

Mains Maintenance Instruction

Routine electrical inspection and maintenance of streetlight columns, LV pillars and associated electrical terminations

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MAINS MAINTENANCE INSTRUCTION

ASSET STANDARDS & DESIGN

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MMI 0022 ROUTINE ELECTRICAL INSPECTION AND MAINTENANCE OF STREETLIGHT COLUMNS, LV PILLARS AND ASSOCIATED ELECTRICAL TERMINATIONS

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1.0 PURPOSE

To set out the minimum requirements of the routine electrical inspection of streetlight columns, distribution fuse panel cubicles and LV pillars.

2.0 SCOPE

This instruction only covers the internal inspection of electrical connections. The external inspection of these assets is covered in MMI 0003 – Routine external structural inspection of streetlight columns and LV pillars.

3.0 REFERENCES

Internal

- Board Policy (Environment) 4.0 – Environment
- Board Policy (Health & Safety) 3.0 – Work Health And Safety
- Company Policy (Network) 9.9.1 – Network Asset Maintenance
- Company Procedure (Environment) GPE 0004 – Pesticide Use
- Company Procedure (Health & Safety) GSY 0003 – Manual Handling
- Company Procedure (Health & Safety) GSY0051 – Incident Management
- Company Procedure (Health & Safety) GSY0067 – Personal Protective Equipment
- Company Procedure (Health & Safety) GSY 1066 – Worksite Hazard and Risk Assessment
- Company Procedure (Network) GAM0070 – Authorisation to Construct and Maintain Underground Mains - Distribution
- Company Procedure (Network) GAM0085 – Authorisation to Construct and Maintain Distribution Substation Equipment and Connection Work
- Company Procedure (Network) GAM0089 – Authorisations Governance and Management
- Branch form (Asset Standards & Design) FAE 3100 – Pillar and column inspection sheet
- Mains Construction Instruction MCI 0005 – Overhead distribution construction standards manual
- Mains Design Instruction MDI 0011 – Underground distribution cables – continuous current rating
- Mains Maintenance Instruction MMI 0003 – Routine external structural inspection of streetlight columns and LV pillars
- Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment
- Substation Maintenance Instruction SMI 113 – Distribution and field transmission data asset structure and nameplate details
- Substation Maintenance Instruction SMI 124 – Maintenance data entry and defect prioritisation
- Endeavour Energy Electrical Safety Rules

External

- *Electricity Supply Act 1995 (as amended)*
- National Electricity (NSW) Act Law 1997
- *Work Health and Safety Act 2011*
- *Electricity Supply (General) Regulation 2014 (NSW)*
- *Work Health and Safety Regulation 2011*
- *AS 5577 – 2013 – Electricity network safety management systems*
- *AS/NZS 3000:2000 – SAA Wiring Rules*
- *AS/NZS 3760:2010 – In-service safety inspection and testing of electrical equipment*

- ENA National Electricity Network Safety Code (Doc 01-2008)
- National Electricity Rules

4.0 DEFINITIONS AND ABBREVIATIONS

accredited	A person who has completed the streetlight column and LV pillar inspection awareness course.
authorised	A person with technical knowledge or sufficient experience and training, who has been approved as competent and is then authorised in writing by the company to perform the function requiring authorisation on or near the company's electricity network or in any other situation determined by the General Manager Asset Management. This definition holds for various forms of the word, for example authorisation and authorise.
CONSAC	LV cable, 3 core with aluminium sheath used as a neutral.
defective	Assets that are likely to deteriorate to a failed condition and impact upon safety, system reliability, or the environment, or impose unacceptable operational constraints on the network.
DFP	Distribution fuse panel – steel or aluminium wall mounted cubicle, containing LV cables and fuses.
Ellipse	Endeavour Energy asset database
EFM	Electrical Fitter Mechanic
GIS	Graphical Information System
inspector	Person bound to execute the work.
IR camera	A camera that detects infrared radiation emitted from objects to produce a two-dimensional image that displays variations in temperature on the object's surface.
LV	low voltage
SL	streetlight
SLCP	street light control point
Streetlight only column	Columns that only contain street lighting supplies and no LV distribution services.
URD	underground residential distribution

5.0 ACTIONS

5.1 Training, authorisations and the extent of inspections

All works must be carried out by persons with inspection qualifications (as set out in Section 5.1.1) and who have been trained and accredited to do so by Endeavour Energy.

Annual assessment and certification is required to maintain the accreditation.

5.1.1 Required authorisations

The inspectors must have the following authorisations:

Description	Qualifications prerequisites
-------------	------------------------------

External thermal inspection using IR Camera	• Authorised in accordance with GAM0089 and the following: - GAM0085: Authorisation to construct and maintain distribution substation equipment and connection work and/or - GAM0070: Authorisation to construct and maintain underground mains – distribution
Internal visual inspection and maintenance	• Authorised in accordance with GAM0089 and the following: - GAM0085: Authorisation to construct and maintain distribution substation equipment and connection work and/or - GAM0070: Authorisation to construct and maintain underground mains – distribution

5.1.2 Inspection intervals

The inspection intervals for columns, DFP cubicles and pillars must be as shown below:

Description	Inspection interval
External thermal inspection of streetlight columns, LV pillars and DFPs using IR Camera. This does not include SL only columns.	Every four (4) years
Internal visual inspection of LV terminations contained within streetlight columns, LV pillars or DFPs.	Carried out on an ad hoc basis: • Follow up thermal scans. • Completing the installation of MEN bonds and column insulation kits. • Any other circumstance where column cover or pillar lid is removed.

