SCHNEIDER RECLOSER, LOAD BREAK SWITCH, SECTIONALISER

1. PURPOSE AND SCOPE

The purpose of this Standard Work Practice (SWP) is to standardise and prescribe the method for tests associated with the following Schneider distribution switching devices:

- N-Series Three Phase Reclosers
- W-Series Single Phase Reclosers
- RL-Series Load Break Switches / Sectionalisers

2. STAFFING RESOURCES

Adequate staffing resources with the competencies to safely complete the required tasks as per 8 Level Field Test Competency Reference - 2597616;

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
- Training in Recloser Installation and Field Testing

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 can 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 equivalent prior Ergon Energy Field Experience.

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

3. DOCUMENTATION

HazChat - On-Site Hazard Assessment

EQL SWMS - Safe Work Method Statements

Health and Safety Policy - 692225

8 Level Field test Competency Reference - 2597616

Schneider Three Phase Recloser, Load Break Switch, Sectionaliser Test Report - 2924339

Schneider Single Phase Recloser Test Report - 2916866

Field Installation, Testing and Commissioning of Schneider Reclosers, Load Break Switches and Sectionalisers with ADVC Controllers - 2902780

Substation Primary Plant and Secondary Systems Field Testing - 2902800

Voltage Transformer Testing - 2934600

Standard for Maintenance Acceptance Criteria - 2928929

AS 1931.1-1996 High Voltage Test Techniques

AS 2067-2008 Substations and High Voltage Installations Exceeding 1 kV AC

AS 2650-2005 Common Specifications for High Voltage Switchgear and Control Gear Standards

AS60060-3-2008 – High Voltage Test Techniques – Definitions and Requirements for Onsite Testing

AS 62271.100-2008 High Voltage Switchgear and Control Gear

Customer Test Procedures
National Electricity Rules
National Electricity Network Safety Code

4. KEY TOOLS AND EQUIPMENT

- Test and Training Set (TTS)
- Secondary Voltage Injection Interface Set (SVIIS)
- Gas Fill Adaptor
- HV test equipment
- High Voltage Insulation Test Set - 5/10kV insulation tester
- Micrometer
- High current injection equipment
- Variable AC or DC voltage supply as required
- Calibrated clamp meter
- Automated secondary injection test set and test software i.e., Omicron CMC, Doble F6 series or equivalent
- Insulated test leads and test blocks
- Manufacturer's software to communicate with and configure controller under test, (WSOS)
- Hot tong and link sticks
- LV mats, covers, barriers as required

Additional PPE Required

Nil.

5. SCHEDULE OF TESTS

Table 1 below details the circumstances in which different tests are carried out:

Test	Section	Workshop Testing	Field Testing
Preliminary Checks	6.3	✓	✓
Insulation Resistance	7.1	✓	✓
Contact Resistance	7.2	✓ (Refer Note 1)	
Auxiliary and Control Circuit Voltage Withstand	7.3	✓ (Refer Note 1)	
High Voltage Withstand	7.4	✓ (Refer Note 1)	
Measurement checks by Primary Injection	7.5	✓ (Refer Note 1)	
Secondary Tests	8.0	✓	
On Load Checks	9.0		✓

Table 1: Schedule of Tests

Note 1: Only required where manufacturer's test certificates are not available.

6. PRELIMINARY TASKS

6.1 Carry out an on-site hazard assessment

Prior to performing this activity any hazards associated with pre-requisite tasks at the worksite shall be identified and assessed with appropriate control measures implemented and documented in accordance with HazChat - On-Site Hazard Assessment and using EQL SWMS.

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

Particular safety risks and issues to consider with reclosers, load break switches and sectionalisers include:

- Electrical testing should be carried out within designated test bays or in a barricaded area with appropriate warning signs attached.
- All field testing should be carried out at ground level where possible to avoid risks associated with working at heights.
- In the interest of safety, special consideration should always be given to initial remote energisation of reclosers, load break switches and sectionalisers when preparing AFW's.
- If remote initial energisation is not possible, the operator should remain below main tank level to limit exposure for an unexpected failure.

6.2 Workshop and field preparation

Testing should be carried out within dedicated test bays, barricaded, and warning signed test areas or controlled areas as assessed through a hazard assessment. Only persons involved in the testing are to be permitted access to the designated test area.

In a workshop environment, solidly bond the main tank and the control cubicle to the test bay earth.

Plan test connections so that clearances are greater than minimum withstand levels between high voltage test leads and equipment under test, other apparatus or earth.

When carrying out testing, always ensure the test set is turned off prior to application and removal of test leads.

Review manufacturer's manuals on test equipment where required.

Review recloser manufacturer's manuals.

Review Test Bay operating protocols where applicable.

