CONTENTS

1. Purpose

This work practice shall be followed by all persons working for or on behalf of TasNetworks Pty Ltd when responding to a Cable PI alarm.

2. Pre-requisites

2.1 General

1) TasNetworks Electrical Practitioner - Electrician or Authorised Service Provider Electrician trained and accredited by TasNetworks to perform metering work in the Power Distribution System.

2) Relevant and current PSSR and WH&S accreditations (e.g. CPR, Rescue etc.).

2.2 Training

1) **Initial Training**

In **Direct Connect Metering** or equivalent managed by TasNetworks.

2) **Refresher Training**

Annual competency assessment, managed by TasNetworks, to the national competency unit "**Testing Within Low Voltage Electricity Networks**".

2.3 Test Equipment Required

- Network Analyser
- 3 Pin plug test leads for Network Analyser
- Multimeter
- Tong Tester
- Volt Stick

3. Work Steps

3.1 Discuss Problem With Customer

Ask the customer some questions such as :-

- What sort of alarm – siren, amber or red colour flashing ?.
- How often has the cable PI alarmed ?.
- What times has it been indicating alarm or fault ?.
- What was happening at the time ?.
- Does it indicate alarm or fault in other power points (test these also)?.

The Cable PI may be alarming in the network peak times, or when there is no load on the transformer (middle of the night) or something else at a specific time that affects the electrical installation.

3.2 Check Cable PI Status

Take note of the current status of Cable PI (alarm still on or not) and cross check that against the explanation given by the customer and the following alarm explanations.

Green	Amber	Red	Siren	Meaning
Off	Off	Off	Off	Power Off or CablePI Failed
Cycle flash	Cycle flash	Cycle flash	Cycle flash	Self Test
Flashing	Off	Off	Chirping	Fail Self Test
Solid	Off	Off	Off	Normal Operation
Off	Solid	Off	Off	Low Voltage
Off	Flashing	Off	Off	High Voltage
Off	Off	Flashing	Continuous	Potentially Dangerous Condition

Cable PI alarm explanations

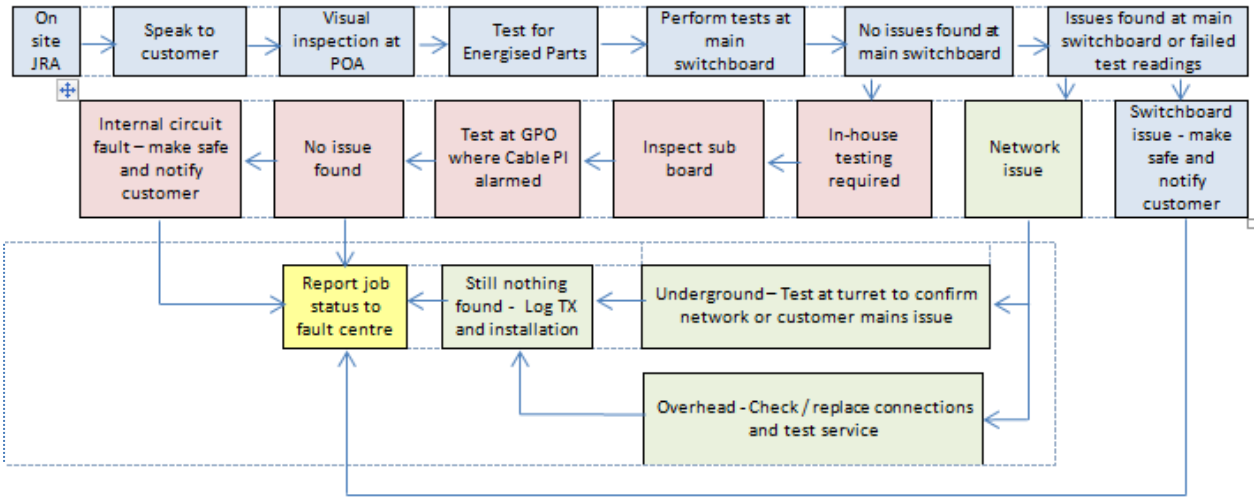
The Cable PI identifies :

- A change in impedance or high impedance in an installation or the distribution network or a broken neutral - Red light **(Above 1.6ohms).** A reading above 1.3 ohms may cause an alarm.
- High voltage (**Above 270v**) – solid amber light.
- Low voltage (**Below 200v**) – Flashing amber light.
- Failed self-test - flashing green.
- No light - broken Cable PI.
- Solid green – passed self-test.

NOTE: High impedance neutral, active or a combination of both, can cause the cable PI to alarm.

3.3 Work Flow Process

Then, inspect and test in accordance with the following flow process covering the steps shown in logical order.



3.4 Visual Inspection Of POA / Pole

Perform a visual check at the POA, pole and switchboard when you arrive looking for obvious signs of a poor connection:-

- Connection Type.
- Service cable type.
- Service cable size.
- Point of attachment type.
- Point of attachment condition.

NOTE: 55 amp Stanger fuses or flat ribbon cables must be replaced.

