SURGE DIVERTER TESTING SWP

1. PURPOSE AND SCOPE

The purpose of this Standard Work Practice (SWP) is to standardise and prescribe the method for testing Surge Diverters.

2. STAFFING RESOURCES

Adequate staffing resources with the competencies to safely complete the required tasks as per MN000301R165: 8 Level Field Test Competency.

These competencies can be gained from, but not limited to any or all of the following:

- Qualifying as an Electrical Fitter Mechanic
- Qualifying as a Technical Service Person
- Training in the safe use of relevant test equipment

Requirement for all live work:

- Safety Observer (required for all "live work" as defined in the ESO Code of Practice for Electrical Work).

All resources are required to:

- Have appropriate Switching and Access authorisations for the roles they are required to perform and have the ability to assess and maintain relevant exclusion zones from exposed live electrical apparatus
- Hold current licences for any vehicles and equipment they may be required to operate.

Required Training

Staff must be current in all Statutory Training relevant for the task.

All workers must have completed Field Induction or have recognition of prior Ergon Energy Field Experience.

Contractors must have completed Ergon Energy's Generic Contractor Worker Induction.

3. DOCUMENTATION

CS000501F115. Daily/Task Risk Management Plan

ES000901R102. Health and Safety Risk Control Guide

SP0512R01. Surge Diverter Testing Job Safety Analysis

SP0512C02. Surge Diverter Testing Competency Assessment

SP0512C05. Construction Tool – Surge Diverter

SP0512C04. Commissioning Tool – Surge Diverter

SP0506. Substation Primary Plant and Secondary Systems Field Testing SWP

STNW1160. Standard for Maintenance Acceptance Criteria

P53. Operate the Network Enterprise Process

AS 1307.1 – Surge arresters (diverters) - Silicon carbide type for a.c. systems

AS 1307.2 – Surge arresters - Metal-oxide surge arresters without gaps for a.c. systems

Test Equipment Manuals

Surge Diverter Manual / Manufacturer's Drawings

4. KEY TOOLS AND EQUIPMENT

Test Equipment within calibration date, tested and tagged. HV Test Set, Insulation Resistance Tester (5kV minimum).

Safety Barriers.

HVIA Operating Equipment – PEDs, Live Line Tester, Class 0 gloves. All equipment to be inspected and confirmed within test date prior to use.

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Additional PPE as required: Leather work gloves, class 00 gloves, hearing protection, safety eyewear. All PPE to be inspected and confirmed within test date (where applicable) prior to use.

Sun protection to be used when working outdoors.

5. WORK PRACTICE STEPS

5.1. Carry Out an On Site Risk Assessment

Prior to performing this activity any hazards associated with prerequisite tasks at the worksite shall be identified and assessed with appropriate control measures implemented and documented in accordance with the **Daily / Task Workplace Risk Management Plan** (CS000501F115) and using the **Health and Safety Risk Control Guide** reference document (ES000901R102).

If any risks cannot be managed or reduced to an acceptable level, do not proceed with the task and seek assistance from your Supervisor.

5.2. All Work to be done with Surge Diverter De-Energised

All of the tests described in this SWP should be carried out with the surge diverter de-energised and appropriate control measures in place (eg barriers, matting) to prevent inadvertent contact with adjacent live plant or breaching exclusion zones. Furthermore, the P53 Operate the Network Process is applicable at all times for isolation and earthing.

Issue a Test Permit and follow the requirements of P53 Operate the Network Process.

As described in Substation Primary Plant and Secondary Systems Field Testing SWP SP0506, particular safety risks applicable to surge diverters include:

- Contact with high voltage at surge diverter primary connections.
- High fault current at surge diverter primary connections.
- Induced voltages and currents from nearby energised / loaded plant.

5.3. Assessment Criteria

Unless stated, refer to STNW1160 Standard for Maintenance Acceptance Criteria for minimum acceptance values for each test.

5.4. Record plant details

Record identification details:

- Manufacturer's name.
- Manufacturer's type description eg Exlim Q60 – AV72
- Manufacturer's serial number.
- Plant or asset number.
- Description, eg. Zinc Oxide.
- Nominal Discharge Current eg 10kA.
- Year of Manufacture.