When working on or near roadways, ensure adequate traffic control measures are in place.

6.3 Preliminary Checks

For field work, preliminary checks should be carried out at ground level prior to installation of the unit on the pole.

6.3.1 Physical Damage

Check the main tank and control cubicle for any signs of physical damage and /or corrosion.

6.3.2 Bushings

Check bushings are tight, and surfaces are clean and free of contamination.

6.3.3 Control Cubicle

1. Check for no signs of moisture ingress or corrosion within the control module.
2. Ensure all seals are in place and secure.
3. Check all glands to ensure IP66 rating is maintained, and no moisture / dust ingress points are present.
4. Ensure integrity of the breather on the control cubicle.
5. Check all wiring is secured and connections firm.
6. Check condition of the control cable and ensure moisture is not present at the plug ends and caps fitted.
7. Check for no signs of corrosion at the battery terminals.

6.3.4 Nameplate

1. Check main tank and VT nameplates are in place and legible.

2. Confirm that the voltage rating of the main tank and VT, as indicated on the nameplate, is compatible with the system voltage.

6.3.5 Surge Arresters

Confirm ratings of the surge arrester are compatible with the system application.

- 11kV Britech Part Number: 214011-CCAA PDV-65.
- 22kV Britech Part Number: 214221-CCAA PDV-100.
- 33kV ABB Part Number: PolimD30 10.

6.3.6 Additional Items (Field Testing Only)

1. Check completed Test Tag is attached to the main tank and control cubicle.
2. Confirm operating number reference sticker on the VT matches the operating number on main tank / control cubicle Test Tag.
3. Verify the Setting File Reference on the Test Tag corresponds with the PSR number on the PSR supplied with the device.
4. Verify the operational number and description on the Test Tags match the site location as per the information on the SAS (System Alteration Sketch).
5. Verify in the “Confirmation of Settings” section of the PSR that the “Remarks Field” and “Testing Complete” sections have been completed.
6. Verify the “Plant Name” as displayed on the ADVC controller aligns with the PSR “Relay Identifier Group Name” field

6.3.7 Review of Manufacturer’s Test Certificates (Workshop Testing only)

Check manufacturer’s test certificates have been supplied with results for all tests as per the Ergon specified Schedule of Tests (refer Table 1).

Confirm all results are within tolerance as per manufacturer’s guaranteed levels.

6.3.8 DC Battery

Confirm the battery meets specification of 12V/12Ah.

6.3.9 Time, Date and Time Zone

Ensure the time/date are set correctly in the ADVC controller.

6.3.10 Functional checks

Connect the control cable between the main tank and the control cubicle and carry out the following functional checks:

- Electrical Trip from control cubicle.
- Electrical Close from control cubicle.
- Manual Trip (for RL load break switches/sectionalisers only)
- Manual Close (for RL load break switches/sectionalisers only)

In each state, check correct status indication at both the control cubicle and on the main tank mechanical indicator flag.

On W series reclosers, check with the mechanical trip lever in the DOWN position that electrical close is blocked

On RL series load break switches/sectionalisers, check when the mechanical lock out ring is pulled that electrical close is blocked

7. PRIMARY PLANT TESTS

For N series Schneider Reclosers, the live side terminals (source) are designated as U1, V1 and W1 with the load side terminals designated as U2, V2 and W2.

For W series Schneider Reclosers, the source side is designated as I with the load side designated as X.

For RL series Load Break Switches/Sectionalisers the source side is designated I, II and III with the load side designated as X, XX and XXX.

Terminal markings are located adjacent to their respective terminals on the main tank.

7.1 Insulation Resistance

Insulation resistance tests are to be carried out in both the open and closed positions for a period of 1 minute or until readings stabilize as per Tables 2 & 3 below. The applied test voltage shall be as per Table 4. Tests are to be conducted with the surge arresters connected.

For field testing, to avoid risks associated with working at heights, insulation resistance testing should be carried out prior to installation on the pole.

The minimum acceptance value for new plant is as per the C3 criteria for Distribution (Vacuum / SF6) circuit breakers in Standard for Maintenance Acceptance Criteria - 2928929.

Note: that these connection arrangements have been specified for consistency with AS 62271-2012 and to allow for future insulation condition diagnostic assessment.

