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132kV Outdoor Metered Substation Design Guide

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Classification: Internal

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Highly confidential	Any documents classified as 'Highly confidential' must be marked on the front page and the top of every page.
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Version			
Version	Author	Date	Reason
01	Abi Chatfield [Ext]	29/09/2024	Initial Draft

Sign off			
Role	Name	Position	Date
Insert here	Mark Sneddon	Delivery Director	16/10/2024

Contents

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1. Introduction

This document has been issued to provide guidance for designers preparing design submissions for 132kV outdoor substation intended for approval and adoption by Aurora Utilities Limited (AUL). It provides an insight into AUL's requirements in terms of type and number of apparatus required as well as contents of the submission document suite. For the purposes of this document, the following voltage thresholds are recognised:

- High Voltage (HV) – 132kV (or 66kV),
- Medium Voltage (MV) – 33kV or 11kV (or 6.6kV),
- Low Voltage – below 1kV, typically 400/230V.

2. Design Submission

An accredited ICP willing to submit their design for AUL's review are asked to follow guidance in this section regarding the required documents and the folder structure. Compliance with this section will contribute towards the adequate documents being submitted and presented in an orderly manner and will significantly ease the process of tracking the documents.

A prepared submission package shall be contained in a zipped folder attached to an email to the allocated AUL design review engineer. Please note that the maximum size of the zipped folder attachment shall not exceed 10MB. If this size is exceeded, the submission pack may be divided into a few emails, indicating in the email subject which part is being sent. The email subject shall always include the name of the project, ICP name, postcode, and the DNO/IDNO/ICP reference number, e.g.

ICP X, Project Y, Postcode: Z, DNO Ref: X, IDNO Ref: Y, ICP Ref: Z, Design Submission – part 1.

The contents present in the zipped submission folder(s) shall be as presented in tab. 2.1.

Tab. 2.1. Submission structure and contents

Folder Name	Folder contents (comments)
001 – Document Control	Document/Drawing Register (please ensure all submitted documents are present on the drawing register – documents not present on the register will not be considered)
002 – DNO General Documentation	DNO Connection Offer, DNO Acceptance Letter, DNO Email record regarding fault level, earthing data and any specific design requirements
003 – ICP General Documentation	Flood Risk Assessment, Designer's Risk Assessment, Developer's Letter of Authority,
004 – SLD	Single Line Diagram
005 – Site Plans	Overall Site Plan, Control Rooms / Switchrooms plans – Equipment layout / Small Power and Lighting

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006 – Cable routes	Onsite and offsite power cables / multicores direct lay / ducted routes with cross section details
007 – Primary Circuits Design	Fault Level Study/Calcs, Power Cable Selection Report, Busbars Calculations Report, Apparatus Safety Clearances drawing, Busbars and Clamps Schedule
008 – Secondary Circuits Design	Multicore Block Diagram and Schedule, Multicore Termination Diagram and Coresheets, Interlocking Diagram
009 – Material Specification	Material Specification listing all apparatus proposed, manufacturer's documentation regarding all switching apparatus, switchgears, transformers, batteries
010 – LVAC Design	Low Voltage design to BS7671 including LVAC SLD showing proposed circuits from the LV source (aux tx, separate DNO feed etc.) to loads – usually supported by LV sizing software report or hand calculations
011 – Civil Design	Civil Calculations, Detailed site plans, Enabling / Cut&Fill Drawing, Setting Out Drawing, Foundation drawings, RC drawings and schedules, Steelwork Design and Calculations.
012 – Protection Design	Main Connection Protection (MCP) / Protection Block Diagram if now shown on SLD, Protection Coordination Study
013 – Earthing Design	Earthing Study Report, Earthing Electrode Layout drawing, Above-Ground Earthing Connections,
014 – Power Systems Studies	As applicable to type of connection designed: Fault Level Study, P28 Study, G5/5 Study, Load Flow, Voltage Control / Regulation, Reactive Power Capability / Stability, Fault Ride Through, Fast Fault Current Injection, Frequency Response Study

It is understood that not all of the documents or studies are available at the time of the first submission therefore partial submissions are accepted. There is no need to resubmit previously submitted documents with further submissions unless changes were made. All design documents shall have number, title and revision in formation in their filenames.

Submitting designs not adhering to these housekeeping rules may significantly extend the review time or in severe cases result in design rejection.

3. Primary Circuits Design

Primary Circuits adopted by AUL shall be designed to meet safety clearance, ensure adequate operational capabilities, means of isolation and current and voltage measuring facilities. AUL 132kV circuits originate at a demarcation point with a DNO which may be an existing feeder bay(s), cable(s) or overhead line(s) constituting a tee or a loop connection.