5.2 Precautions before commencing any work

5.2.1 Safety standards

All Endeavour Energy employees, contractors or subcontractors must abide by Endeavour Energy's Safety Rules, and any amendments to these documents, for the duration of the works.

5.2.2 Worksite Hazard and Risk Assessment (WHRA)

Prior to commencing work on site, a Worksite Hazard and Risk Assessment must be completed in accordance with GSY 1066 – Worksite Hazard and Risk Assessment.

Where hazardous works are to be corrected, a specific WHRA must be prepared. Safe Work Method Statements must be prepared and be available for generic work processes, including typically simple temporary hazard controls and repairs, such as affixing temporary covers.

5.2.3 Duty of care

Endeavour Energy employees/contractors must take all reasonable steps as far as possible to prevent injury to the public, Endeavour Energy contractors and their staff, and Endeavour Energy employees during the course of their work.

If a potential safety issue is identified, the inspector must correct the problem within the limits of the provisions outlined in Section 5.2.8.4 and make the problem safe, or advise the responsible person to repair it at a later date.

All corrective works of any type must be photographed to show the issue requiring correction, and recorded in Ellipse.

5.2.4 Clothing

All employees, contractors or subcontractors must be appropriately dressed at all times in accordance with Endeavour Energy's Electrical Safety Rules.

5.2.4.1 Insulating gloves

Rubber insulating gloves with leather outer gloves must be worn on each hand during testing, external structural inspections, and excavation around or maintenance of streetlight columns, distribution fuse panel cubicles (DFP) and LV pillars.

5.2.4.2 LV rescue kits

An LV rescue kit must be positioned directly beside each job site if an inspection and/or rectification works are to be conducted.

5.2.5 Manual handling

All works that involve manual handling must comply with the requirements of GSY 0003 - Manual Handling.

5.2.6 Environmental

All noise, waste materials, run off, cleaning solvents, and items such as water and oil, must be controlled to meet EPA and local council guidelines, and be in accordance with Board Policy 4.0 - Environment. All equipment must be suitable for the environment in which it will need to operate.

Any environmental incidents must be addressed in accordance with GSY0051 - Incident Management.

5.2.7 Tools

All tools and equipment must be kept in good working condition so that they are safe to use at all times. Any tools and equipment that require inspection must be current in their period of inspection and tagged/logged accordingly.

Only approved insulated tools will be used within 500mm of exposed live LV.

5.2.8 Voltage leakage check

Before commencing any related inspection activities of steel columns, the inspector must carry out a voltage leakage check on the columns.

The inspector must be suitably attired with low voltage insulating gloves worn on both hands to perform the voltage leakage test and to prove the column safe to touch before direct contact is made with the column and attachments.

The integrity of the meter must be checked in accordance with Section 5.2.8.1. After each column check, the functionality of the device must be re-checked in accordance with the manufacturer's instructions.

5.2.8.1 Multimeter check

The multimeter used to perform the voltage check must have a function to measure both LOW and HIGH impedance (proximity test), for example, Fluke 117.

Prior to and after checking any column for voltage leakage, the multimeter must be checked for integrity.

This test must be performed in accordance with the manufacturer's instructions by either:

- using a known voltage point such as a power point or another known live circuit; or,



Figure 1: Multimeter voltage tester

- as this meter is sensitive to static electricity, it can be checked for functionality by vigorously rubbing the meter on a cotton shirt sleeve.

When used as a proximity tester (*Volt Alert* setting), the multimeter will indicate the presence of an electrical field with a light and an audible buzz.

A spare 9V alkaline battery must be carried by the inspector as a back-up for the meter as replacement of the battery may be required at any time.

5.2.8.2 High impedance check

Approach the column and visually inspect for burnt grass, electrical tracking on column, or any other indication of an electrical failure.

Using a high impedance (Z) capacitively coupled measuring device, such as a *Fluke 117* meter on the **Volt Alert** setting and on **Lo** RANGE, stand approximately one (1) metre from the column and extend at elbow height, moving towards the column, and touch the surface.

- Repeat for all metal (conductive) surfaces.
- A *positive* indication (light and buzz sound) must be treated with caution and the voltage level confirmed using the *Fluke 117* meter set to the **AUTO-V LoZ** setting, as described in the voltage test below.

5.2.8.3 Voltage test

Upon receiving a positive high impedance indication, perform a *voltage test* measurement using a low impedance resistively coupled device, such as the *Fluke 117* set to **AUTO-V LoZ**.

Probes are to be connected between an earth/ground stake or similar, driven into the ground a minimum of approximately one (1) metre from the column and the column surface. Where available, the test is to be performed on a metallic surface, such as the side of the steel column.

If the voltage on the **AUTO-V LoZ** setting is less than 5V, no further action is required and work may proceed on the column.

If the voltage on **AUTO-V LoZ** is equal to or greater than 5V, guard the column and immediately report the problem for attention by qualified personnel.

If a hazardous condition and/or an unsafe situation is found, such as a live or failed steel column, it must be reported immediately as set out in Section 5.2.8.4.

In addition, the following action must be taken:

The inspector must:

- cordon off the area where the hazardous conditions exists;
- prevent the public from entering the area;
- notify the supervisor that a hazardous condition has been found;
- stand by until emergency employees have arrived;
- not proceed with any further work on the column until advised that it is safe by an authorised person, and a further voltage leakage check confirms that the column is safe.