Test	Position	Voltage Applied to	Earth Connected to
1	Closed	U1-U2 I-X*	V1-V2-W1-W2-Tank II-XX-III-XXX-Tank*
2	Closed	V1-V2 II-XX*	U1-U2-W1-W2-Tank I-X-III-XXX-Tank*
3	Closed	W1-W2 III-XXX*	U1-U2-V1-V2-Tank I-X-II-XX-Tank*
4	Open	U1 I*	U2-V1-V2-W1-W2-Tank X-II-XX-III-XXX-Tank*
5	Open	U2 X*	U1-V1-V2-W1-W2-Tank I-II-XX-III-XXX-Tank*
6	Open	V1 II*	U1-U2-V2-W1-W2-Tank I-X-XX-III-XXX-Tank*
7	Open	V2 XX*	U1-U2-V1-W1-W2-Tank I-X-II-III-XXX-Tank*
8	Open	W1 III*	U1-U2-V1-V2-W2-Tank I-X-II-XX-XXX-Tank*
9	Open	W2 XXX*	U1-U2-V1-V2-W1-Tank I-X-II-XX-III-Tank*

Table 2: N Series Recloser & RL Series Load Break Switch/ Sectionaliser*

Test	Position	Voltage Applied to	Earth Connected to
1	Closed	I-X	Tank
2	Open	I	X-Tank
3	Open	X	I-Tank

Table 3: W Series Recloser

Rated Voltage, Ur	Test Voltage kV (DC)
12kV	5
Above 12kV	10

Table 4: Applied Voltages for IR Tests

Insulation resistance testing on the external voltage transformer is to be carried out in accordance with Voltage Transformer Testing - 2934600 Standard for Maintenance Acceptance Criteria - 2928929.

7.2 Contact Resistance

Prior to connecting the insulated cables, measure the contact resistance of each phase. Place the device in the closed position and connect the test leads to the terminals of the main tank. Using a micro-ohmmeter, inject DC current of at least 100A and less than the nominal current rating, (Ir), to measure the contact resistance. The tests shall be conducted as close as practical to ambient temperature.

The contact resistance of each phase shall be less than 100μΩ and consistent between phases. These values are to be compared to the factory test results for an indication of changes during transport.

The insulated cables may be fitted on completion of the contact resistance checks. Repeat contact resistance checks after fitting, to confirm connections and compare between phases.

7.3 Auxiliary and Control Circuit Voltage Withstand

Auxiliary and control circuit voltage withstand testing is only required in a workshop environment and when:

- Manufacturer's test certificates are not available or,
- The device is aged of refurbished
- Secondary wiring has been substantially modified

The device auxiliary and control circuitry shall be subjected to a 1-minute power frequency withstand test at 2kV to confirm insulation integrity. The test voltage is to be applied between the auxiliary/control circuitry wiring and earth.

The circuitry shall be considered to have passed if no disruptive discharge occurs during the test.

Special consideration is to be given to isolation of electronic components used in the auxiliary and control circuitry. Different test procedures may be adopted subject to agreement by a Senior Commissioning and Maintenance Engineer.

7.4 High Voltage Withstand

High voltage testing shall be applied as follows and in accordance with the test levels details in Table 2:

- Where no HV testing has been carried out at the manufacturer's works – 100%.
- Where HV testing has been carried out at the manufacturer's works, but subsequent assembly of the bushings are required – 90%.
- Where HV testing has been carried out at the manufacturer's works and no assembly is required – No HV withstand test.
- If the recloser is aged or refurbished or if no evidence is available of HV testing being conducted at the manufacturer's works – 80%.

The requirements of the test are satisfied if no disruptive discharge occurs.

Application of a 1-minute power frequency withstand test is to be in accordance with AS 1931 Part 1 between the live and load terminals of the recloser as detailed below.

Device in **CLOSED** Position	U1,U2,W1,W2 to V1,V2+E OR I,X,III,XXX to II,XX+E
	V1,V2 to U1,U2,W1,W2+E OR II,XX to I,X,III,XXX+E
Device in **OPEN** Position	U1,V1,W1 to U2,V2,W2+E OR I,II,III to X,XX,XXX+E
	U2,V2,W2 to U1,V1,W1+E OR X,XX,XXX to I,II,III+E

Table 5: Three Phase HV withstand connections

Device in **CLOSED** Position	I,X to E
Device in **OPEN** Position	I to X+E
	X to I+E

Table 6: Single Phase HV withstand connections

Nominal Voltage Un kV rms	Rated Voltage Ur kV rms		Short Term Power Frequency Test Voltage (100%) – kV
	N/RL Series	W Series	
11.0	15.5		50 (refer Note 1)
22.0	27		60
33.0	38		70
<=19.1		24	60

Table 7: Applied Voltages for HV Withstands

Notes:

1. For RL Series 15.5kV rated maximum voltage sectionalisers, the 100% power frequency test voltage is to be reduced to 40kV
2. It is necessary to fit the switchgear cables and bushing boots before the HV Withstand test to prevent flashover across the bushings. Earth the frame of the switchgear to the main earthing bar at the test point.

Caution: Apart from an auxiliary mains supply there must be no connections to the control cubicle, neither to the frame or electronics. If the internal VT is fitted, take care not to apply voltages in excess of those specified.