3.1. 132 (66)kV Cable Design

A 132(66)kV cable selection shall always be supported by a detailed cable design report. The report shall detail the load and fault conditions the cable will be exposed to and prove the selection is adequate. The report shall specify the exact cable laying and ground conditions as well the cable sheath bonding arrangement. A detailed cable route plan shall be submitted presenting graphically the position of the cable with any identified obstacles or utilities it is meant to cross as well as detailed trench cross-section presenting cable laying arrangements.

3.2. Substation Compound Layout & Apparatus

Type of apparatus required in AUL 132kV substations may vary and it depends on how the connection is made available from the DNO. Most common arrangements involve single, teed and cabled connection. Discussion between AUL, DNO and the customer shall be held to establish the scope of the apparatus adopted by AUL. Depending on the agreement AUL may adopt all or some of the 132kV apparatus planned to be installed in the new substation.

Discussed below is the case of AUL adopting all planned new apparatus in the 132kV substation being developed. This involves adoption of the offsite 132kV cable route, through 132kV busbars and outdoor apparatus, including a 132kV Grid Transformer over to MV circuits and 33(11)kV Switchgear. Example of a 132kV compound elevation is shown in Fig. 3.1.

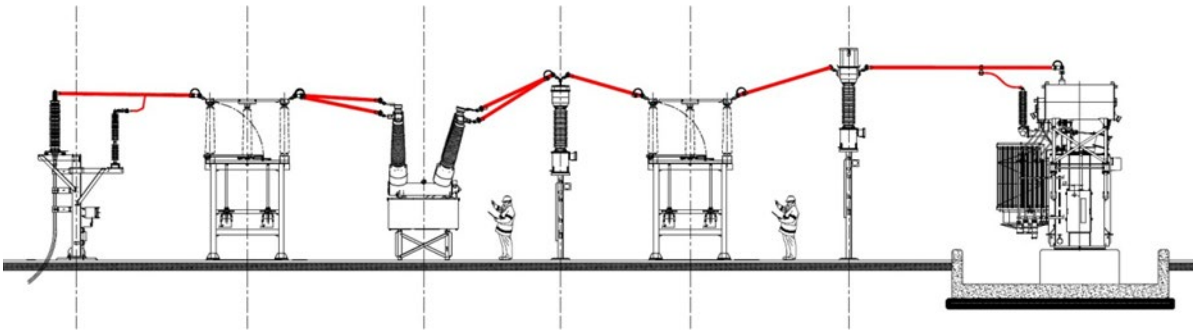

Fig. 3.1. Example of a 132kV compound elevation view – refer to PR-DN-DWG-01

Apparatus presented in Fig. 3.1 are as follows (left to right): Cable Sealing Ends, Surge Arrestor, Line Disconnector with Earth Switches, Dead Tank Circuit Breaker, Voltage Transformer, Bus Disconnector with Earth Switches, High Accuracy Metering Unit (if required) and Grid Transformer.

The HAM Unit positioned between the bus disconnector and the grid transformer is not required by AUL, however can be accommodated if the customer required access to voltage and current signals for their purposes, which usually includes G99 AC6 meter or Power Park Controller input signals.

3.3. Operational Capability & Safety

Isolation facilities are crucial to operational capability and safety. This is afforded by line and bus disconnectors. The disconnectors must be in AUL's direct control. If AUL do not adopt all apparatus in the 132kV compound, amongst the adopted apparatus there must be a disconnector, even if this means repeating of functionality afforded by a neighbouring disconnector in other party's control. AUL's disconnectors must be motorised and controllable locally and remotely. Disconnectors shall be equipped with earth switches on both sides and the line earth switch shall be suitable for induced current switching. Earth switches shall generally be motorised, however manual only mechanisms are acceptable.

All apparatus shall be fully, or as far as possible, electrically interlocked. An Interlocking Diagram shall be attached to the design submission, listing conditions that must be met to operate each apparatus and detailing interlocking circuits. If electrical interlocking is not achievable or not practicable, mechanical interlocking shall be included. If any apparatus

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remain not fully interlocked and it is not practicable to implement electrical or mechanical interlocking, a clear warning label must be installed.

In general, the interlocking philosophy shall satisfy the following conditions:

- Conditions to operate disconnectors:
  - Corresponding circuit breakers opened,
  - Corresponding earth switches opened,
- Conditions to operate earth switches:
  - Corresponding disconnectors are opened,
  - Corresponding circuit breakers are opened,
- Conditions to close circuit breakers:
  - Corresponding earth switches are opened,

The above conditions are very general and project specific consideration shall always be made.

