

## 1. SCOPE

This document details the **Approved** procedure for removal of the insulated voltage test sockets and the associated wires from the ABB Nitran LV Take-Off Chamber (LV fuse cabinet) applicable to OPSAF-16-215 SOP 215-ABB-TYPE IP2X LV fuse cabinets.

## 2. ISSUE RECORD

This is a **Reference** document. The current version of the document is held on the EN Document Library.

**It is your responsibility to ensure you work to the current version.**

Issue Date DD/MM/YYYY	Issue No.	Author	Amendment Details
20/08/2019	1	Stephen Batten	Initial Issue

## 3. ISSUE AUTHORITY

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## 4. REVIEW

This is a **Reference** document which has a 10 year retention period after which a reminder will be issued to review and extend retention or archive.

## 5. DISTRIBUTION

This document is part of the Management Safety Procedures maintained by Document Control but does not have a maintained distribution list.

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## 7. REFERENCE DOCUMENTS

OPSAF-11-005	ScottishPower Safety Rules (Electrical and Mechanical) MSP 1.3 Achieving Safety From the System by Limiting the Testing, Work or Work Area
OPSAF-11-010	MSP 1.8 Recording and Reporting of High Voltage and Low Voltage Switching
OPSAF-11-015	MSP 2.4 Procedure for Work On or Testing Of Plant and Apparatus where The Safety Rules or their Support Documents Cannot or Should Not be Applied
OPSAF-12-003	LWM 2.1 Operation of LV System
OPSAF-12-004	LWM 2.2 Operation of the HV AC System Up To and Including 33kV
OPSAF-12-006	LWM 2.4 Connection of Mobile Generation in Parallel with the Distribution System
OPSAF-12-007	LWM 3.1 Substation Distribution Boards and Network Pillars
OPSAF-14-054	OR 54 ABB Power T&D Limited Fully Shielded LV Fuse Cabinets fitted with insulated test sockets
OPSAF-16-215	SOP 215 - ABB - TYPE IP2X LV fuse cabinets
QUAL-10-204	Operations QMS HV & LV Customer Affecting Planned Outage Procedure
SWG-17-111	Modification Sheet D5/C – ABB LV Switchgear and Fusegear – ABB LV Fuse Cabinets

## 8. DEFINITIONS

Terms printed in bold type are as defined in the ScottishPower Safety Rules (Electrical and Mechanical).

LV TOC	LV Take-Off Chamber, or Transformer mounted Substation Distribution Board or LV Fuse Cabinet
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## 9. INTRODUCTION

There is a known failure mode associated with insulated voltage test sockets fitted to the transformer incoming side of LV Take-Off chambers manufactured between 1991 and 1998 by ABB Power T&D. The voltage test sockets are not fused hence there is potential for disruptive failure when the voltage test socket insulated body fractures during use. To prevent a flashover occurring at the transformer busbar connected LV voltage test sockets, OPSAF-14-054 required that the insulated voltage test sockets fed from the top contacts (incoming side) of the transformer disconnector were not to be used for **Live** testing. SWG-17-111 was introduced to retrospectively install blanking caps to prevent further use.

Subsequently the ageing of the sockets has now presented a different failure mode whereby mechanical vibrations are sufficient for the degraded voltage test sockets insulated body to fracture, causing the unfused voltage test socket to dislodge from the panel fixing and for the exposed conductive end of the voltage test socket to make contact and short to adjacent earthed metalwork or live busbars (refer Figure 6: Test socket wire). As the failure is due to aged degradation, this failure mode is applicable to voltage test sockets that may visibly appear to be in good condition. It is noted that even the vibrations during the opening and closing of the LV TOC door are sufficient to trigger this failure mode as experienced at Pollockshaws Road substation on the August 31<sup>st</sup> 2018. OPSAF-16-215 was updated to reflect this different failure mode requiring full **Live** working personal protective equipment to be worn when accessing the LV TOC.

The degraded test sockets require removal, however the modification procedure itself presents a risk that the deteriorated condition could give rise to **Danger** arising from a flashover with potential for disruptive failure during the work modification activity that requires removal of the integral shielded protection. This **Approved** procedure mitigates this risk by opening of the transformer disconnector links and isolating the **HV** supply from the transformer before opening the LV TOC lid. This approach

removes the sources of electrical energy directly connected to the test socket before elements of the integral shielded protection of the LV TOC are removed. It is considered that the residual risk of working **Live** with **LV** back-feeds or generation (known or unknown connected locally at an outgoing way or remotely within the distribution network) is tolerable to facilitate subsequent removal of the test sockets and the associated wires to clear SOP 215. However if there are signs of poor condition or distress then an emergency **LV** outage (without connected back-feeds or generation) is required to mitigate this residual risk.

