tender is compliant with the clauses therein other than as detailed in our List of Deviations.

Name:
Company:
Position in Company:
Date:

20004748 QM08
20001785 QM08
20001785 UM
20001785 BSOH

ISO 9001
ISO 14001
OHSAS 18001

LS Cable & System

Contract No.	:	Ref. No.	: LSGS-20-PC0570
Customer	: ESB	Page No.	: 1 of 5
Project Title	: Substation framework 5-years		
Contractor	: LS Cable & System Ltd.		
Document Title			

Specification

For
220kV XLPE POWER CABLE

0	19. Nov. 2020	For Bidding	H. J. Kwak	K. R. Ko	J. S. Kim
Rev. No.	**Date**	**Descriptions**	**Prepared By**	**Reviewed By**	**Approved By**

LS Cable & System

1. Scope

This specification covers the construction, dimensions, packing and tests requirements of 220kV single core insulated copper conductor, cross-linked polyethylene(XLPE) insulated, aluminum wire screened, aluminum laminated foil and black HDPE oversheathed power cable.

2. Reference standards

- ■ IEC 60228 : Conductors of insulated cables
- ■ IEC 62067 : Test for power cables with extruded insulation and accessories for rated voltages above 150kV(Um=170kV) up to 500kV(Um= 550kV) – Test methods and requirement

3. Construction and material

Construction of the cable shall meet the requirements specified in the attached table and as follows.

3.1 Conductor

The conductor shall consist of Milliken construction from the plain annealed copper wires in accordance with IEC 60228(class 2) in which copper wires are insulated from each other.
The conductor shall be water sealed by additional water swellable tape(s) between the conductor strands.

3.2 Conductor binder

Semi-conducting tape(s) shall be applied between the conductor and the conductor screen.

3.3 Conductor screen

The semi-conductive screen over conductor shall consist of an extruded layer of semi-conducting thermosetting compound.

3.4 Insulation

The insulation shall consist of an extruded layer of cross-linked polyethylene (XLPE) over the conductor screen.
The minimum thickness at any point shall not be less than the specified value in the attached table.

3.5 Insulation screen

Over the insulation, semi-conducting thermosetting compound shall be extruded as insulation screen and shall be firmly bonded to the insulation.
The conductor screen, insulation and insulation screen shall be extruded simultaneously by dry curing process.

3.6 Longitudinal water barrier

Semi-conducting swellable tape(s) shall be applied over the insulation screen to prevent longitudinal water penetration.

3.7 Metallic screen

The metallic screen consisting of the aluminum wires shall be helically applied with suitable lay length and a narrow aluminum tape shall be applied directly over the aluminum wires with suitable gap in an opposite layer of the aluminum wires.

3.8 Longitudinal water barrier

Semi-conducting swellable tape(s) shall be applied over the metallic screen with suitable overlap to prevent longitudinal water penetration.

3.9 Radial water protection screen

The laminated aluminum foil shall be applied longitudinally over the longitudinal water barrier to prevent radial water penetration.

3.10 Oversheath

The oversheath shall be an extruded layer of black HDPE (ST7) compound.
The average thickness shall not be less than the nominal thickness specified in the attached table and the minimum thickness at any point shall not be less than 85%-0.1mm of the nominal thickness specified in the attached table.

3.11 Conductive layer

Black semi-conducting PE compound(conductive layer) shall be extruded over the oversheath to serve as electrode for the voltage test on the oversheath.

4. Cable Marking

The following description shall be embossed on the oversheath throughout the entire length of the cable.

1) Electric Cable
2) Voltage
3) Client: ESB
4) Specification
5) Conductor size
6) Designation
7) Maker
8) Year of Manufacture

Ex) Electric Cable 220,000 Volts, ESB, 18091, 2500SQ, XLPE, LS Cable & System, 2020

Production batch number and continuously increasing meter marking shall be provided on the oversheath at an interval of 100 cm. They shall be distant from the cable marking 90°.

Ex) XXX 0001m
*Production batch number : XXX
**Meter marking : 0001m

5. Sealing and Drumming

Immediately after the works tests, both ends of the cable length shall be sealed by means of metal cap, pulling eye fitted with soldering work over the end for storing for several months in the ground. The complete cable shall be wound on non-returnable metallic drum. All cable drums shall be arranged to take a round spindle and lagged with closely fitting steel sheets.

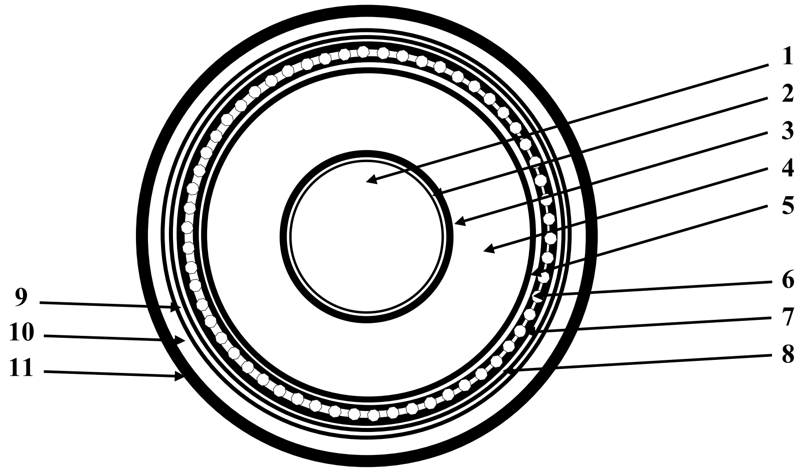
6. Tests

The routine tests and sample tests shall be carried out at manufacturer’s works according to the approved ITP.

Attached Table

Characteristics & Cross- sectional drawing

Scale : Not to scale



No	Description	Unit	Particulars
0	**Rated voltage**	kV	220
1	**Conductor**		Insulated copper wires & Plain annealed copper wires
	- nominal cross- sectional area	㎟	2500
	- shape		Milliken
	- overall diameter of conductor(nom.)	㎜	63.5
2	**Conductor binder**	-	Semi-conducting tape(s)
3	**Conductor screen**		Semi-conducting thermosetting compound
	- nominal thickness	㎜	1.5
4	**Insulation**		Cross-linked polyethylene(XLPE)
	- nominal thickness	㎜	20.0
	- minimum thickness at any point	㎜	18.0
5	**Insulation screen**		Semi-conducting thermosetting compound
	- nominal thickness	㎜	1.3
6	**Longitudinal water barrier**	-	Semi-conducting water swellable tape(s)
7	**Metallic screen**		Aluminum wires
	- diameter / no. of wires	㎜ x no.	2.3 x 93
8	**Longitudinal water barrier**	-	Semi-conducting water swellable tape(s)
9	**Radial water protection screen**	-	Aluminum laminated foil
10	**Oversheath**		Black HDPE compound
	- nominal thickness	㎜	4.0
11	**Conductive layer**		Black semi-conducting PE compound
	- nominal thickness	㎜	1.0
12	**Overall diameter(approx.)**	㎜	128
13	**Weight of cable(approx.)**	kg/m	33.2
14	**D.C. resistance of conductor at 20℃(max.)**	Ω/km	0.0072
15	**Electrostatic capacitance(nom.)**	㎌/km	0.299