3.4. Busbar Design

Busbars shall be sized adequately to the rated current of the circuit as well as to withstand short circuit currents. Mechanical forces acting on the busbars shall be calculated. These include:

- Weight of the busbars,
- Weight of the connectors and downdroppers,
- Weight of ice that may accumulate on busbars,
- Wind forces,
- Short circuit forces.

Adequate busbar cross sectional area shall take into consideration maximum mechanical forces so bending stresses and deflections remain in acceptable range. Attention shall be given to long busbar runs, especially exposed to high forces and deflections. Established mechanical forces originating from busbars shall be compared with admissible cantilever forces acting on bushings and insulators. Suitable clamps shall be proposed to connect the busbars to the corresponding apparatus. Busbar thermal expansion shall be considered, which in most cases mean installing a flexible connector on one side of each busbar run.

Busbar and clamps schedule as well as busbar calculations in line with BS EN 60865-1 shall be attached to the design submission.

3.5. Safety Clearances

Distances between apparatus within a 132kV compound and the resultant dimensions of the compound are determined by safety clearances between the apparatus in line with BS EN 61936-1. Depending on the voltage the designed equipment operates at, the following clearances shall be considered:

- Phase to Earth clearance,
- Vertical Safety Working Clearance,
- Horizontal Safety Working Clearance,
- Insulation Height (Pedestrian Access),
- Phase to Phase Clearance

AUL standard distance between 132kV busbar centres is 2500mm. All elements of HV apparatus shall be above the Insulation Height, generally considered as 2.4m. Any marshalling / fuse / link / drive cabinets shall be however positioned for convenient access.

Safety clearances drawing shall be attached to the design submission. Example of a safety clearances graphical representation is shown in Fig. 3.2.

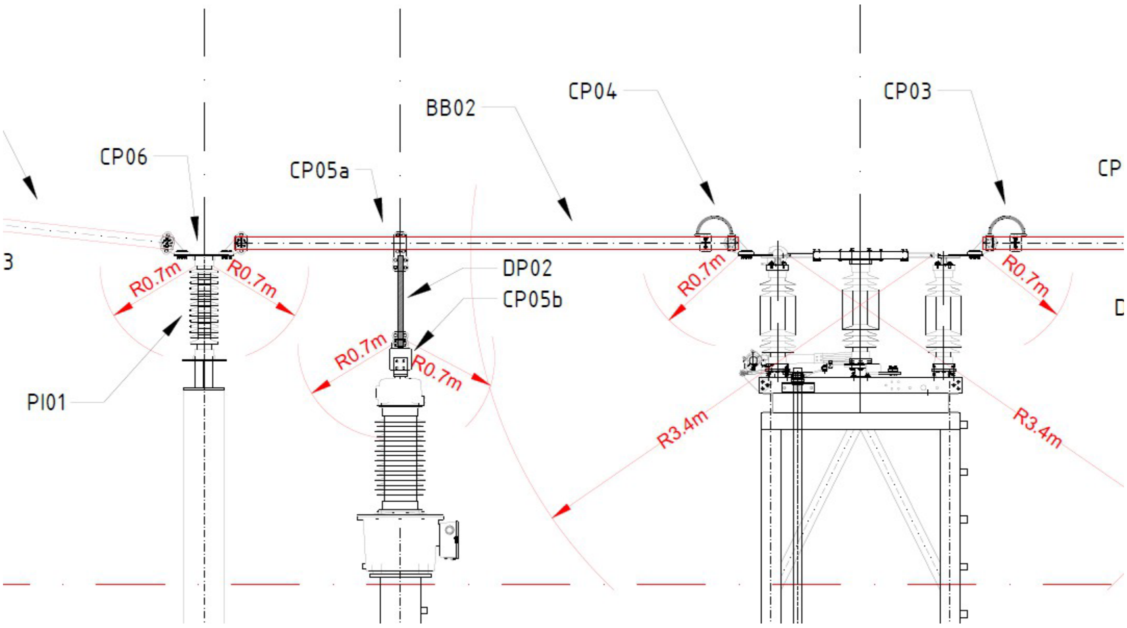

Fig. 3.2. Example of an HV apparatus safety clearances drawing detailing vertical clearances as well as types of busbars and clamps proposed

3.6. Apparatus Support Steelwork

Steelwork supporting 132(66)kV outdoor apparatus comes usually in a form of columns for standalone single phase apparatus (e.g. VTs) or crossbeam structures for combined 3-phase apparatus (e.g. disconnectors). It shall be fully made of galvanised steel and bespoke for the apparatus it supports. It shall be designed to withstand their mass and withstand mechanical forces / torques transferred from the apparatus to the steelwork and the foundation. Steelwork calculations shall be attached to the design submission.