Poor IPC connection

Broken service neutral at pole

Broken service neutral at POA

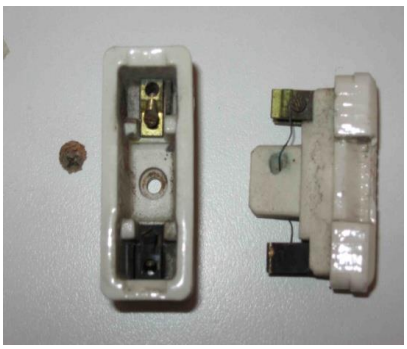
3.5 Visual Inspection At The Switchboard

Test all metallic parts for voltage using a volt stick or independent earth and multi meter.

Check : -

- Switchboard location.
- Switchboard enclosure type.
- Earth electrode location / condition.
- Remove escutcheon panel and perform a visual inspection look for hot connections.
- Look for burnt or heat damaged circuit breakers and cable.
- Check for broken conductors.

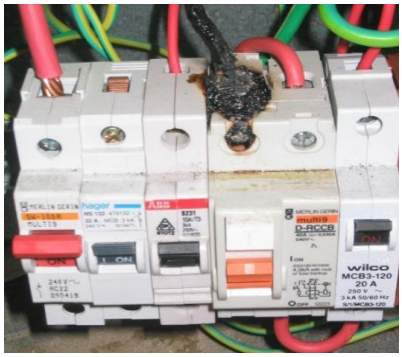
Burnt out fuse



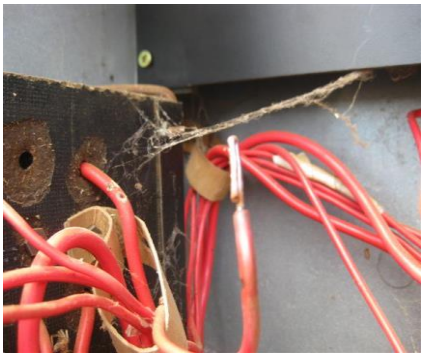
Poor rewirable fuse wedge contact

Poor termination / corroded link

Failed active on federal switchboard



Loose RCD connection



Termination loose - over heating

3.6 Testing At The Switchboard

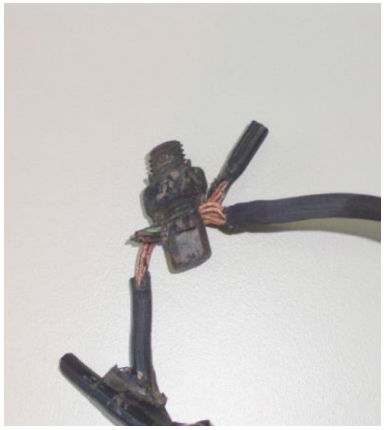
If visual inspection does not find the cause of the Cable PI alarm problem then conduct testing in conjunction with the following :-

- Perform a Network Analyser test at the switchboard.

- If the readings are outside normal parameters (1 ohm for the neutral) there may be an issue between the switch board and the distribution transformer.
- Check all connections at the switchboard are tight.
- Check for conductors terminated on cable insulation creating a poor connection.
- Load test the consumer mains – turn on a load and check for a current flow in the active, neutral & MEN/main earth. The active and the neutral should be carrying similar current.
- If the Network Analyser shows the earth and neutral impedance to be similar, the earth will carry some current. If the earth impedance is a lot higher than the neutral impedance, there should be no or little current on the earth.

3.7 High Impedance Found - Inspect At The POA

If testing at the switchboard indicated high impedance, check all terminations and connections at the POA. Look for loose connections, poor contacts and corrosion.



Poor service connection

Corroded connections at Mains Box

Burnt contacts at service fuse

If the above is okay then working back towards the transformer, inspect and test connections. It may be necessary to inspect the supply transformer.

3.8 Inspect And Test At Distribution Transformer Or Turret

Visually inspect all connection and test across connections for voltage drop. If connections are old or you have any doubt then the connections should be replaced.

Hot / poor connection at TX

Fuse not fitted correctly

Heat damaged fuse contact

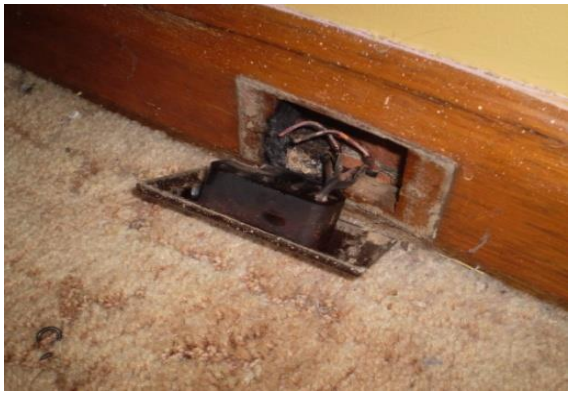
3.9 Test Inside The Installation

If all the connections at the switch board are okay and the Network Analyser readings are good then you will need to enter the installation and :-

- Request access to perform some more tests internally.
- Check **Z Line Neutral** and **Z Line Earth** impedance at each GPO along the circuit (use the 3 pin plug connection lead on your Network Analyser). The impedance should decrease as you get closer to the switchboard.
- Depending on circuit length, impedance of >0.1 ohms between GPO's should be investigated.
- Circuit faults can be at any connection or within the GPO itself e.g. a switch.
- Check the circuit impedance at the power point that the cable PI is alarming in, a reading above 1.3 ohms may cause an alarm.
- Apply load to the circuit (e.g. plug in a heater) and re test. The impedance should not increase very much. If it increases a lot, there is an issue on that circuit.