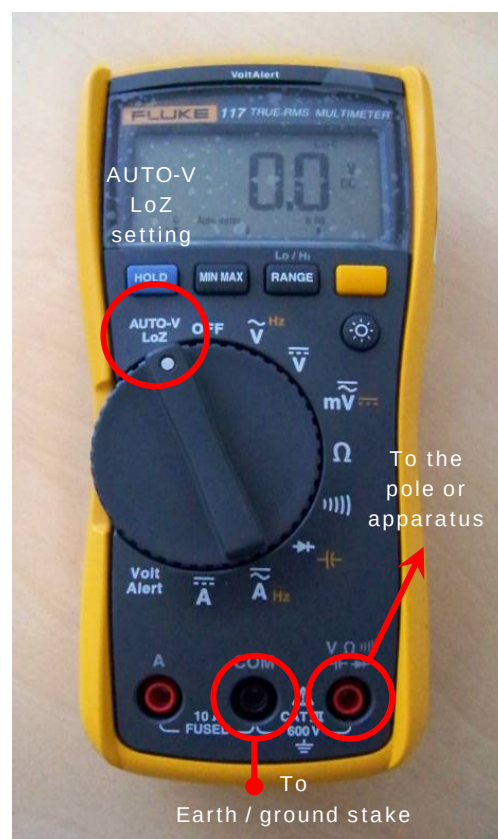


Figure 2: Settings for voltage test

5.2.8.4 *Hazardous conditions*

If a hazardous condition and/or an unsafe situation is found, and it cannot be rectified safely by the inspector within 15 minutes work time, it must be reported immediately to the responsible Regional Operations Manager or Project Manager for action.

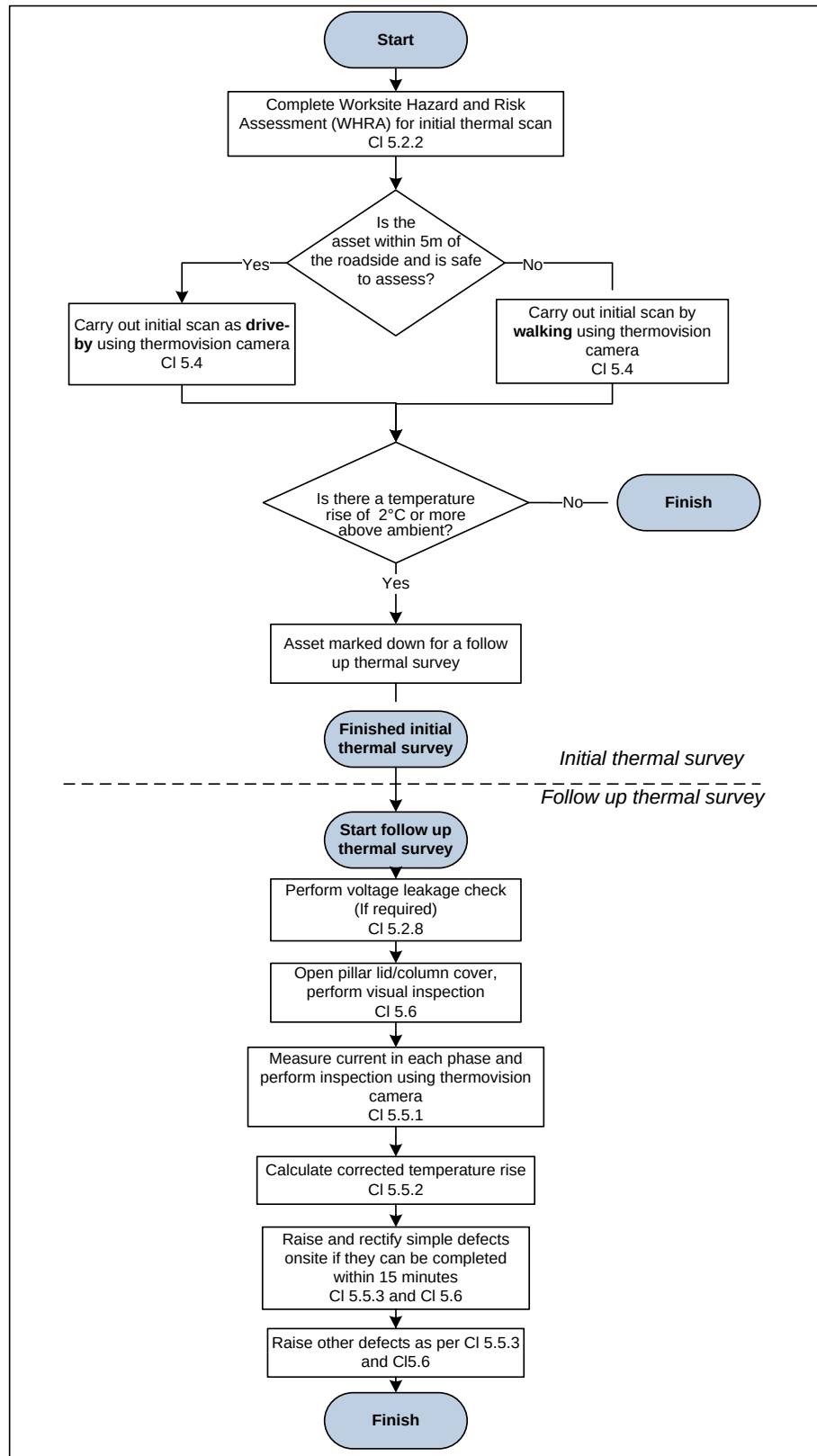
In an emergency, call the Contact Centre on 131 003 and provide details.

