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SUBSTATION LVAC SUPPLIES

TABLE OF CONTENTS

PURPOSE AND SCOPE	1
PART 1 – PROCEDURAL	1
1 PROCESS	1
2 GENERAL SYSTEM REQUIREMENTS	2
3 SPECIFIC REQUIREMENTS	4
4 DIESEL GENERATOR SPECIFIC REQUIREMENTS	7
5 CONTROL AND PROTECTION GENERAL REQUIREMENTS.	10
6 TEST REQUIREMENTS	14
7 FORMS AND RECORDS	18
PART 2 - DOCUMENT HISTORY	18
8 DEFINITIONS	18
9 AMENDMENTS RECORD	19
PART 3 - GUIDANCE NOTES AND APPENDICES	20
10 REFERENCES	20

PURPOSE AND SCOPE

This document defines the technical procurement requirements for 400V 3-phase LVAC power supplies systems, (previously referred to as 415 V supplies), within a substation.

It is intended to cater for the connection arrangements of primary LVAC equipment within a substation environment, ie switchgear distribution boards both within the LVAC room and remote secondary supply locations (if applicable), the standby diesel generator and its associated changeover panel facilities. It does not cover secondary equipment requirements installed away from the switchgear listed above, ie transformer marshalling kiosks and cooling circuits, interconnecting cables or any non-operational specific equipment such as LVAC supplies to offices, blockhouses or stores all of which are all adequately covered by relevant British Standards.

PART 1 – PROCEDURAL

1 PROCESS

This specification makes reference to and should be read in conjunction with the documents listed within the references section of this document. Its intention is to provide the minimum functional requirements needed to be met in order to comply with type registration procedures.

Where a British Standard is equivalent to or identical with an IEC document, both references are given.

1.1 Type Registration

1.1.1 Type Registration is a documented, risk managed process, which enables National Grid to verify that substation LVAC supply equipment offered to and purchased by National Grid comply with the requirements detailed within this Technical Specification.

1.1.2 The equipment manufacturer or the lead supplier who offers up equipment to National Grid must undertake and implement the type registration process philosophy outlined within TGN(E)185 – Type Registration to meet the performance and test requirements listed within this document. Submissions offered which are ambiguous, part complete or not in accordance with the format detailed within Appendix A of TGN(E)185 will be rejected.

Supporting justification must be provided if alternative international standards are offered to those detailed within this specification. Under no circumstances will inferior standards take precedence.

As a checklist, the manufacturer or lead supplier should ensure:

- a) The complete system satisfies the requirements of this specification.
- b) The system and/or its sub-components have been type tested in accordance with the relevant British or International Standards.
- c) The system and its sub-components are of adequate strength and capability for the specified duty.
- d) Type test reports from an accredited testing station (or other evidence by agreement with National Grid) for the system and its sub-components shall be made available to National Grid upon request.
- e) The type registration pack is complete prior to its submission.

1.1.3 Equipment needing type registration includes:

- a) LVAC switchgear packages, that is the switchboard, associated on-board switching devices and any supporting subsystems.
- b) Diesel generator packages, that is the diesel engine, its supporting subsystems and the alternator

1.2 Site Supply Arrangements

- 1.2.1 The effective operation of a transmission substation is dependent on the security of its LVAC auxiliary supplies when subject to normal and standby running arrangements. To achieve the required level of security, substations should be configured to comply with the National Grid policy statement, PS(T)068 - Low Voltage Alternating Current (LVAC) Auxiliary Supplies for Transmission Substations.

2 GENERAL SYSTEM REQUIREMENTS.

2.1 LVAC Equipment Electrical Ratings

- 2.1.1 The rated insulation voltage of the equipment must be no less than 660V A.C.
- 2.1.2 Equipment which provides fault current interruption shall be selected from one of the two following options:-

Short Circuit Breaking Capacity kA (rms)	Power Factor	Duration (seconds)
20 – 50	≤ 0.25	1.0
> 50	≤ 0.2	1.0

Informative Note: In order to obtain the power factor requirements for a particular installation it may be necessary to specify the higher short circuit breaking capacity.

2.2 General Equipment Performance Requirements

- 2.2.1 The LVAC system shall be fully rated and selected such as to be capable of supplying the site's connected loads in accordance with PS(T) 068 – Low Voltage Alternating Current (LVAC) Auxiliary Supplies for Transmission Substations.

For the avoidance of doubt, the diesel generator package should be sized so as to maintain the full HV operational capacity of the site. In other words, that the site will not be de-rated as a consequence of being supported by its diesel generator(s). Its sizing should take into account all connected standing loads plus the dynamic loads imposed from the largest connected block load or induction motor connected device.