Apart from the apparatus, steelwork shall also support required marshalling / fuse / link boxes as well as elements of the above ground earthing system. Provisions shall be made at the steelwork design phase for suitable mounting brackets. Any alteration or drilling on site shall be avoided since this may damage the galvanised coating.

4. Equipment Specification

The type of 132kV apparatus that may be subject to AUL adoption are as follows:

- Power Cables,
- Busbars,
- Disconnectors and Earth Switches,
- Circuit Breakers,
- Cable Sealing Ends,
- Surge Arrestors,
- Post Insulators
- VTs, CTs or combined VT/CT units also referred to as High Accuracy Metering (HAM) Units,
- Transformers (refer to AUL-SPEC-1051 for more information).

This may be accompanied by adequate MV (33kV or 11kV):

- Power Cables,
- Switchgears,
- Earthing / Auxiliary Transformers
- Neutral Earthing Resistors.

There are multiple manufacturers for the equipment above. To aid the connection process, there is no fixed and published list of approved providers, instead AUL are open to accept equipment approved by the host DNO and all other DNOs in the UK. The proposed equipment shall be ENA approved. It is possible to suggest using an alternative product, however this may require a thorough and time consuming review process, before making the decision.

4.1. Insulators & Bushings

For all apparatus comprising a bushing or an insulator, environmental conditions shall be taken into consideration as this determines the creepage distance of HV insulators. Mechanical cantilever withstand force is of great importance as well when selecting type of a bushing. Table 4.1. presents a set of basic technical parameters that shall be met by any insulator or bushing.

Tab. 4.1. Required parameters for 132kV bushings and insulators

Parameter	Unit	Required value	Comments
Insulation levels (HV) Um / AC / LI (132kV)	kV	145 / 275 / 650	-
Bushing / Insulator creepage distance	mm/kV	31.5mm/kV	The creepage distance can be reduced to 25mm/kV – this must be however supported by a suitable environmental report proving acceptable pollution level. For the reduction, the site must also be in a greater than 10 miles distance from the sea.
Mechanical cantilever withstand force	kN	2kN	This shall be minimum withstand force, however busbar forces calculation report is required to support each insulator choice

4.2. Switching Apparatus

In all cases the Switching apparatus shall be adequate to withstand load and short circuit currents. Environmental conditions and mechanical forces shall also be taken into consideration. Protection and operational considerations shall also be made. Table 4.2. presents a set of crucial technical parameters for switching apparatus that shall be met.

Tab. 4.2. Required parameters for switching apparatus

Parameter	Unit	Required value	Comments
Insulation levels (HV) Um / AC / LI (132kV)	kV	145 / 275 / 650	-
Bushing / Insulator creepage distance	mm/kV	31.5mm/kV	The creepage distance can be reduced to 25mm/kV – this must be however supported by a suitable environmental report proving acceptable pollution level. For the reduction, the site must also be in a greater than 10 miles distance from the sea.
Mechanical cantilever withstand force	kN	2kN	This shall be minimum withstand force, however busbar forces calculation report is required to support each insulator choice
Rated Current	A	see comment	Adequate to connection power
Short Circuit Withstand Current	kA	31.5kA	-
Control Voltage	V	110VDC	-
Type of Circuit Breaker	-	Dead / Live Tank	Both options acceptable, dead tank allows for CT installation in the bushings
Disconnector Mechanism	-	Motorised	-
Earth Switch Mechanism	-	Motorised / Manual	Subject to detailed discussion but may be manual
Control Cabinet Heater Voltage	-	230 / 110VAC	Both voltages are acceptable
Auxiliary Contacts	-	see comment	Generally as required by multicore design

4.3. Instrument Transformers

Instrument transformers usually come as a single phase CT or VT units, or combined CT/VT units (HAM Units), which shall operate with suitable marshalling / fuse boxes. It is also common to install CT in the bushing of transformer or circuit breaker which is accepted by AUL. In all cases instrument transformers shall be adequate to withstand load and short circuit currents. Environmental conditions and mechanical forces shall also be taken into consideration. Protection and operational considerations shall also be made.

Table 4.3. presents a set of basic technical parameters that shall be met by instrument transformers.