Following discussions with the Regional Operations Manager or Project Manager, the area where a readily unresolvable hazardous condition exists must be cordoned off. Inspectors must stand by and prevent entry by the public until a repair crew arrives or the hazardous condition is rectified.

5.3 Procedure for thermal inspection

The thermal inspection of columns and pillars consists of an initial scan with an IR camera and a follow-up scan where a defect is suspected.

5.3.1 Thermal inspection process flowchart



5.4 Initial thermal inspection using an IR camera

The purpose of the initial thermal inspection is to detect potentially overheated connections for follow up thermovision scans. The following points outline the process:

- IR cameras with a minimum resolution of 320x240 are suitable for the initial and follow up thermal inspections.
- To maintain sufficient measurement accuracy, the distance between the camera and the pillar/column must not be greater than five (5) metres.
- Inspections are preferably carried out as a drive-by, but in some instances it may not be possible due to safety concerns, such as excessive traffic or speed limits. A risk assessment must be carried out on a case by case basis to determine the best method.
- When carried out as drive-by, the vehicle must have and use appropriate safety measures, such as flashing lights, and warning signs such as “Caution, Frequent Stopping”.
- To confirm accurate measurements and safety, the vehicle must come to a **complete stop** whilst using the IR camera.
- The inspection must be carried out during winter months (June, July and August). This is due to the fact that daylight hours are reduced and that the ambient temperature is lower.
- Inspections are to be carried out early in the morning (generally 6am to 7.30am) or in the evening at least 30 minutes after the sun has gone down (generally 6pm to 8pm).
 - Morning inspections must cease when the effect of direct sunlight begins to adversely affect temperature readings
 - Evening inspections must cease as customer demand decreases thereby reducing the effectiveness of the thermal inspection.
- Extra time may be needed before evening inspections commence to allow for the dissipation of heat remaining due to solar radiation. Performing the inspection with minimised heat from solar radiation **will** give the best conditions to identify possible problem pillars.
- The difference between the ambient temperature and the pillar temperature must be measured. If the temperature difference is **two (2)** degrees Celsius or greater, the asset must be flagged for a follow up scan.
- As the ambient temperature may change while the inspection is carried out, **it must be re-checked at regular intervals**.
- This scan is **not** required on street light only columns.
- It should be noted that this methodology will produce false positives due to:
 - Connections in contact with the pillar;
 - Ambient temperature variations; or,
 - Pillars with a large thermal mass (for example, concrete bases).
 - Different thermal properties metal column as opposed to a plastic pillar.

Therefore, the temperature rise in the initial thermal inspection does not correlate to the severity of the defect and should not be used to create a defect priority.

5.5 Follow-up thermal inspection using an IR camera

The purpose of the follow-up thermal inspection is to determine the validity and priority of the defect identified with the initial inspection. The follow-up thermal inspection must be carried out within **six (6) weeks** of the initial thermal inspection.

5.5.1 Procedure

The following points outline the procedure for the follow up thermal inspection:

- The visual internal electrical inspection must be carried out, as set out in Section 5.6.
- Measure the current in each phase using a tong ammeter or flexible ac current probe.

Note: A risk assessment must be carried out to determine if it is safe to proceed with this measurement. If it is safe to continue, effort must be made to apply minimal pressure to cable terminations. If it is deemed unsafe, do not carry out the measurement, and it must be reported for immediate action, to be rectified within 48 hours.

- A scan for overheating connections using an IR camera.

Where a hot joint or connection is detected, a more detailed examination of the component or equipment must be carried out to determine the cause of the overheating. The healthy phases or conductors must be used as a reference to determine the relative temperature rise of the hot joint. This temperature must be corrected as set out in Section 5.5.2.

5.5.2 Temperature correction

The temperature rise of the hot joint will depend on the severity of the poor connection and the current in that phase. The temperature rise of the hot joint must therefore be corrected to what would be expected if the pillar was under full load current. The correction formula is given below:

$$\Delta T_{corrected} = \frac{\Delta T_{measured}}{\left(\frac{I_{measured}}{I_{rated}}\right)^{1.78}}$$

where:

- $\Delta T_{corrected}$ = Corrected temperature rise that would be expected under full load.
- $\Delta T_{measured}$ = Measured temperature rise of the hot joint.
- $I_{measured}$ = Measured current in through the hot joint
- I_{rated} = Rated current of the feeder; refer to MDI0011 Section 5.3 for ratings.

5.5.3 Defect prioritisation

The inspector must record and attempt to rectify the defects on-site, provided they can be completed safely within 15 minutes. If the defects cannot be rectified on site, they must be raised as per the following table:

Corrected temperature rise ($\Delta T_{corrected}$)	Defect priority
< 70°C	No action
70-80°C	Repair in 12 months
81-90°C	Repair in 3 months
91-100°C	Repair in 1 month
>100°C	Immediate – 48 hour
No noticeable temperature rise, however signs of heat damage is visible	Immediate – 48 hour

5.6 Visual internal electrical inspection

Check for signs of insects nesting before opening pillar. The inspector must record and attempt to rectify defects on-site, provided they can be completed safely within 15 minutes. If defect cannot be fixed on site and it is not considered hazardous as set out in Section 5.2.8.4, it must be rectified within six (6) months.

Insulating kits, mats and rubber gloves with leather outer gloves are to be used when carrying out the following procedures.

