PANEL OF INQUIRY SAFETY HEALTH

ENVIRONMENT

DOCUMENTATION

TECHNICAL ScottishPower **Express**

ENERGY

Reference no.: EXP-11-248 INC-1027490 - SPM - Secondary transformer failed disruptively.

Date: 09/04/2019

IN-SERVICE FAILURE OF 500kVA ORMAZABAL CABLE-CONNECTED DIST.TRANSFORMER NETWORKS

On 9th April 2019, a 500kVA Ormazabal cable-connected distribution transformer (serial no. 273742) was reported to have failed in service (INC-1027490) at Wandsworth Way S/S (SPM). The original incident report suggested the transformer disruptively failed with the transformer tank found split and oil leaking into trenches.

The transformer was recovered from site and a joint failure investigation was undertaken.

The investigation concluded that:

- The transformer did not disruptively fail as the tank integrity was not compromised during the fault event (Fig.1).
- No evidence was found that a flashover in air occurred due to exposed HV conductor or terminals caused by low oil level.
- There was an HV winding fault caused either by a manufacturing defect or particle contamination during manufacturing; or,
- A Tap Changer fault caused either by a manufacturing defect or a high resistance in the tapping leads connection.

As a result of this incident a TLR was issued affecting all Ormazabal ground mounted transformers on the network, both unit and cable connected types of both 500kVA and 1000kVA rated power.

The information gathered during the investigation, together with the previous quality records and non-conformity reports on Ormazabal transformers, was used to develop an inspection regime to assess the condition and suitability for service of the already installed transformers and also those in the stores.

The data received from these inspections is being evaluated in conjunction with the manufacturer and further guidance on the recovery plan to allow re-energisation of those units that have been taken out of service will be provided including a course of action for any identified faulty/defective unit.



Fig.1 Failed Wandsworth Way transformer as arrived to Ormazabal UK facilities



Fig.2 Evidence of damage to HV winding



Fig.3 Oil gauge showing level below level gauge cannot be trusted

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Recommendations and action points

- All Ormazabal ground-mounted distribution transformers, either on site or in the stores, shall be inspected and assessed to determine their condition and identify any potential issue.
- For units in service the initial inspection regime shall comprise of:
 - Check for oil leakages, with special attention to flanges, welds and LV monobloc
 - Check for low oil level.
 - De-energise for an oil sample to be taken and oil and DGA analysis undertaken.
 - All data gathered will be reviewed by the Engineering Standards team.
 - A decision will be made by the team on which units can be returned to service based on satisfactory DGA and condition/presence of leaks. This will be communicated to the District leads and the control room.
 - Units with no or insufficient back feeds shall be de-energised for DGA sampling and then be re-energised remotely and further advice will follow once results are reviewed.
 - On any units returned to service a modified TLR will be put in place which removes the need to de-energise and maintain the limitation on time spent on site.
 - A repeat oil sample shall be taken between 4 5 weeks of the transformer being returned to service. Further advice will be provided in due course as to whether the sample can be taken live.
- For units in stores/onsite but not yet energised, the inspection regime shall comprise of:
 - Check for oil leakages, with special attention to flanges, welds and LV monobloc.
 - · Check for low oil level.
 - Oil sample for oil analysis.
 - Electrical testing, including winding resistance and insulation resistance where practicable.
 - All data gathered will be reviewed by the Engineering Standards team and a decision will be made by the team on which units can be energised or deployed to site. On any units energised for the first time a modified TLR will be put in place.
 - A repeat oil sample shall be taken between 2 3 weeks of the transformer being energised. This sample shall be taken with the transformer de-energised.

• Defects found during site inspections

- It has been found during the investigation that the oil level indicator provided is a defective design which traps a small amount of oil at the bottom of the gauge even if the oil level is below that point (Fig. 3). If oil is found at the minimum level, indication shall not be trusted and oil level checked by other means (e.g. removing lid).
- Where oil level is found to be low but no oil leaks are visible, the HV cable box cover shall be removed for inspection of HV bushings as this area has been a source of leaks in recently delivered transformers.

The TLR on all Ormazabal ground-mounted distribution transformers shall remain in place until further guidance on recovery plan is provided.