Rated voltage U_r. This is the maximum RMS voltage that the surge diverter may be subjected to during temporary over voltage conditions. For an effectively earthed system, U_r is normally equal to System Highest Voltage (ph-ph) divided by sqrt(3) times 1.4. For example, a 66 kV system uses surge diverters with U_r = 60 kV (72.5 / 1.732 x 1.4).

Continuous Operating Voltage U_c. This is the maximum RMS voltage that may be applied continuously between the surge

diverter terminals, and will be approximately 80% of U_r for zinc oxide surge diverters.

5.5. Visual Inspection Of Surge Diverter Condition

Inspect the external surfaces and ensure the surge diverter is clean and dry.

Check that primary connections are correct.

Check earthing to surge diverter base, counter and support structure.

5.6. Measure Insulation Resistance

DC insulation tests as listed below are to be

The voltage applied will be as per Table 1 for a duration of 1 minute.

- HV terminal to Earth (guard near base of insulator).

  Minimum C3 acceptance value for new distribution plant (U_m <= 36kV) is 1,000MΩ. Minimum C3 acceptance value for new transmission plant (U_m >= 72.5kV) is 10,000MΩ.

- Insulated base (if fitted) to Earth (no guard).

  Minimum C3 acceptance value for new plant is 100MΩ.

Primary Voltage Rating	Test Voltage in kV (DC)
Up to 3.6kV	1
Above 3.6kV	5
Insulated base	1

5.7. Carry out HV Testing

High voltage testing of surge diverters is only required if specifically requested by the asset owner, and is normally only requested if there are specific manufacturing or batch issues to be resolved.

A surge diverter shall withstand a power-frequency RMS Test voltage applied for 1 minute between the primary terminal and earth.

The test should be carried out at two voltage levels as detailed below with the RMS leakage current recorded at each voltage. Both new and aged plant should be tested at these voltages.

Caution: Being non-linear devices, surge diverters can be damaged by applying excessive voltage during high voltage testing. Do not exceed the surge diverted rated Continuous Operating Voltage U_c during high voltage testing. Note that this voltage is *substantially less* than the one minute power frequency withstand voltage that is normally applied during HV Withstand testing.

Test 1 – Apply U_m / sqrt (3) for 1 minute, where U_m is the System Highest Voltage. For example, the test voltage for a 66kV system is 72.5 / 1.732 = 42kV.

Test 2 – Apply U_c for 1 minute. U_c is given from the surge diverter nameplate, and will normally be slightly higher than the voltage of test 1. For example, an ABB Exlin zinc oxide surge diverter for use on a 66kV system has U_c = 48kV.

The requirements of the test are satisfied if no disruptive discharge occurs. Additionally, similar surge diverters should have leakage currents within 10% of each other. Note that the leakage current of metal oxide surge diverters is dependent on temperature.

When a shunt resistor in the earth return path is being used to measure leakage current, ensure that suitable protection is wired across the shunt, for example an LV MOV, in order to protect the test equipment from overvoltage if the surge diverter fails during test. In any case, personnel should not be in contact with such measurement equipment during the test.

Following the HV Withstand test, repeat the HV terminal to Earth insulation resistance measurement to confirm insulation integrity.

Note: The resistive component of the leakage current of metal oxide surge diverters is a good indicator of surge diverted quality, and it is preferred that both the total (i.e. resistive plus capacitive) and resistive component only of the leakage current are recorded. Instruments such as the ABB LCM have the capability for this measurement.

Further diagnostic information can be obtained from analysis of the harmonic content of the leakage current.

5.8. Carry out DLA Testing

If required by the Asset Manager, carry out Dielectric Loss Angle measurements on the bus as per MN000301R172 Doble DLA Testing.

Refer to STNW1160 Standard for Maintenance Acceptance Criteria for minimum acceptance values.

5.9. Schedule of Tests

The table below details the circumstances in which different tests are carried out:

Test	New Surge Diverter	Aged Surge Diverter
Insulation Resistance	On-site test required.	
High Voltage Withstand	At Asset Manager discretion.	
DLA	At Asset Manager discretion.	

5.10. Complete pre-commissioning checklist

A requirement for surge diverters being placed in service for the first time or after modification is that all checklists nominated in the Construction and Commissioning Tools have been completed.