5.6.1 Column insulation kit

Stores item no. SS20431.

Columns and DFPs must be insulated as follows:

- Lay the insulating mat in front of the column or cubicle. While standing on the insulating mat, install the clear inserts between the switchboard and the inside wall of the column or cubicle on both sides of the doorway. Use a combination of the longer and shorter inserts if required.
- Insulate the top and bottom of the column doorway, by installing the small mats, tucking the flaps into the opening of the column and securing them with the built in magnets and clips. Overlap the bottom cover with a rubber mat.

Some wall-mounted cubicles in commercial areas have side brackets where extra insulation can be installed to prevent accidental contact between a live conductor and earth.

- Insulate the top and bottom of cubicle doorway by installing additional mats, tucking the flaps into the opening of the cubicle and securing them with the built in magnets. Overlap the bottom cover with a rubber mat.

5.6.2 Electrical inspection and maintenance of columns and cubicles

- Check panels (where fitted) for cracking and tracking.
- Check panel support brackets and steelwork are secure. If defects cannot be fixed onsite, it must be rectified within 48 hours, and the inspector must put warning tag inside.
- Check all front connections for tightness, paying particular attention to neutral connections. Burnt or loose connections must be investigated and corrected or referred to the **Regional Operations Manager / Project Manager** to organise a short outage to the customer, to enable repairs.
- Check service fuses (where installed) for evidence of overheating or burning. If burning or overheating is evident, refer to the **Regional Operations Manager / Project Manager** to organise an outage to the customer and the removal or replacement of the fuse carrier.

Direct connection to the bluepoint link is the preferred option. If defects cannot be fixed onsite, it must be rectified within 48 hours, and the inspector must put warning tag inside.

- Broken or cracked boards must be referred to the **Regional** Operations Manager / Project Manager and are to be replaced with like boards (where practical). This will require LV isolation and lifting of the column.
- Signs of carbon tracking must be referred to the **Regional** Operations Manager / Project Manager to be rectified. This may require a LV isolation to clean or replace components as required.
- Check neutral/earth (MEN) bond is connected to the column, install if required.
- Check earth is connected and tight.
- Check all insulating boots (marble bags), heatshrink caps and any other insulating covers for cracking/tracking/burn marks/loss of flexibility. Existing blue bags are not voltage rated and can deteriorate if any burning or heat is produced from a faulty joint. If an existing boot shows any signs of deterioration, temporarily place a new yellow boot over the old one and arrange for isolation so the column can be lifted and any faulty connections repaired and boots replaced with new yellow voltage rated bags or an unlined heatshrink end cap.

Blue marble bags must be replaced with yellow marble bags if safe to do so either at the time of inspection or in accordance with the above paragraph.

The yellow *marble bag* has two (2) sizes - single core, 110mm wide by 180mm long (Stores item no. 1005170) and multi-core, 190mm wide by 245mm long (Stores item no. 1075822).

Installing an insulation sheet (Stores item no. 001558865) will provide additional insulation and must be installed when the connections are against the column.

- Check supply and phasing.
- Check the street light circuits (including incoming circuits); they must be controlled by a fuse. This in-line fuse assembly is to be installed in accordance with Drawing no's 075035K and 241059E.
- *Closed* open points and *opened* closed points *Open point switching status* (refer to GIS maps) are to be checked and recorded for correction by Regional employees.
- Foreign matter, such as grass, spiders, bees, ants and the like are to be removed.

Particular attention must be paid to the following:

The neutral bond: The inspector must verify that all columns have a neutral bond. If missing, the inspector must install the bond at the time of inspection.

The neutral bond to earth must be provided in accordance with Drawing no. 075035K.

Note: All columns must be supplied with an earth stud to allow for connection of the bond. If the stud is not supplied, it must be installed in accordance with Drawing no. 075035K. The earth stud must be a stainless steel bolt, nuts and washers no less than M10 in diameter.

Any holes that must be drilled in the column to mount the earth stud must be painted with a suitable paint (cold galvanising) to provide corrosion protection.

5.6.3 Internal inspection of pillars

An application of a commonly available broad spectrum herbicide must be applied to the ground surface beneath the pillar lid, below the electrical components. The herbicide is not to be sprayed on any live components.

The LV terminations must be examined for:

- Check neutral/earth (MEN) bond is connected in the pillar, install if required.
- Check the street light circuits (including incoming circuits); they must be controlled by a fuse.
- Loose connections in service blocks to be tightened.

- Evidence of burning connections.
- Damaged insulation. Check all insulating boots (marble bags), heatshrink caps and any other insulating covers for cracking/tracking/burn marks/loss of flexibility. Existing blue bags are not voltage rated and can deteriorate if any burning or heat is produced from a faulty joint. If an existing boot shows any signs of deterioration, temporarily place a new yellow boot over the old one and arrange for isolation so any faulty connections can be repaired and the damaged boots replaced with new, yellow, voltage rated bags or an unlined heatshrink end cap.

Blue marble bags must be replaced with yellow marble bags if safe to do so either at the time of inspection or in accordance with the above paragraph.

The yellow *marble bag* has two (2) sizes – single core, 110mm wide by 180mm long (Stores item no. 1005170) and multi-core, 190mm wide by 245mm long (Stores item no. 1075822).

- Check supply and phasing.

5.6.4 *Inspection of DFP wall cubicles*

Insulating mats are to be laid around the inside of the doorway and in front of cubicle.

