WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Company Directive

STANDARD TECHNIQUE: SD3A/2

Relating to Low Voltage AC Supplies at 33kV and 66kV Substations

Policy Summary

This document specifies the requirements for LVAC auxiliary supplies at primary substations and 33kV and 66kV metered connections.

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Implementation Date: September 2015

Approved by

Policy Manager

Date: 18 September 2015

IMPLEMENTATION PLAN

Introduction
ST:SD3A/1 specifies the requirements for Low Voltage AC (LVAC) auxiliary supplies at 33kV and 66kV substations.

Main Changes
A page amendment has been made to clause 2.2.2.2. Further details are included within the Document Revision Table.

Impact of Changes
For generator connections, it is acceptable for G59 protection to initially disconnect LVAC supplies as long as they are automatically restored within a few seconds via an alternative LV connection or a permanently installed and adequately maintained and fuelled standby generator.

Implementation Requirements
This document shall be implemented in full for new 33kV and 66kV substations and when changes are made to an existing substation that directly affect the LVAC supplies or the ability to restore them. Duplicate LVAC supplies shall be provided retrospectively at substations with two or more 33kV or 66kV transformers when a new primary transformer is installed, or a transformer is replaced.

Managers shall ensure all staff and contractors involved with the design, installation, operation and maintenance of Western Power Distribution's 33kV and 66kV substations are familiar with the requirements of this Standard technique.

Implementation Timescale
This document shall be implemented immediately, with the following exception:

- For Offers made by WPD on or before the date of issue of this document that are accepted within the validity period, the associated LVAC supplies may comply with the requirements of the previous version of this document (i.e. ST:SD3A) as long as the installation and commissioning is completed by 1st January 2016.

REVISION HISTORY

Document Revision and Review Table		
Date	**Comments**	**Name**
July 2015	The following page amendment has been included: • The final paragraph of 2.2.2.2 has been added to allow the use of permanently installed standby generation or an alternative switched supply to automatically restore LVAC supplies following the operation of G59 protection.	A Hood
March 2015	The following changes have made: • Document has been rebranded • Duplicate LVAC supplies shall be provided at substations with two or more 33kV or 66kV transformers • It must be possible to restore LVAC supplies within 6 hours. • Sockets and, where necessary changeover switches shall be provided for critical equipment to facilitate the connection of mobile generators • LVAC supplies for single customer substations that include critical protection systems shall be provided by WPD. • LVAC supplies to single customer substations that do not include critical protection systems may be provided by the customer. • LVAC supplies shall not be disconnected by the customer's generator interface protection (G59 protection).	A Hood

1.0 INTRODUCTION

1.1 This Standard Technique defines requirements for Low Voltage AC (LVAC) auxiliary supplies at 33kV and 66kV substations, including 33kV and 66kV metered connections.

1.2 Where any difficulty is encountered with the application of this policy, the author should be notified, who will consider if a variation is appropriate.

2.0 POLICY

2.1 General

2.1.1 LVAC supplies shall be provided at all 33kV and 66kV substations for auxiliary loads, such as lighting, battery chargers, tap-changer motors, spring charge motors, sockets and heating etc.

The following arrangements may be used for this purpose:

- Appropriately fused 11kV/LV or 6.6kV/LV auxiliary transformer connected to a 33kV or 66kV incoming transformers. Specifications for auxiliary transformers are included in EE SPEC:8.
- Dedicated ground mounted distribution transformer ringed into the most reliable HV feeder circuit (e.g. shortest circuit or smallest proportion of overhead line) via a ring main unit.
- Dedicated pole mounted transformer teed into an HV overhead circuit.
- Dedicated HV circuit breaker and transformer.
- LVAC derived from a local LV network. This is only acceptable where the 33/66kV substation is a cold site[1].

2.1.2 At sites with more than one Western Power Distribution (WPD) owned 33kV or 66kV transformer the LVAC supplies shall be duplicated. The preferred method of achieving this is to provide two or more 11kV or 6.6kV auxiliary transformers at the site. Each auxiliary transformer is connected directly to a 33kV or 66kV transformer.

