Electricity Distribution

nationalgrid

Company Directive

STANDARD TECHNIQUE: SD11D

Requirements for Category D Load Management Schemes - Overload Protection

Policy Summary

This document specifies the requirements for **Category D Load Management Schemes (LMSs)** including the network design requirements. **Category D LMSs** utilise overcurrent and/or thermal protection to disconnect overloaded plant and/or equipment.

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Implementation Date: **April 2022**

Approved by

Carl Ketley-Lowe
Engineering Policy Manager

Date: **26th April 2022**

Target Staff Group	**Staff involved with the analysis, design, construction, maintenance, replacement, operation and control of Western Power Distribution's network**
Impact of Change	**Red - The document specifies the requirements for Category D Load Management Schemes**
Planned Assurance checks	**1 year after the issue of this document the author will audit a number of new / significantly modified Category D LMSs to check that the requirements have been implemented.**

All references to Western Power Distribution or WPD must be read as National Grid Electricity Distribution or NGED

IMPLEMENTATION PLAN

Introduction

ST: SD11D specifies the detailed requirements for **Category D Load Management Schemes (LMSs)**. These schemes utilise overcurrent and/or thermal protection to disconnect overloaded items of plant and/or equipment.

Main Changes

This is a new document.

Impact of Changes

Target Staff Group	**Staff involved with the analysis, design, construction, maintenance, replacement, operation and control of Western Power Distribution's network**
Impact of Change	**Red - The document specifies the requirements for Category D Load Management Schemes**

Implementation Actions

Managers shall ensure that staff involved in the design, installation, maintenance, modification, operation and control of load management schemes are aware of and follow the requirements of this document.

A short presentation video is available <here>

Implementation Timescale

This document is implemented on issue for new and substantially modified **Category D LMSs**.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
April 2022	• New document	Andy Hood

Contents

1.0 INTRODUCTION

This document describes the requirements for the application of **Category D Load Management Schemes (LMS)**. It shall be read in conjunction with POL: SD2, POL: SD3, POL: SD4, POL: SD5 and POL: SD11 as applicable.

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

2.0 DEFINITIONS

2.1 **Category D**: A category of **LMS** that utilises local overcurrent, overpower or thermal protection relays to disconnect load to mitigate overloads on items of plant and / or equipment.

2.2 **Category Z:** A category of **LMS** that does not satisfy the prerequisites associated with any other category of **LMS**.

2.3 **Demand Security**: The ability to meet customer demand under **Intact Network** and outage conditions.

2.4 **Generation Security**: The ability to accept customer export under **Intact Network** and outage conditions.

2.5 **Intact Network**: A network operating with open points in their normal position and without any outages that are material to the condition being considered or studied. The **Intact Network** arrangement shall be agreed between Primary System Design, Network Services, Network Strategy, Operations Support and Control and indicated on network diagrams and Western Power Distribution's control systems (PowerOn Fusion etc.).

2.6 **Load:** The apparent power (e.g. kVA or MVA) associated demand, generation and/or electrical energy storage.

2.7 **Load Management Scheme:** Plant, equipment and software systems that together manage network loading and voltages by either controlling demand and/or generation connected to the network, operating switchgear to change the topology of the network and/or controlling the settings of tap-change controllers, reactive compensation equipment and flexible power links.

Examples of **Load Management Schemes** include but are not limited to:

- Operational Intertripping
- Active Network Management (ANM)
- Soft-intertripping
- Timed connections
- Overload protection
- Auto-changeover
- Voltage constraint systems
- Remote control of switchgear or other plant and equipment
- Flexibility Services

The following are outside of the scope of this definition:

- Customer Limitation Schemes (i.e. export or import limitation schemes owned by a customer)
- Conventional independent tap-change control schemes
- Network protection for fault clearance
- Loss-of-mains protection, including loss-of-mains intertripping

2.8 **Network Integrity**: The ability of a network to operate within thermal, voltage and other technical limits, excluding frequency-related limits, under both **Intact Network** and outage conditions.

2.9 **Secured Outage**: An outage or combination of outages after which **Demand Security, Generation Security**, **Network Integrity** and **System Integrity** requirements must be satisfied in design studies. Further guidance is provided in POL: SD2, POL: SD3, POL: SD4, POL: SD5 and POL: SD11, as applicable.