The LV terminations must be examined for:

- Street light circuits (including incoming circuits) are controlled by a fuse.
- Evidence of burning connections.
- Damaged insulation.
- Evidence of tracking or cracks on the panels, where fitted.

5.7 Inspection records and reporting requirements

5.7.1 General

If doubt exists regarding a defect condition, the **Regional Operations Manager / Project Manager** must be contacted for further assessment.

5.7.2 Asset database (Ellipse)

Reporting and recording of all the details of the column and pillar inspections, treatments and defects are to be entered into the Endeavour Energy's asset database system, Ellipse.

Details of how to enter maintenance related activities are documented in SMI 124, while the entry of asset structure details is documented in SMI 113.

For each asset inspected, records must include:

- (a) All defects found and the priority (as set out in SMI 124) for rectification, as determined by the inspector.
- (b) Close off for all defects no longer existing on the structure.
- (c) Details of any alterations to the inspection map that may be required to improve its accuracy.
- (d) Completed form FAE 3100, retained for audit purposes.
- (e) No hours are booked against defects that can be rectified within 15 minutes.

5.7.3 Photographic requirements

Each identified defect must have the three digital photographs. The camera used must also record GPS co-ordinates. This does **not** include simple defects such as replacing asset identification numbers or cover bolts.

A photo is to be first taken of the associated **asset** number, for example, **LV014186**. Two photographic images of each defect are then to be taken from different directions.

The photographic images related to each defect are to be saved to *G:\EE Maintenance\Distribution* and titled by the asset number for example, **LV014186**. An example of the directory structure is shown below:

Folders	Name	Size	Type	Date Modified
SD (E:)	Image 1.JPG	792 KB	JPEG Image	20/01/2010 9:46 AM
PL502402	Image 2.JPG	772 KB	JPEG Image	20/01/2010 9:46 AM
PL502403	Image 3.JPG	796 KB	JPEG Image	20/01/2010 9:46 AM
PL502404				

Figure 3: Directory structure of defect photos

If the defects cannot be rectified within 15 minutes and require follow up work must be reviewed using these photos. The purpose is to provide depot maintenance employees with a better understanding on the deterioration of the asset and provide a clear picture of the defective asset to facilitate the prioritisation of repairs.

5.8 Drawings

No.	Amdt.	Title
075035	K	Streetlight column connection arrangement
241059	F	URD Rectangular mains pillar arrangement
280143	D	Public lighting PE cell controlled SL termination arrangement
280144	B	Public lighting SLCP controlled SL connection arrangement with con mains
280146	B	Public lighting PE cell controlled 1ph & 3ph SL only connection arrangement
280255	B	Public lighting construction standards SL only connection arrangement CCT

6. AUTHORITIES AND RESPONSIBILITIES

General Manager Asset Management has the authority and responsibility for:

- approving this Standard, including any variations.
- making all decisions concerning compliance in respect of this Standard.
- delegating any of these authorities and responsibilities to the Manager Asset Standards & Design.

Manager Asset Standards & Design has the authority and responsibility for:

- endorsing this Standard, including any variations.
- reviewing this Standard and making recommendations to the General Manager Asset Management.
- making recommendations concerning compliance in respect of this Standard.

Mains Assets Manager has the authority and responsibility for:

- clarifying all the technical aspects of this Standard with stakeholders.
- updating the relevant actions required and outlined in this Standard.
- determining column ownership and issuing painting defects to customers.
- making the final decision on the serviceability of any columns, DFPs, or pillars referred for assessment, in the event of any dispute.

Operations Managers / Project Managers have the authority and responsibility for:

- confirming that the inspectors are aware of their responsibilities under this instruction.
- confirming that employees are provided with the relevant training.
- archiving copies of inspection details and signed copies of maps for a period of eight (8) years.
- verifying that the inspection details are entered into the asset database.
- confirming that following any remedial work to a defected asset, a follow-up inspection and assessment is completed.

Manager Technical Training has the authority and responsibility for:

- providing the necessary training to achieve accreditation for all employees involved in the inspection of streetlight columns and LV pillars to the requirements of this Standard.

All Endeavour Energy employees and/or contractors have the authority and responsibility for:

- Identifying any nearby potential safety issues during the inspection, making the problem safe, and/or advising the responsible person to repair it at a later date.
- Organising and funding traffic control, when required.
- Carrying out all of the procedures of this instruction, appropriate to each column, DFP, or pillars examined.
- Seeking clarification of this instruction, where necessary, from the Operations Manager / Project Manager.
- Conducting themselves in a manner that meets the requirements of this Mains Maintenance Instruction and Mains Maintenance Instruction MMI 003 - Routine external structural inspection and maintenance of streetlight columns and LV pillars.
- Working in accordance with local and statutory requirements.
- Managing public safety so that it is not compromised.
- Working in accordance with Endeavour Energy's Electrical Safety Rules.

7. DOCUMENT CONTROL

Documentation Content Coordinator : Mains Assets Manager

Documentation Distribution Coordinator : Branch Process Coordinator

ANNEXURE 1: TYPICAL COLUMN AND PILLAR ARRANGMENTS

A.1 Column Internal configurations

A.1.1 Circuitry

Since their inception, streetlight columns, URD and commercial pillars have been constructed with varying forms of circuitry:

- LV distribution mains connections, with and without panels.
- Consumer mains connections to LV distribution mains, with or without panels.
- Lantern supply from the LV distribution mains cable, with a photoelectric cell in the head of the column, with and without panels.
- Lantern supply by a separate circuit from a control point located at the distribution substation or another part of the circuit, with or without a panel to mount connection components.
- Lantern supply by a separate active in the distribution mains cable from a control point located at the distribution substation or another part of the circuit, with or without a panel to mount connection components.