2.1.3 At sites with only one WPD owned transformer duplicate LVAC supplies are not normally required, however, where the LVAC supplies are derived from an auxiliary transformer (connected to the 33kV or 66kV transformer) an alternative LVAC supply shall be provided. This is because the auxiliary transformer is likely to be disconnected for long periods of time when the transformer or its associated circuit are shut down for maintenance.

[1] *A cold site is either:*

- *A substation with a rise of earth potential that does not exceed 430V RMS, or*
- *A substation where the power circuits contributing to the earth fault current are high reliability type, having an operating voltage of 33kV or greater and controlled by switchgear with main protection that will clear earth faults within 500mS and generally within 200mS that has a rise of earth potential not exceeding 650V.*

2.1.3 Whichever option is selected, it shall be possible to restore LVAC supplies to the substation within 6 hours on failure of the main supply. Options for restoring LVAC supplies may include:

- Manual or automatic changeover arrangement (for duplicate LVAC supplies).
- HV switching to restore the associated distribution transformer.
- LV linking. This option is only acceptable if the 33/66kV substation is a cold site[1].
- Connection of a mobile generator.
- Use of a permanently installed standby generator.

2.1.4 Sockets and, where necessary, manual changeover switches shall be provided to facilitate the connection of mobile generators in order restore LVAC supplies to critical items of equipment quickly. Critical items of equipment may, for example, include battery chargers, tap-changers and AC spring charger motors etc.

2.2 Single Customer Sites

The requirements for 33kV and 66kV substations that are dedicated to one customer and that are expected to be dedicated to a single customer for their entire life (e.g. 33kV and 66kV metered connections) are given below:

2.2.1 Sites with critical protection systems

2.2.1.1 Critical protection systems are those that are deemed to be critical to the security or stability of Western Power Distribution's (WPD's) 132kV, 66kV or 33kV system, for example, where a substation is ringed in to WPD's network and the relays at the site are used to protect WPDs circuits.

2.2.1.2 LVAC supplies to critical protection equipment shall be derived from WPDs network using one of the methods described in 2.1.1 and shall not be derived from the customer's network.

2.2.2 Sites with non-critical protection

2.2.2.1 Non-critical protection systems are deemed to be those that are not critical to the protection of WPD's 132kV, 66kV or 33kV system. An example of non-critical protection is where a substation is teed into WPD's network and the main function of the relays at the site is to protect the customer's installation.

2.2.2.2 LVAC supplies to non-critical protection systems may be derived from the customer's LV network as long as:

- The LVAC voltage is maintained between 400/230V RMS +10%, -6% and has a frequency of 50Hz +/-1%.

- The LVAC supply is firm. The customer must restore the LVAC supply within 6 hours, should the main LVAC supply fail, for any reason.

- At sites with embedded generation, the LVAC supply is not disconnected when the Customer's generator protection or G59 interface protection operates.

In this context, it is acceptable to initially disconnect the LVAC supplies as long as they are then automatically restored within a few seconds via an alternative LV connection or by a permanently installed and adequately maintained and fuelled standby operator.

2.2.2.3 Customer's may back up the LVAC supplies using a fixed standby generator or a mobile generator. Where the customer uses a generator to back up the main LVAC supply they must ensure it is adequately maintained, periodically tested and has a sufficient supply of fuel to maintain the LVAC supplies for as long as is required.

2.3 Auto-changeover Arrangements

2.3.1 Auto-changeover facilities for the LVAC supplies are not normally provided at 33kV and 66kV substations but may be provided where:

- This improves network performance (i.e. reduces Customer Minutes Lost), or
- The additional cost can otherwise be financially justified.

2.3.2 An example of where an automatic changeover arrangement may be warranted is where a substation has circuit breakers with AC spring charge motors. In this case an HV fault that disconnects the LVAC will prevent the closing springs from charging and will restrict the ability to sectionalise and restore the faulty circuit quickly. An alternative way of resolving this issue could be to replace the AC spring charge motors with DC motors.

3.0 BACKGROUND

3.1 Auxiliary Loads

3.1.1 The following equipment typically requires an LVAC supply:

- Tap-changers (3 phase and single phase)
- Fans and pumps for transformer forced cooling
- Battery chargers (associated with batteries for switch-tripping, relay supplies and telecommunication)

- AC motor-wound spring charging for closing circuit breakers
- AC Lighting
- AC indication
- Line isolation units (some types)
- EMU terminals (at only a few locations).