Tab. 4.3. Required parameters for instrument transformers

Parameter	Unit	Required value	Comments
Insulation levels (HV) Um / AC / LI (132kV)	kV	145 / 275 / 650	-
Bushing / Insulator creepage distance	mm/kV	31.5mm/kV	The creepage distance can be reduced to 25mm/kV – this must be however supported by a suitable environmental report proving acceptable pollution level. For the reduction, the site must also be in a greater than 10 miles distance from the sea.
Mechanical cantilever withstand force	kN	2kN	This shall be minimum withstand force, however busbar forces calculation report is required to support each insulator choice
VT construction		Inductive / Capacitive / RCVD	Inductive VT must be provided for metering, RCVD for special applications
Nominal voltage of VT primary winding	kV	132/√3 kV	-
Nominal voltage of VT secondary star winding	kV	110/√3 V	-
Nominal voltage of VT secondary open delta winding	kV	110/3 V	Open delta winding are subject to detailed protection design – only if applicable
VT voltage factor	-	1.5 for 30 seconds	-
VT Class	-	0.5/3P	VT metering class shall be 0.2 for circuits above 100MVA
Number of VT star secondary windings	-	2	If an open delta winding required it shall be another winding
VT rated power	VA	min. 50VA	Winding shall be rated at least at 50VA unless detailed burden calculations are presented
CT primary rated current	A	see comment	Adequate to connection power, single or dual ratio
CT secondary rated current	A	1A	For special or legacy applications 5A may be proposed
Metering CT class and power	-	0.2s / min. 15VA	-
Protection CT class CT and power	-	5P20 / PX	5P20 burden or PX class detailed parameters as per protection design
Number and types of CT windings	-	see comment	Subject to detailed protection design, generally metering class, 5P20 for BUP and PX class for MP

Detailed parameters of the instrument transformers are usually determined by the protection scheme.

5. Protection Design

The protection design for 132kV circuits is usually considered bespoke and discussed on an individual basis, however certain standard elements may be mentioned. Most often current based protection are used, however generation interface protection, distance protection and directional protection voltage signals are required. Usually 132kV protection CT are installed in the bushings of a Dead Tank Circuit Breaker which is its main advantage, however for live tank CBs, CT have to be located elsewhere, usually in a form of freestanding or combined with VTs units. For 132kV feeder bays, the following CT cores are required:

- Main Protection Upstream (MP-US) – Usually Differential (Biased) protection cooperating with CTs at the DNO end of the connection cable,
- Main Protection Downstream (MP-DS) – Usually Differential protection (Biased or Hi-Imp) cooperating with CTs at the customer end, downstream of the 132kV busbars, often at or spanning an 132kV/MV transformer – the opposite side CT's may then be located at the customer's HV transformer bushing or MV switchgear,
- Back-Up Protection / High Voltage Overcurrent (BUP/HVOC) – Usually Overcurrent Protection (Directional or Non-directional),
- Settlement Metering CTs – terminating at a CoP meter panel,
- Transducer CTs – allowing to remotely monitor electrical parameters of the connection.
- Spare CTs – if practicable to do so.