To assist with managing the asset risk, data concerning the condition of degraded voltage test sockets and the likelihood of imminent failure shall be recorded by the districts and provided to Network Planning & Regulation team for monitoring and reporting to the business.

## 10. APPROVED PROCEDURE

The following figures show the ABB Nitran LV TOC unit with the location and connection arrangement of the voltage test sockets.

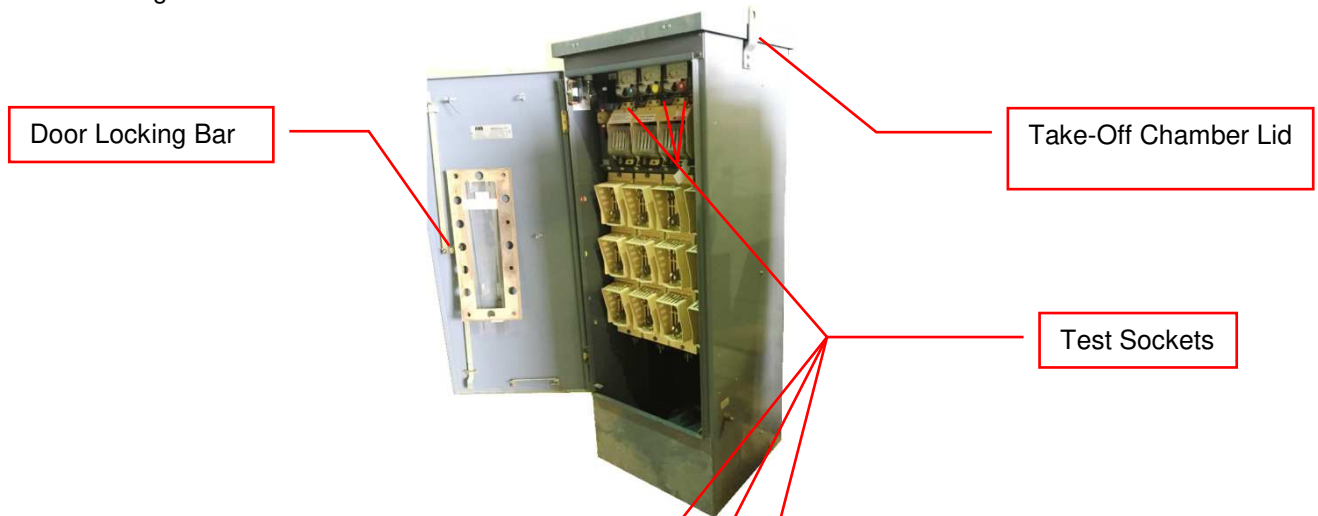


Figure 1: ABB Nitran Take-Off Chamber



Figure 2: Test Sockets

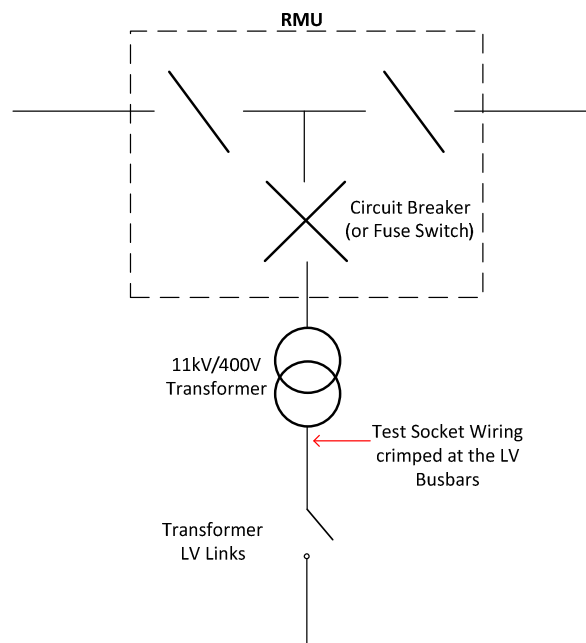


Figure 3: Example of a Line Diagram of Ring Main Unit, Transformer, and LV Take-Off Chamber

## 10.1 Isolation Procedures

### 10.1.1 HV isolation with LV back-feeds or generation.

Modification works performed **Live** with either **LV** back-feeds or **LV** generators or potential back energisation from generation sources within the distribution network.