3.2 **Standard Arrangements**

3.2.1 The options described in 2.1.1 are shown in Figure 1, 2 3, 4 and 5, below:

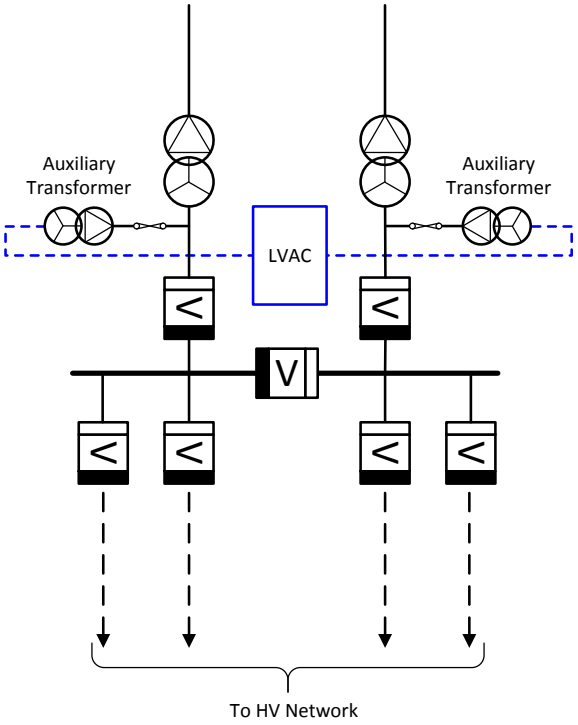

Figure 1 LVAC supplies derived from auxiliary transformers

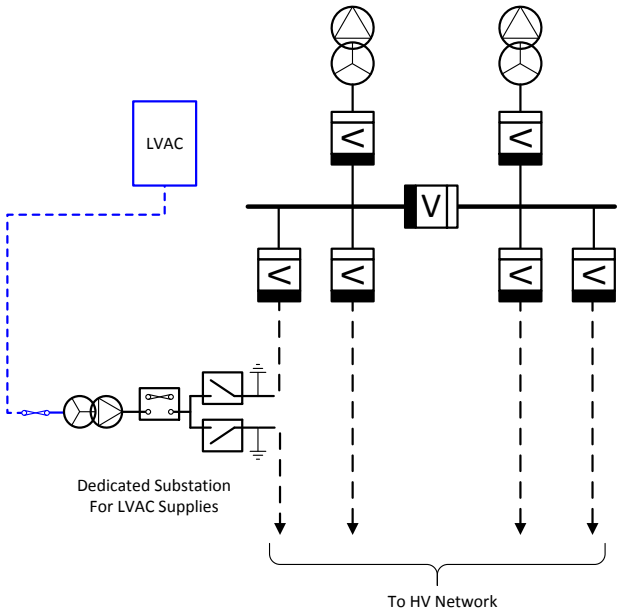

Figure 2 LVAC supplies derived from dedicated ground mounted substation

* Note, duplicate LVAC supplies are required for sites with two or more WPD owned 33kV or 66kV transformers

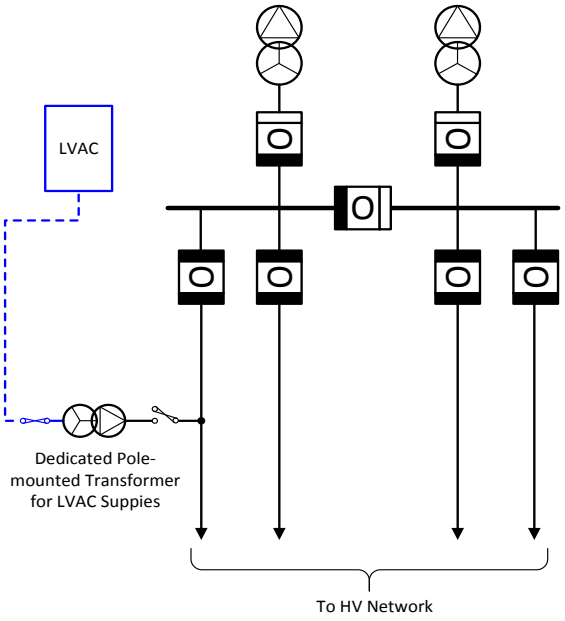

Figure 3 LVAC supplies derived from dedicated pole-mounted transformer

* Note, duplicate LVAC supplies are required for sites with two or more WPD owned 33kV or 66kV transformers