For all non HV operational loads, a diversity factor of 0.8 shall be applied

In specifying the equipment the designer should consider:

- a) The site load demands from its connected LVAC loads.
 - b) Any legacy partitioning (essential/standby configurations) of the LVAC board remaining following replanting.
 - c) Any forecasted re-planting schemes that may effect the overall HV rating of the site.
 - d) The ability of the system to meet the application of large block or large induction motor connected loads whilst meeting the regulation performance requirements detailed within 4.2.3.
- 2.2.2 The LVAC system should accommodate a +10% load growth prediction to that of the current design requirements without modification to the equipment housing or building.

2.3 Asset Life Requirements of Equipment

- 2.3.1 Equipment, the on-board supporting subsystems and the housings / enclosures of the equipment shall have an overall projected asset life of 25 years, in accordance with PS(T)EPS 12.1. Where this is not achievable, the manufacturer shall list those components within the solution offered together with their projected lives at the time of the type registration submission.
- 2.3.2 Under no circumstances shall components declared as having an asset life less than 25 years limit the life expectancy of the overall system or asset. Components replaced on the equipment (consumables) under the manufacturers normal maintenance schedules should not be considered.

2.4 Work Area Layout Design

- 2.4.1 Design for Adequate Work Space

The positioning of equipment within a room or work space, if done badly, can present a hazard to those present who have a right for access, e.g. persons undertaking maintenance activities on the equipment or on equipment in its vicinity.

To promote a safe working environment, minimum distances must be designed into the installation that allow both safe access and egress to and from the point of work and a minimum work area requirement for persons to undertake all expected maintenance/repair/replacement activities once at the point of work.

The philosophy for calculating appropriate dimensions is taken from BS EN 547-1 *Safety of machinery. Human body measurements. Principles for determining the dimensions required for openings for whole body access into machinery.*

Examples of acceptable dimensions are given below:

- a) When access is required behind a relay panel or LVAC switchboard etc for work above waist height.

Minimum head height: 2100mm, Minimum passageway width: 750mm
- b) When access is required behind a relay panel or LVAC switchboard etc for work below waist height that requires a kneeling or sitting stance.

Minimum head height: 2100mm, Minimum passageway width: 1100mm
- c) Maintenance reach levels into enclosures or equipment housings etc:
 - (i) Standing: 900-1500mm
 - (ii) Kneeling: 600-1200mm
 - (iii) Sitting: 300-900mm

2.4.2 Provisions for Ancillary Support Equipment Within a Work Area Design

Consideration should be given within the work area for the provision of facilities that will aid staff to implement general maintenance or breakdown conditions. Examples of good design may include a hoisting arrangement within the diesel room for use during major engine work, or the provision for a 3-phase 400V plug-in outlet local to GIS switchgear for use by portable equipment such as SF6 gas handling carts or Oil handling plant.

3 SPECIFIC REQUIREMENTS

3.1 Switchboard Requirements

- 3.1.1 All incoming supplies (normal and standby) shall be controlled by circuit-breakers at the distribution board. Where a single distribution board is provided, alternative switching devices with equivalent isolation and ease of maintenance may be offered subject to the agreement of National Grid.
- 3.1.2 The switchboard assembly shall comply with the requirements of BS EN 60439-1, and shall be provided with a nameplate as detailed BS EN 60439-1 clause 5.1. Individual devices and self-contained components shall comply with the appropriate BS EN or other relevant standard.
- 3.1.3 Switchboard separation of circuits shall be as specified in BS EN 60439-1 Clause 7.7 Form 4. Rigid metallic or non-metallic barriers or partitions shall provide separation.
- 3.1.4 All equipment supplied shall be provided with the following degrees of protection against ingress of objects and moisture, as specified in BS EN 60529.
 - a) Outdoor Equipment

The level of protection during normal operation shall be IP54. With access doors open, without the use of tools, the level of protection of live electrical conductors shall be IP20.
 - b) Indoor Equipment

The level of protection during normal operation shall be IP31. With access doors open, without the use of tools, for the level of protection of live electrical conductors shall be IP20.

Informative Note: Switchgear small wiring cable termination blocks which are used to interface between the substation and the switchgear shall be positioned on the equipment so as to be freely accessible for maintenance and faultfinding activities without staff being exposed to any live busbar or cable circuit components.