2.10 **System Integrity**: The ability of the GB system to operate within acceptable frequency-related technical limits under both **Intact Network** and outage conditions.

System Integrity is primarily managed by National Grid, but it can be affected by the operation of WPD's network and customers. This includes but is not limited to:

- Low Frequency Demand Disconnection
- Generator Interface Protection
- Changes in net **Load** caused by protection operation, manual intervention or the operation of **LMSs**.

3.0 POLICY

3.1 General Requirements

3.1.1 **Category D LMSs** shall be designed and operated to:

- locally measure[1] current flowing through items of plant and/or equipment and where necessary voltage, to determine if the plant or equipment is overloaded[2]
- determine when the plant / equipment is overloaded
- trip local circuit breakers and/or intertrip remote circuit breakers to disconnect load connected to the affected plant/equipment in order to mitigate the overload

Note 1: ***Category D LMSs*** *shall be located at the same site as the CTs and VTs used to measure the current and voltage.*

Note 2: *Winding temperature indication, alarm and tripping systems (that are typically used on primary, grid and super grid transformer) are outside of the scope of this document.*

3.1.2 **Category D LMSs** shall be designed and implemented to satisfy the requirements specified in POL: SD11 and POL: SD2, POL: SD3, POL: SD4 and POL: SD5 as applicable, including the requirements for:

- Demand Security
- Generation Security
- Network Integrity
- System Integrity
- Failure Mitigation
- Scheme Interaction
- Thermal Ratings

3.2 Prerequisites

3.2.1 All **Category D LMSs** shall satisfy the following prerequisites. Where a **LMS** does not meet all of the **Category D LMS** requirements or those associated with any of the other **LMS** categories it shall be considered as a **Category Z LMS** and satisfy the requirements of ST: SD11Z.

3.2.2 Principle of operation

3.2.2.1 The scheme shall monitor local current and where necessary voltage (e.g. to determine active power, reactive power or the direction of power flow) using a protection relay or appropriate transducer and shall utilise definite time or thermal characteristics to identify when the plant / equipment becomes overloaded. The definite time delay / thermal characteristic setting shall be chosen so that the overload protection operates before the thermal rating of the plant/equipment is exceeded.

3.2.2.2 Where the **Category D LMS** utilises a definite time characteristic the pick-up setting shall be no higher than 105% of the associated plant / equipment rating under the most onerous conditions (e.g. load profile, ambient temperature, wind speed, soil conditions etc.) that are expected to be experienced. This allows sufficient margin to allow the overload protection to reset when the load drops below the plant / equipment rating. For this application an alarm level shall be set up in PowerOn to warn Control that plant / equipment is operating close to the overload trip setting.

3.2.2.3 Where the **Category D LMS** utilises a thermal characteristic the settings shall be no higher than the estimated thermal characteristic of the plant / equipment. In this case the overload protection shall include a thermal alarm stage that provides sufficient time, based on expected conditions, for Control to reduce the load to prevent tripping.

3.2.2.4 Where necessary the **LMS** settings may be automatically modified / updated by PowerOn to reflect the different conditions that may reasonably be expected to occur at different times of the year (e.g. based on summer, winter and intermediate conditions). Where this is the case information shall be displayed in PowerOn to clearly indicate and explain which setting is currently applied.

3.2.2.5 When the overload relay or transducer trip setting is exceeded it shall trip / intertrip WPD circuit breakers to immediately disconnect the load from the relevant plant and/or equipment. In this context 'immediately, means within 300ms of the relay / transducer output contacts operating.

3.2.3 Inputs and triggers

3.2.3.1 The sources of current and voltage, e.g. CTs and VTs (or equivalent sensors) shall be located at the same substation as the overload relay/transducer. The scheme may be armed by local circuit breaker statuses and local Isolator statuses.

3.2.3.2 Where a **Category D LMS** is required to operate for outage conditions that cannot be detected locally it shall include arming controls. These arming controls shall be made available as both:

- Supervisory arming controls on PowerOn, and
- Local arming switches on site.