Pillars have been used primarily for LV distribution and underground service mains and may or may not contain a panel to terminate cables.

Switching points may be contained within both the streetlight columns and LV pillars.

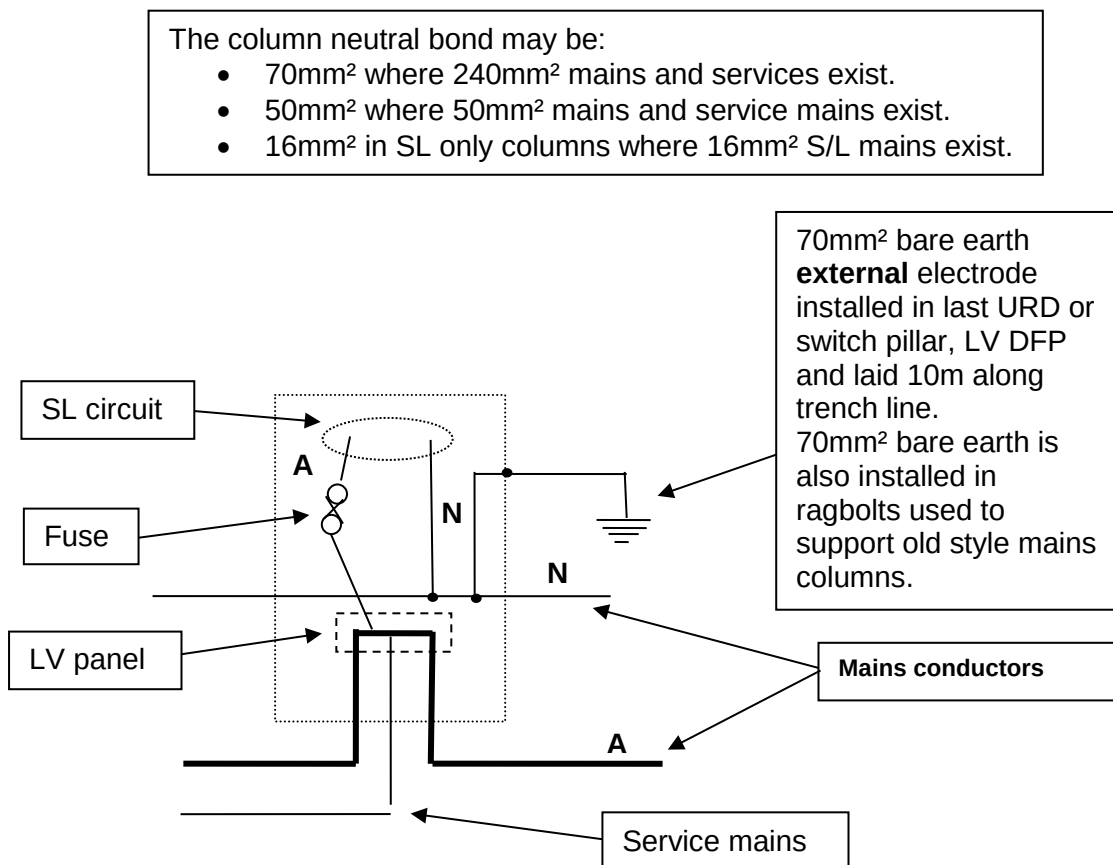


Figure 3: Typical column or pillar circuitry

A.1.2 Column and pillar variations

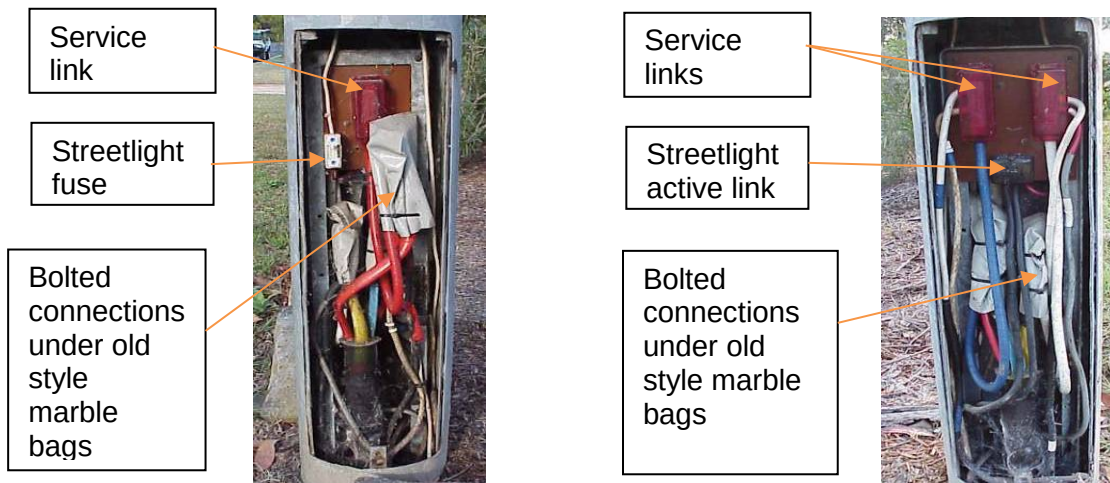


Figure 4: Blue Mountains boards - originally CONSAC cable with epoxy fill in the crotch