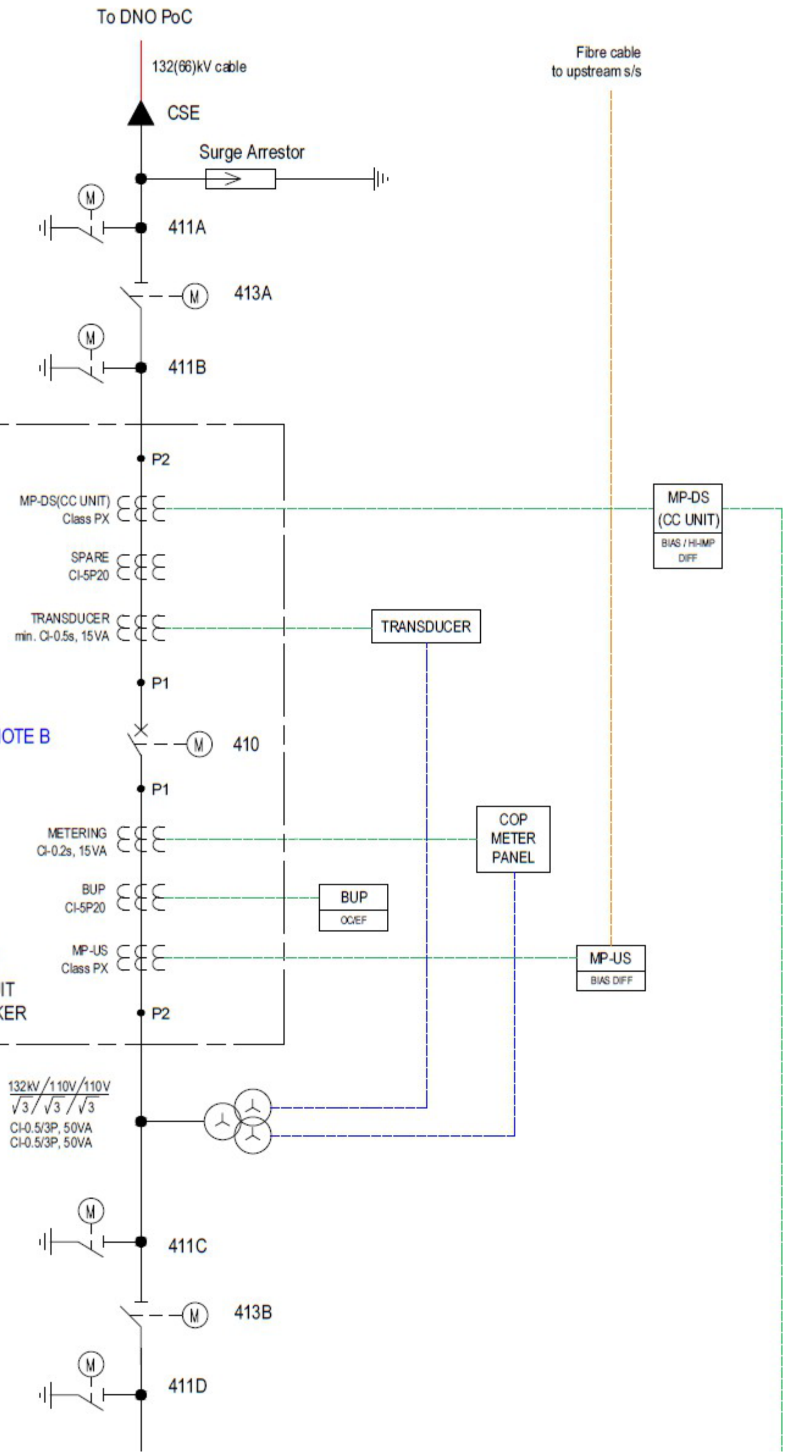

Fig. 5.1. Typical AUL 132kV feeder bay protection arrangement

Protections related to the feeder bay shall be accommodated in a AUL 132kV Feeder Protection Panel. It shall house protection relays and associated secondary circuits allowing for testing, remote and local control, signalling and SCADA interface. Refer to AUL standard drawing AUL-STD-1001 for details. The extract showing a typical protection arrangement for AUL 132kV feeder bays with a dead tank circuit breaker is presented in Fig. 5.1.