An insulation resistance test is to be repeated after the HV withstand test to confirm that insulation degradation has not occurred.

7.5 Measurement Checks

Primary Injection

Perform a primary injection of the switchgear at a current less than the continuous current rating as stated on the nameplate. Ensure that the current displayed in the Instantaneous Demand screen of the control panel matches the injected current.

8. SECONDARY TESTS

Secondary injection testing is achieved using the Test and Training Set, Secondary Injection Voltage Interface Set, ADVC and secondary injection gear.

8.1 Test Plan Approval

Approval of test plans will be facilitated by a Senior Commissioning Engineer or delegate.

8.2 Protection Settings

No changes to issued protection setting files are allowed during testing without the consent of the Protection Engineer providing RPEQ signoff. This includes turning elements off for testing purposes which is to be avoided.

Only test functions that are applicable.

8.3 Populate the Test Plan

Apply relay specific settings to the test plan for each active setting group.

8.4 Apply Protection Setting Request

Apply the approved settings to the CAPM module using the WSOS software.

8.5 Analogues

Carry out the secondary injection to confirm phasing and polarity of the test lead connections. Confirm displayed values match injected values.

8.6 Power Factor Testing

Simulate a close on the Schneider and confirm Side 1 (Source) status as Live and Side 2 (Load) as live at the Live / Dead Indication screen at the Control Cubicle or WSOS software. Set each phase at 120 degrees and secondary inject with a phase angle of 0 degrees between voltage and current to confirm a Power Factor of 1 and a positive kW reading on Instantaneous Demand screen. Adjust the Phase Angle between the Voltage and Current on each phase to 180 degrees to confirm the negative kW reading.

This test confirms that the CAPM correctly interprets changes in the phase relationship between three phase voltage and current.

8.7 Definite Time

Check Pickup and Timing at 2x pickup on all contacts that are tripped by this fault type.

8.8 Overcurrent

Check Pickup and Timing for all phases at 2x, 5x and 10x on all active trips as determined by Trips to Lockout.

8.9 Earth Fault

Check Pickup and Timing for 2x, 5x and 10x on all active trips as determined by Trips to Lockout.

8.10 Directional Overcurrent/Earth Fault

Check characteristic angle and confirm operate and non-operate zones on all active trips as determined by Trips to Lockout.

8.11 Sensitive Earth Fault

Check Pickup and Timing at 2x and 5x.

8.12 Single Shot Protection

With Auto Reclose enabled, within single shot reset time, simulate a fault to confirm the controller goes directly to lockout after one trip (i.e., no Auto Reclose). Test all the respective elements of the Single Shot Protection, such as Overcurrent, Earth Fault and Sensitive Earth Fault, for Pickup and Timing as individually described.

8.13 Work Tag Protection

With Auto Reclose enabled, confirm that Work Tag activates reduced trip times and drives to Lock Out. Confirm that further closing cannot take place when Work Tag is enabled.

8.14 Loss Of Phase Trip

Confirm Pickup and Timing of Loss of Phase element for a reduced phase voltage condition. Confirm that recloser has locked out.

8.15 Auto Reclose

Auto Reclose sequence to be tested for every fault type in accordance with the PSR.

8.16 Live Load Blocking

With the Schneider open, enable Live Load Blocking and apply voltage to the Load side and confirm that the recloser does not close.

8.17 High Current Lockout

Confirm lockout for a sustained current condition above the High Current Lockout level. Confirm that recloser has gone to locked out and will not reclose.

8.18 Inrush Restraint

Confirm Timing of the Inrush Restraint element for a sustained current condition above the Inrush Restraint multiplier level.

8.19 Cold Load Pickup

Check operation of the Cold Load Pickup element based on the formula below at a point above 50% of the User Set Cold Load Time.

$$Oper.Cold.Load.Mult. = 1 + \left(\frac{Oper.Cold.Load.Time}{User.Set.Cold.Load.Time} * (User.Set.Cold.Load.Mult. - 1) \right)$$

8.20 IOEX Testing

Confirm mapping of the IOEX inputs and outputs at the Events screen of the PTCC.

8.21 Fast Trip Module Testing

Confirm operation of the Fast Trip Module by applying voltage to input terminals to initiate a trip.

8.22 Setting Group B

If additional Setting Groups are enabled, test all elements of the Setting Group as previously described.

8.23 SCADA Testing

Check all relevant Ergon Standard mapping points are received at the ABB database.

9. ON LOAD CHECKS

Confirm analogue values in the PTCC and the control centre against measured primary current. Confirm analogue values in the PTCC and the control centre for elements such as voltage, power factor, kW, kVA and kVArs. Confirm that the kW reading is positive and that NPS current is low with respect to PPS current, (load current).