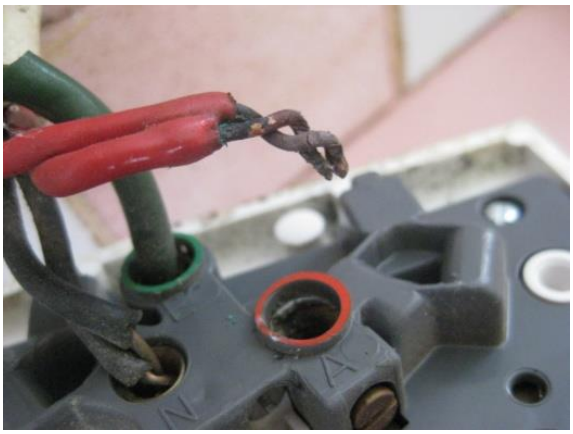
Typical internal faults

If a circuit fault is found, the circuit shall be isolated and a notice of non-compliance / disconnection issued to the customer to have this repaired by their Electrical contractor.



Burnt out power point socket

Poor connection and burnt wiring



Loose / poor active connection

Useful information

- Typical **Z Line Neutral** result at the customers' switchboard is between 0.3 – 0.7ohms. This can vary depending on conductor sizes and the distance from the transformer. **Z Line Earth** results can vary greatly. Readings <1.5 ohms can mask a network neutral fault.
- Compare switchboard results to GPO results. Depending on circuit length, impedance increases of >0.7ohms from the switchboard to the GPO could indicate a problem.
- If the circuit impedance is above 1.3 ohms and does not increase very much when load is applied, there may be nothing wrong and the reading is due to the length of the circuit and distance from the switchboard. Test GPO's moving towards the switchboard until you get a lower impedance reading and install the cable PI in one of these GPOs and advise the customer of the GPO's the Cable PI should not be plugged into.
- Test GPO's moving towards the switchboard until you get a lower impedance reading. If the impedance stays high, this may indicate an issue in the beginning of the circuit.
- Ensure testing is completed in the same outlet as the cable PI was plugged into. There have been cases of one outlet being faulty in a double GPO.
- Measuring impedance under load gives a more accurate representation of the impedance the Cable PI measures. If impedance under load is more than 0.3ohms greater than the unloaded measurement, this is a strong indicator of a hot joint on the circuit, on either the active or neutral conductor.
- On the power circuit, **Z Line Neutral** impedance and **Z Line Earth** impedance should be similar given the MEN. If not, this is a strong indicator of a high resistance joint on the neutral or earth conductors. A fault on the active conductor will affect both readings.

- Typically, 2.5mm copper TPS has a circuit resistance of 0.17 ohms per 10 metres without taking into account any joints or connections. A typical GPO connection will add an extra 0.1 ohm to the circuit.
- A Cable PI should not be plugged into double adaptors, power boards or GPO's in bath rooms as these may cause false alarms.
- A lightly loaded transformer or a failing transformer can create noise (Harmonics) and this can also cause a cable PI to alarm. A voltage Logger can be installed at the Distribution Transformer & the installation switchboard to check this.
- It is possible for multiple faults to be found in a single installation causing a device to alarm.

4. Other Options If Cannot Find Cause

Below are some options if you can't find the cause of the Cable PI alarm :-

- 55 amp Stanger fuses or flat ribbon cables must be replaced.
- Have the installation and distribution transformer logged (this can be arranged through the TasNetworks, Fault Centre).
- Try the Cable PI in a different circuit with circuit impedance below Cable PI tolerances.
- Leave the Cable PI in a GPO closer to the switchboard and having lower circuit impedance.

5. If Still Cannot Find Cause

- If the Electrical Practitioner or the field crew attending cannot find a cause for the cable PI to alarm from general inspection and testing;

- Refer to the Fault Centre to pass onto the Technical Competence Group for follow up and resolution.

6. References

- TasNetworks **Testing Low Voltage Procedure.**
- **AS/NZS 3017: Testing and Verification**.
- **AS/NZS 4741: Testing of Connections to Low Voltage Electricity Networks**.

7. Attachment – Cable PI Testing Booklet

The following is an example layout from the Cable PI Testing Booklet.

The booklet will enable persons to record test results and keep a carbon copy as well as backup for reference should the same Cable PI problem appear again in the future.

The Cable PI Testing Booklet can be obtained from the TasNetworks, Cambridge Store by quoting stock item number 37-15-08.

Cable PI Onsite Testing Booklet