- 3.1.5 Principle incoming and outgoing cable circuit terminations within the LVAC equipment should be sited to provide sufficient clearance to ensure that recommended cable radii can be maintained for all foreseeable circumstances. Where a single stud termination is used mechanical phase separation shall be provided.
- 3.1.6 Interconnection into the small wiring of the installation from the substation shall comply with the appropriate requirements of TS 2.19.
- 3.1.7 All normal and standby supply incoming circuits shall be provided with a lockable selectable local close/open control switch
- 3.1.8 All normal and standby supply incoming circuits shall be provided with a lockable selectable automatic/manual control switch.
- 3.1.9 All normal and standby supply incoming circuits shall be provided with meters indicating incoming phase and line voltages and phase load currents.

Information Note1: A phase selectable switch to facilitate these requirements is acceptable

Informative Note2: Ammeters shall be selected so that maximum site load demand currents gives approximately 75 per cent full-scale deflection.

Informative Note3: Multi-function instruments are acceptable.

- 3.1.10 All normal and standby supply incoming circuits shall be provided with load demand indication.

Informative Note: Individual phase ammeters with maximum demand indication (reset slave pointer) will normally suffice.

- 3.1.11 The switchboard should be earthed to the substation main earthing system with a fully rated conductor. Consideration should be given to preventing transfer potentials into the LVAC network seen under substation primary fault conditions. Guidance on techniques are described within TS 3.1.2 – Earthing.

3.2 Circuit Breaker Requirements

- 3.2.1 Circuit-breakers shall comply with the requirements of BS EN 60947-2 and shall be fitted with a label detailing the data listed in Clause 5.2 of BS EN 60947-2.
- 3.2.2 Circuit-breakers shall be a withdrawable type; the withdrawable mechanism shall be fitted with a reliable indicating device to show the contact position.
- 3.2.3 Circuit-Breakers shall be self supporting in the isolated and withdrawn position.
- 3.2.4 The Circuit-Breakers shall be provided with a device to support the unit when removing from the switchboard when manual handling derived acceptable weight limits are exceeded.
- 3.2.5 Interlocks shall be provided which only permit the isolating contacts to separate or re-close with the circuit-breaker open.

- 3.2.6 The circuit-breaker shall normally be provided with lockable shutters on both the incoming and outgoing isolation contacts. The shutters shall be clearly identified. Shutters are not required where a degree of protection conforming to Class IP20 of BS EN 60529 is provided when the circuit-breaker is removed from its enclosure. The circuit-breaker shall be lockable in the isolated position and shall satisfy the additional safety requirements for isolation specified in BS EN 60947-2 Sub-clause 7.1.2.
- 3.2.7 Closing - The closing mechanism shall be of the stored energy type as defined in BS EN 60947-2 Sub-Clause 7.2.1.1.5, or shall be supplied from a no-break power supply. Stored energy systems shall be automatically recharged.
- 3.2.8 Opening - The circuit-breaker shall be trip free and shall have the energy for tripping stored via the closing operation.
- 3.2.9 Utilisation Category - shall be 'A' in accordance with BS EN 60947-2 Table (iv).
- 3.2.10 Trip supply supervision shall be provided.
- 3.2.11 Mechanical indication of the circuit breaker status shall be clearly visible to the operator of the switchgear.

3.3 Fuse-Switch Disconnectors and Switch-Disconnectors Requirements

- 3.3.1 This equipment shall comply with the general requirements of BS EN 60947-3, and as defined in Clause 2 of that Standard.
- 3.3.2 The equipment type shall be "Independent manual operation".
- 3.3.3 The equipment utilisation category shall be AC23A or AC23B as defined in BS EN 60947-3 Clause 4.4 Table 11.
- 3.3.4 The devices shall fully comply with the additional constructional requirements for equipment suitable for isolation as specified in BS EN 60947-3 Clause 7.1.6.1.
- 3.3.5 Outdoor equipment shall be lockable when switched to both closed and open positions. Unless otherwise specified by National Grid, indoor equipment shall be lockable in the open position only. The locking facility shall be suitable for padlocks specified by National Grid.
- 3.3.6 Where opening of any access door removes the locking feature, an additional internal feature capable of locking the device in the open position shall be provided.
- 3.3.7 Mechanical interlocking shall prevent access unless the equipment is in the open position. It shall be possible to defeat this interlock by use of special tools with the door or access cover open; however it shall not be possible to close the door or access cover unless the interlock has been restored.
- 3.3.8 The equipment shall be marked as specified in BS EN 60947-3 Clause 5.2.

3.4 Contactor Requirements (Where Applicable)

- 3.4.1 This equipment shall comply with the general requirements of BS EN 60947-4-1.
- 3.4.2 Contactors shall be of the electromagnetic, non-latching type unless otherwise specified.
- 3.4.3 The equipment utilisation category shall be AC3, defined in BS EN 60947-4-1 Clause 4.4 Table 1.
- 3.4.4 Contactors shall be marked as specified in BS EN 60947-4-4 Clause 5.2.