3.2.4 Components

3.2.4.1 The scheme shall be assembled from protection-class relays, transducers and other components. If the overload functionality is derived from a relay that is used for other protection functions and overload elements shall:

- operate separate output contacts
- operate separate local alarms / LEDs / alarm messages that clearly indicate which elements/functions (e.g. protection or overload) have operated
- provide separate SCADA alarms that clearly identify which elements/functions have operated (e.g. protection or overload)

3.2.5 Communications Paths

3.2.5.1 Overload protection may rely on intertripping circuits to disconnect load. Where this is the case WPD-owned or WPD-managed protection-class communication paths that satisfy the requirements of POL: TP20 shall be used for this purpose. Options for these paths include:

- Fibre optic cable
- Microwave link
- Pilot cable
- BT EAD (Ethernet Access Direct) or other equivalent 3rd party service, where no other reasonably practical solution is available

3.2.5.2 Conventional SCADA facilities and their associated communication systems may be used for supervisory arming.

3.2.6 Outputs

3.2.6.1 The scheme shall achieve curtailment by:

- Tripping or intertripping WPD-owned circuit breakers.

3.2.6.2 Each **Category D LMS** shall require no more than 5 circuit breakers to trip. These circuit breakers shall be located at no more than 3 different sites.

3.2.6.3 When a **Category D LMS** operates it shall send an appropriate unambiguous alarm to Control via PowerOn, e.g. 'Overload Protection Operated'.

3.2.7 Failure mitigation

3.2.7.1 Detectable scheme failures including but not limited to communications failure alarms, relay/transducer watchdog alarms and battery system alarms shall be presented to Control as high priority alarms.

3.2.7.2 In addition, at least one of the following measures shall be used to mitigate scheme failure:

- An alternative **LMS** without common failure modes
- Conventional back-up overcurrent protection designed / set to operate for short-circuit faults

3.2.7.3 When mitigation measures are selected the wider **System Integrity** risks (e.g. widespread tripping due to communication network failures and cascade tripping due to overload) shall as far as possible be considered and controlled.

3.2.8 Preventing over-commitment of networks

3.2.8.1 Under **Intact Network** conditions, neglecting the behaviour of the **Category D LMS** and its failure-mitigation measures, no overloads and/or unacceptable voltages shall occur. For overhead lines, the applicable rating shall be the normally assigned Pre-Fault rating (ST: SD8A refers).

3.2.9 Ensuring sufficiency of Load Management Schemes

3.2.9.1 Under both **Intact Network** conditions and **Secured Outage** conditions, when the **Category D LMS** is in service and functioning correctly, it shall prevent the thermal ratings of associated plant and equipment from being exceeded. Once the overload relay / transducer has operated the potential overload condition shall be removed / addressed within 300ms.

3.3 Design Assessment

3.3.1 As part of the network design process all **Category D LMSs** shall be assessed to ensure they satisfy the requirement of POL: SD11 and this Standard Technique. The results of this assessment shall be recorded by the Primary System Design Engineer or Planner responsible for the **LMS** design and kept with the associated scheme records, in accordance with POL: TP10.

3.3.2 A proforma used for recording the design assessment and further supporting information is available from the following link:

<assessment information>

APPENDIX A

SUPERSEDED DOCUMENTATION

This document partially supersedes POL: SD11.

APPENDIX B

RECORD OF COMMENT DURING CONSULTATION

<ST: SD11D – Comments>

APPENDIX C

ANCILLARY DOCUMENTATION

POL: SD2	132kV Network System Design.
POL: SD3	66kV and 33kV Network System Design.
POL: SD4	11kV and 6.6kV Network System Design.
POL: SD5	LV Network Design.
POL: TP10	Protection, Alarm, Control Scheme and Load management Scheme Records.
EE SPEC: 98	Approved Protection, Voltage Control and Alarm Relays and Test Access Blocks.
EE SPEC: 136	Ancillary Electrical Equipment for Use in Conjunction with Switchgear and Protection/Control Panels.
ST: SD1B	Management of P2 Non-compliance.
ST: SD11Z	Requirements for Category Z Load Management Schemes that do not meet the prerequisites for other Load Management Scheme categories.
ST: TP10E	Requesting, Issuing and Recording Settings for Protection Relays, Tap-change Control Relays and Load Management Schemes.
POL: TP20	Protection Class Communication Links.
EREC P2	Security of Supply.
ENA TS 48-6-7	Communication Services for Tele-protection Systems.

APPENDIX D

KEY WORDS

ANM, Category A, Category Z, design, intertrip, Load Management Scheme, network, overload, system, planning, protection, network analysis