1. Wear full **Live** working personal protective equipment including an **Approved** full-face visor and **Approved** rubber gloves throughout this **Approved** procedure. An **Approved** insulated rubber mat shall be positioned in front of the LV TOC before work commences.
2. Open the cabinet door and visually inspect the sockets for degradation. If there are any signs of poor condition of the sockets or other signs of distress then stop any further operation and arrange a **HV Isolation** with emergency **LV** outage (refer section 10.1.2) to perform the modification works on the **Apparatus** not **Live**.
3. Check that the door locking bar is secure otherwise secure temporarily and modify according to the modification sheet SWG-17-111 after this **Approved** procedure is completed.
4. Check the LV TOC using a thermal camera. If there are any signs of overheating (high-resistance contacts) then stop any further operation and arrange a **HV Isolation** with an emergency **LV** outage (refer section 10.1.2) to perform the modification and remedial works on the **Apparatus** not **Live**.
5. Install **LV** back-feeds or **LV** synchronous generator(s) following OPSAF-12-006. Note there is no permanent generation connection facility for this LV TOC however **Approved** LV fuse way adapters (with integral generator connection) can be used in either spare way(s) or by removing existing fuse way(s) that will result in a short duration disconnection to customers.
6. Isolate the transformer **LV** links and apply a **Safety Lock** and **Caution Notice**.
7. Isolate the 11kV transformer circuit breaker (or transformer fuse switch) and apply a **Safety Lock** and **Caution Notice**.
8. Close the transformer earth switch and apply a **Safety Lock**.
9. Check the **LV** voltage on the LV TOC transformer **LV** busbars (top-side of transformer links) to prove not **Live**.
10. **Danger Notices** shall be applied onto adjacent **Apparatus**.
11. Issue a **Limited Work Certificate**. The details of the **Limited Work Certificate** shall refer to this **Approved** procedure OPSAF-11-101 section 10.1.1 HV Isolation with LV back-feeds or generation.
12. Follow the modification work procedure below (refer section 10.2) to carry out the modification.
13. Clear and cancel the **Limited Work Certificate**.
14. Restore supplies as per section 10.1.3.

### 10.1.2 HV Isolation with LV Outage

Modification works performed not **Live** (with residual risk of inadvertent back-feeds from unknown sources within the distribution network).

If the unit cannot be back-fed, or a **HV Isolation** with an emergency **LV** outage is required due to: visibly degraded sockets, or overheating, or if excess rust on the wire mesh or other signs of distress are present:

1. Review **LV** plans to ensure that there are no back-feeds or **LV** generation and spare ways are shrouded.
2. Wear full **Live** working personal protective equipment including an **Approved** full-face visor and **Approved** rubber gloves throughout this Approved procedure. An **Approved** insulated rubber mat shall be positioned in front of the LV TOC before work commences.
3. Open the LV TOC door and visually inspect the sockets for degradation.
4. Check that the door locking bar is secure otherwise secure temporarily and modify according to the modification sheet SWG-17-111 after this **Approved** procedure is completed.
5. Check the LV TOC using a thermal camera. If there are any signs of overheating (high-resistance contacts) then identify that necessary remedial works are required in accordance with LWM 3.1 (refer element 9 of section 10.2 work procedure).
6. Isolate the transformer **LV** links and apply a **Safety Lock** and **Caution Notice**.
7. Isolate the 11kV transformer circuit breaker (or transformer fuse switch) and apply a **Safety Lock** and **Caution Notice**.
8. Close the transformer earth switch and apply a **Safety Lock**.
9. Check the **LV** voltage on the LV TOC both top-side and bottom-side of transformer links to prove not **Live**.
10. **Danger Notices** shall be applied onto adjacent **Apparatus**.
11. Issue a **Limited Work Certificate** document. The details of the **Limited Work Certificate** shall refer to this **Approved** procedure OPSAF-11- 101 Section 10.1.2 HV Isolation with LV Outage.
12. Follow the modification procedure below (refer section 10.2) to carry out the operation.
13. Clear and cancel the **Limited Work Certificate**.
14. Restore supplies as per section 10.1.3.