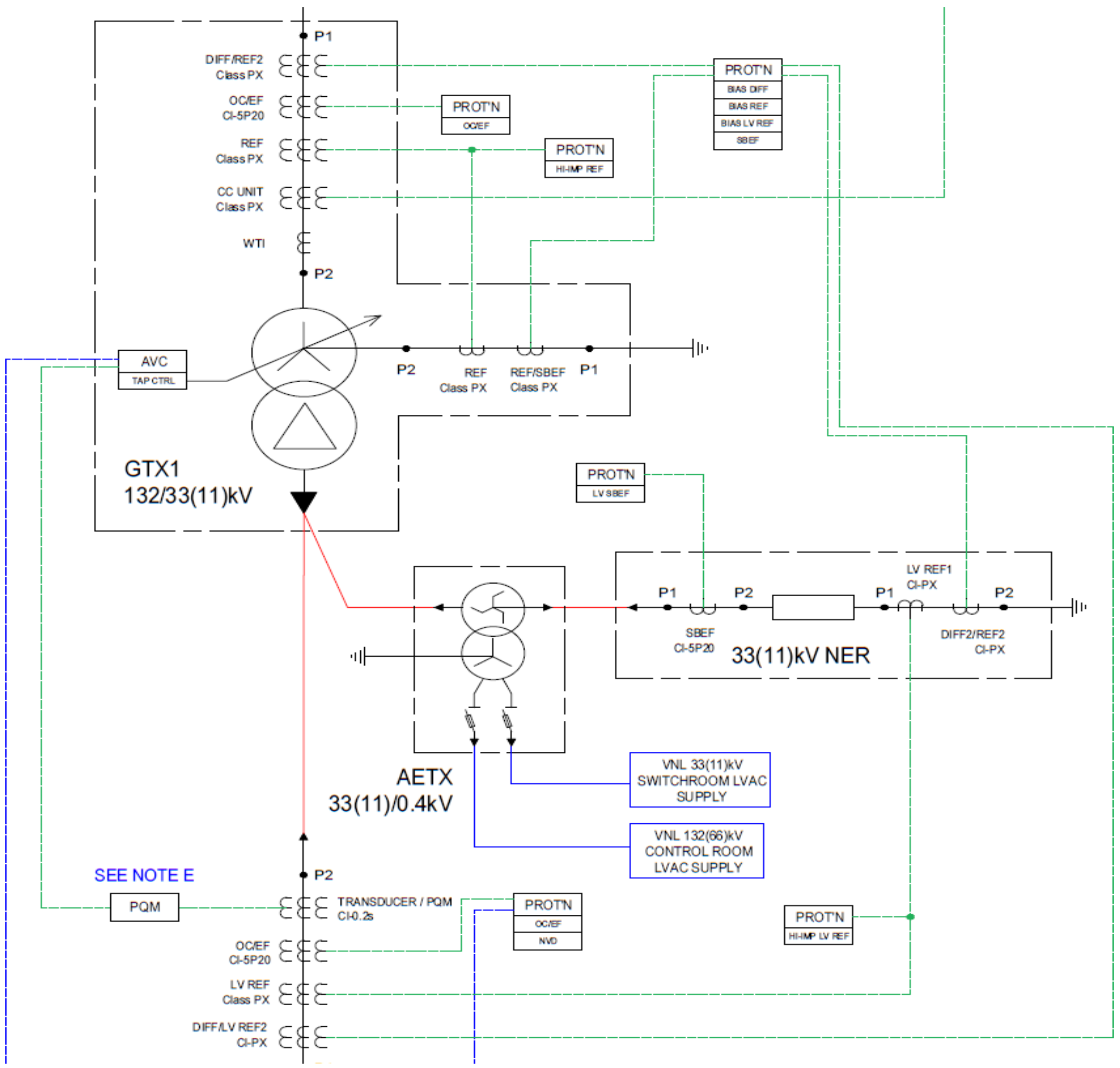

Fig. 5.2. Typical AUL 132kV Transformer bay protection arrangement

If a Grid Transformer is present and adopted by AUL it shall be equipped with the following protections:

- Biased Differential Protection – spanning circuits between CTs installed in the transformer's HV bushings and MV switchboard incomer panel,
- High Impedance Restricted Earth Fault for HV and LV windings – usually afforded by an analogue relay,
- Biased Restricted Earth Fault for HV and LV windings – usually afforded by a digital relay,
- Standby Earth Fault for HV and LV windings,
- High Voltage Overcurrent and Earth Fault.

Protections related to the transformer bay shall be accommodated in a AUL 132kV Transformer Protection Panel. It shall house protection relays and associated secondary circuits allowing for testing, remote and local control, signalling and SCADA interface. Refer to AUL standard drawing AUL-STD-1001 for details. The extract showing a typical protection arrangement for AUL 132kV transformer bays is presented in Fig. 5.2. Protection scheme is a vital part of the design, directly related to the safety of personnel and apparatus, therefore it shall be thoroughly reviewed during the approval process. Due to its importance there is limited space to compromise on or deviate from the expected scheme as shown above, however AUL remain open for discussion. The protection scheme shall take into consideration both DNO and customer's intended protection arrangements, providing adequate sensitivity and grading as well as adequately send and receive intertripping.

A Main Connection Protection / Protection Block Diagram shall be attached to the design submission.

6. Secondary Circuits Design

The Secondary Circuits design or Multicore Design shall detail all signal connection between AUL apparatus and indicate interconnections with other parties (DNO, Customer). It should allow for apparatus control, status check, intertripping and interlocking. Control / status / alarm functionality shall be local (e.g. from a protection panel) as well as remote (provisions for SCADA shall be made). Depending on the complexity of the multicore design, an Outdoor Multicore Marshalling Kiosk may be installed closer to outdoors apparatus if beneficial to do so. At interface points with the DNO and the customer, suitable interface panels shall be installed.

7. Substation LVAC Design

The LVAC supply for the substation may be derived from an Earthing / Auxiliary Transformer adopted by AUL or separate DNO LV connection. It is also accepted to derive the supply from the customer's LV network. The supply shall be accessible at an LVAC distribution board located in the AUL 132kV control room. A suitable generator socket with a changeover switch shall be provided. In most cases a 100A single-phase distribution board is sufficient. The generator socket shall be rated at least 63A.

The installation must be fully compliant with BS7671. All trunking / trays shall be galvanized steel and all switches and sockets shall be of metal clad construction. All general purpose sockets shall be provided with a 30mA RCD protection which can be afforded by and RCBO.

The LVAC distribution board shall of metal clad construction suitable for terminating SWA multicore cables and provided with a 100A 2-pole main switch. The general outgoing LV circuits requirements are as follows:

- Sufficient number of outgoing ways to feed lighting, heating and socket outlets circuits,
- Dedicated outgoing ways of D type with adequate rating for battery chargers,
- Dedicated outgoing ways for any motor drives (if applicable) of adequate rating and D type
- At least 3 spare outgoing ways

8. Substation DC Supplies

A suitable 110V battery shall be provided. The battery capacity shall be adequate so in the event of an LVAC supply loss it is capable to support the substation's standing load for 48 hours. The battery charger shall be suitable to charge the battery within 10 hours. In most cases the battery of capacity in excess of 100Ah and charger rated in excess of 10A are suitable for most applications, however if ratings lower that this are suggested, these shall be supported with battery sizing calculations. In all cases battery chargers shall have at least 1 spare DC outgoing way (2 if practicable). See section 9 for SCADA battery requirements.