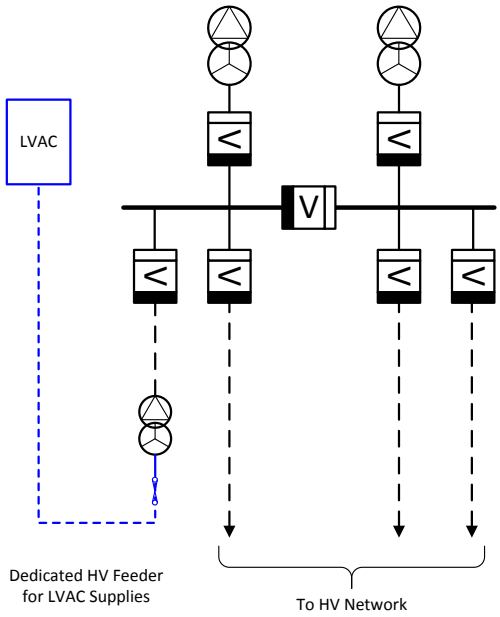

Figure 4 LVAC supplies derived from dedicated HV feeder

* Note, duplicate LVAC supplies are required for sites with two or more WPD owned 33kV or 66kV transformers

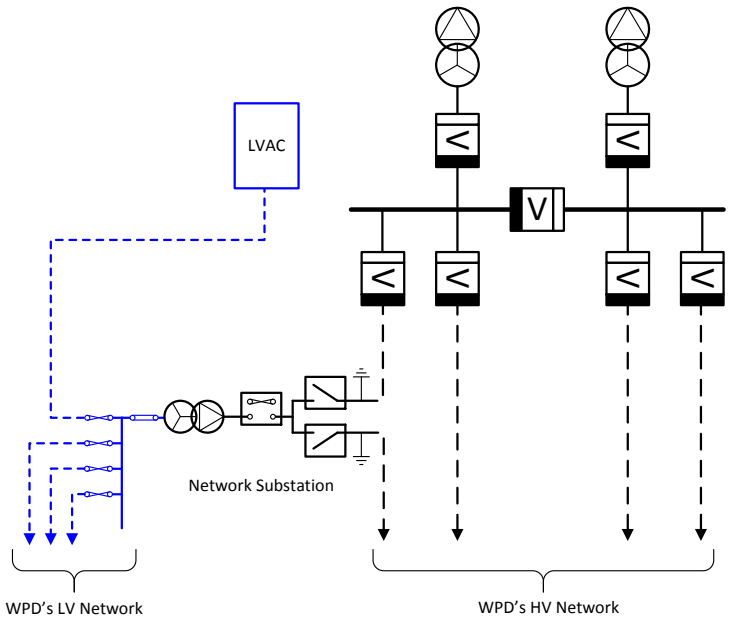

Figure 5 LVAC Supplies derived from LV network

* Note, duplicate LVAC supplies are required for sites with two or more WPD owned 33kV or 66kV transformers

APPENDIX A

SUPERSEDED DOCUMENTATION

This document supersedes ST:SD3A/1 dated March 2015 which is now withdrawn.

APPENDIX B

ASSOCIATED DOCUMENTATION

POL: SD4	HV System Design
POL: TP6	Requirements for auxiliary supplies, control functions and alarms
ST: TP6K	Substation Battery and Charger Selection
ST: TP21B	Design and Installation of Fixed Earthing Systems - Major Substations
EE SPEC: 89	Fixed Earthing Systems for Major Substations

APPENDIX C

KEYWORDS

LVAC, Auxiliary Supplies, Primary Substation, Customer Minutes Lost, Duplicate Supplies, Auto-changeover