### 10.1.3 Restoring supplies

1. Replace **LV** fuses, where applicable
2. Remove the **Safety Lock** and open the transformer earth switch.
3. Remove the **Safety Lock** and **Caution Notice** and close the 11kV transformer circuit breaker (or transformer fuse switch).
4. Remove the **Safety Lock** and **Caution Notice**, where applicable phase out and close the **LV** transformer links.
5. Remove **LV** back-feeds or **LV** generators as applicable.

## 10.2 Work Procedure

This procedure details the modification works to remove the voltage test sockets and associated wiring as shown in Figure 4 below with the LV TOC lid and wire mesh removed. This modification procedure shall only be conducted by persons whom have attended the OPSAF-11-101 training course at the SPEN Training Centres.

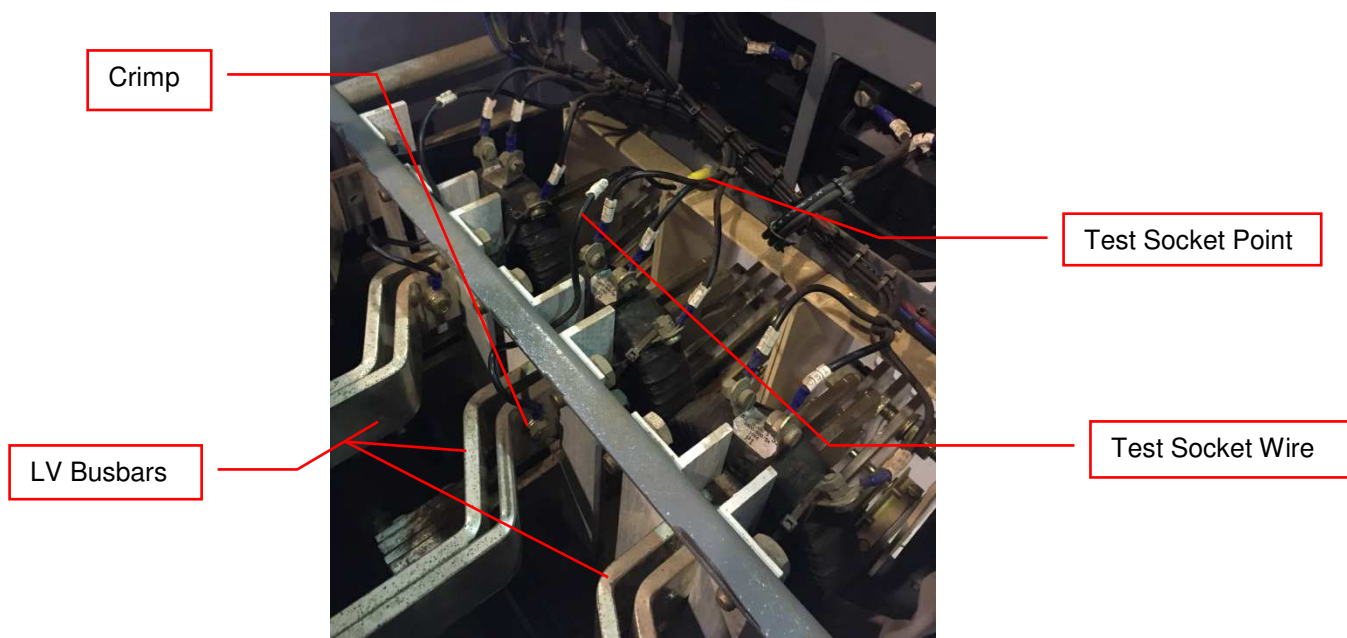


Figure 4: Internal View of LV Take-Off Chamber

1. Open the LV TOC lid. There is a wire mesh guard under the lid (refer Figure 5 below). If there are signs of excess rust on the wire mesh and if working **Live** under the **Limited Work Certificate**, then stop any further operation, cancel the **Limited Work Certificate** and arrange a **HV Isolation** with an emergency **LV** outage (refer section 10.1.2) to perform the modification works on the **Apparatus** not **Live**. The works shall be carried out under a new **Limited Work Certificate**. Otherwise, remove the wire mesh temporarily.
2. Visually inspect the internal condition, if there are any signs of distress and if working **Live** under the **Limited Work Certificate**, then stop any further operation, cancel the **Limited Work Certificate** and arrange a **HV Isolation** with an emergency **LV** outage (refer section 10.1.2) to perform the modification works on the **Apparatus** not **Live**. The works shall be carried out under a new **Limited Work Certificate**.