9. SCADA

AUL are currently in the process of developing the SCADA system which is expected to be launched in the first half of 2024. From the design perspective it shall be treated as an operational system and it shall be included in the design provisions. The system will comprise an RTU panel and may require an external battery (24V or 48V). ICP shall then submit their designs considering the following:

- Floor space of 1000mm (D) x 1000mm (W) reserved for the RTU installation,
- Floor space of 600mm (D) x 900mm (W) reserved for SCADA battery charger installation,
- Two LVAC outgoing ways reserved for SCADA equipment,
- Alarm and control multicore wiring to SCADA

10. AUL Control Room

AUL 132kV Control Rooms shall be generally brick build, offering relatively low maintenance and high security. Other materials like GRP or containerised steel enclosures are also acceptable, however may require additional considerations or discussions in terms of its longevity and security. A Control Room shall house all equipment required for control and protection of the 132kV compound together with LVAC Small Power and Lighting installation for their supply. Main pieces of equipment present in the control room are as follows:

- 132kV incomer / feeder / transformer Protection Panel – separate panel for each bay,
- 110V Battery,
- SCADA battery (see section 9),
- DNO Interface Panel,
- Customer Interface Panel,
- LVAC board.

It shall be ensured that suitable space is provided for convenient access to each panel to open its door without any clashes and for its withdrawing if replacement needed. All escape routes shall be at least 750mm wide. Equipment may have top or bottom multicore entries. Suitable floor multicore trench or multicore wall suspended installations are acceptable.

The control room foundation may be of a bunded design or the enclosure may be installed on stilts. Control room may also be adjacent to an MV switchroom or be housed in the same enclosure provided that there is a partition wall and separate entries to each room. Care shall be taken to ensure adequate internal conditions inside the control room in terms of temperature and humidity.

11. Site Access

AUL require unrestricted 24/7 access to their apparatus. Access road shall be at least 4.5m wide and suitable for a low-loader trailers. As far as practicable, access from the public highway to the substation shall be provided so that AUL personnel do not need to pass though any gates or security control points.

12. Flood Resilience

AUL substations shall be designed in such way that it minimises the flood risk. Generally the site's finished ground level shall be at least 500mm above the most significant foreseeable flood event. Care shall be taken so the presence of any ducts of cable entries do not breach any flood defences. If the flood risk is recognised using a desktop study, a detailed Flood Risk Assessment shall be provided and suitable mitigation measures proposed.

13. Earthing Requirements

When designing the earthing system for AUL 132kV compound a conscious effort shall be taken to minimise the earth system resistance as far as practicable. In any case earthing system shall ensure the resultant values of touch and step potential are kept within safety limits. A detailed earthing study shall be carried out by a professional consultant and a bespoke earthing electrode layout shall be developed for each site. Generally the following points shall be considered:

- Earth electrode cross-sectional area and all other above or below ground earthing/bonding connections shall be adequate to the expected earth fault currents,
- AUL earthing system shall be combined with DNO/customer earth systems as far as practicable, with means of systems disconnection provided,
- All control rooms / Switchrooms shall have internal earth bars installed that provide interface between internal and external earthing systems,
- All switching apparatus and their supporting steelwork as well as all outdoor marshalling cabinets shall be connected to the earthing system
- All construction elements of transformers, including cable boxes and tanks shall be connected to the earthing system directly or via local earth bars,
- All transformer star windings neutral points of all voltages shall be connected directly to the earthing system unless explicitly designed and supported the decision not to – exceptions may be dictated by DNO (e.g. floating HV star point) or some MV transformers windings that are connected to earth through impedance (e.g. NER),
- Enclosures of Neutral Earthing Resistors (NER) as well as LV side terminal or resistive element shall be connected directly to the earthing system,
- Earthing terminals or Surge Arrestors and Capacitive Voltage Transformers shall be connected to High Frequency Earth Rods. The high frequency leads shall be routed so there is as little and as gentle bends on their route as practicable to keep their impedance at high frequency as low as possible

Earthing design shall be always supported by an earthing study report, earth electrode layout and above ground earthing connections drawings.

14. Referenced Documents

List below provides other AUL relevant documents:

1) 132(66)/33(11)kV Grid Transformers and associated Earthing Transformers and Neutral Earthing Resistors – Specification
2) AUL Standard 132kV Connection – Site Layout and SLD

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