3. Identify and firmly hold the L1 test socket wire prior to breaking off the test socket end from the instrument panel. Lift the test socket end of the wire (complete with test socket, see Figure 6: Test Socket Wire) clear from contact with conductive parts.
4. Using **Approved** diagonal cutting nippers (SAP Commodity Code: 30982456), cut the wire as close to the top end of the ring crimp on the L1 busbars as possible (care shall be taken not to drop the wire markers). The ring crimp on the busbar shall not be removed or tampered with.
5. Remove the wire (complete with the test socket) from the LV TOC and dispose of the wire and socket.
6. Repeat steps 3 to 5 for L2 and L3.



7. Remove any previously fitted test socket blanking caps and SOP 215 labels. The remaining socket openings shall not be sealed; this will ensure that operational staff can visually confirm that this latest **Approved** procedure has been completed.
8. Perform an internal visual inspection to ensure there is no debris remaining behind the transformer links and outgoing ways.
9. If overheating is applicable perform the necessary remedial works in accordance with LWM 3.1
10. Update SAP / PowerOn to remove the SOP 215 status on the completed unit.
11. To assist with managing the asset risk, record data concerning the condition of degraded voltage test sockets and the likelihood of imminent failure.



Figure 5: LV Take-Off Chamber with Wire Mesh (Lid removed)



Figure 6: Test Socket Wire

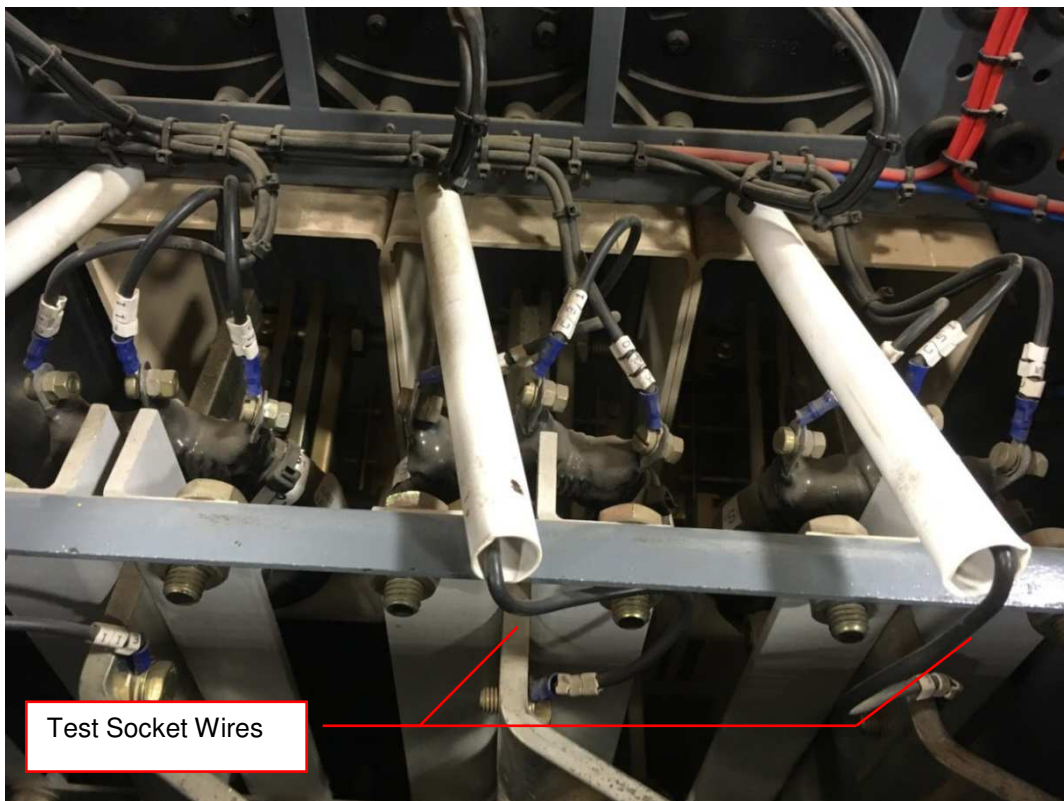


Figure 7: Alternative Internal View of LV Take-Off Chamber (with Test Socket Wires in Plastic Tubes)