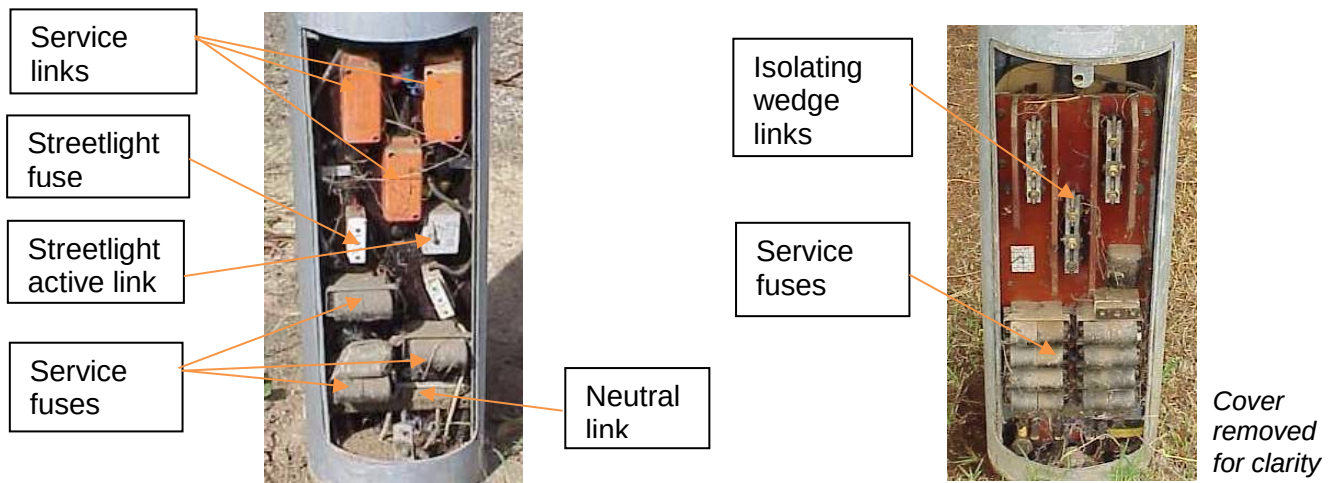


Figure 5: Prospect original LV board, three phase switch, services fuses, generally CONSAC cable installed, pre-1980 Type 7

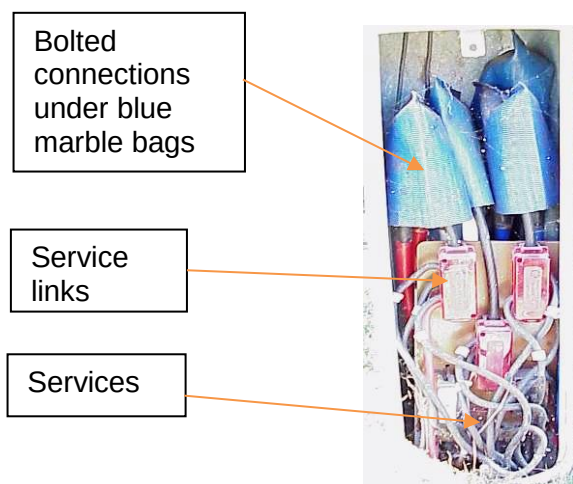


Figure 6: Prospect LV board Type 9

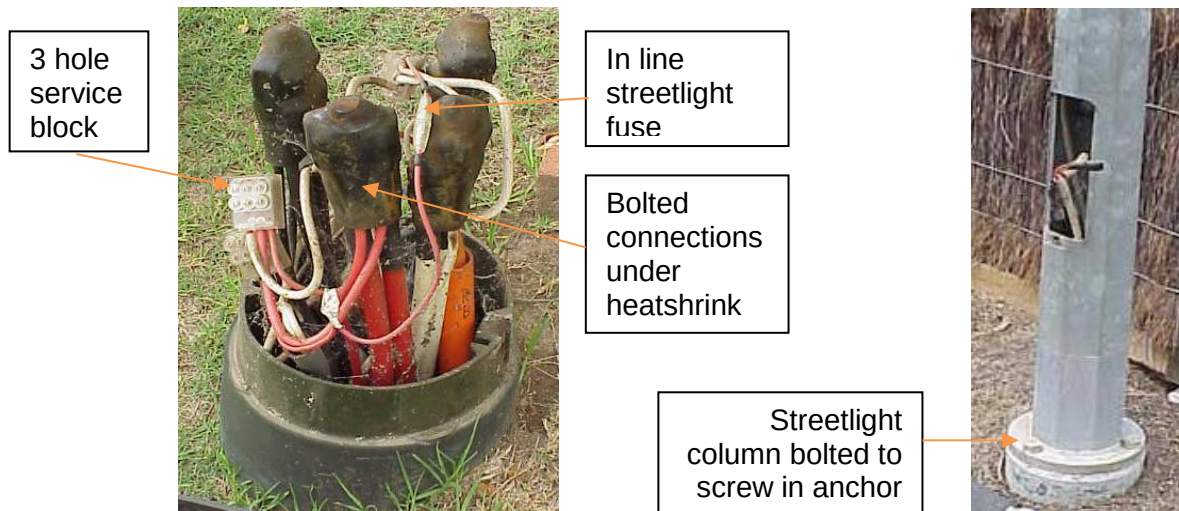


Figure 7: Prospect post-1990 pillar and streetlight columns

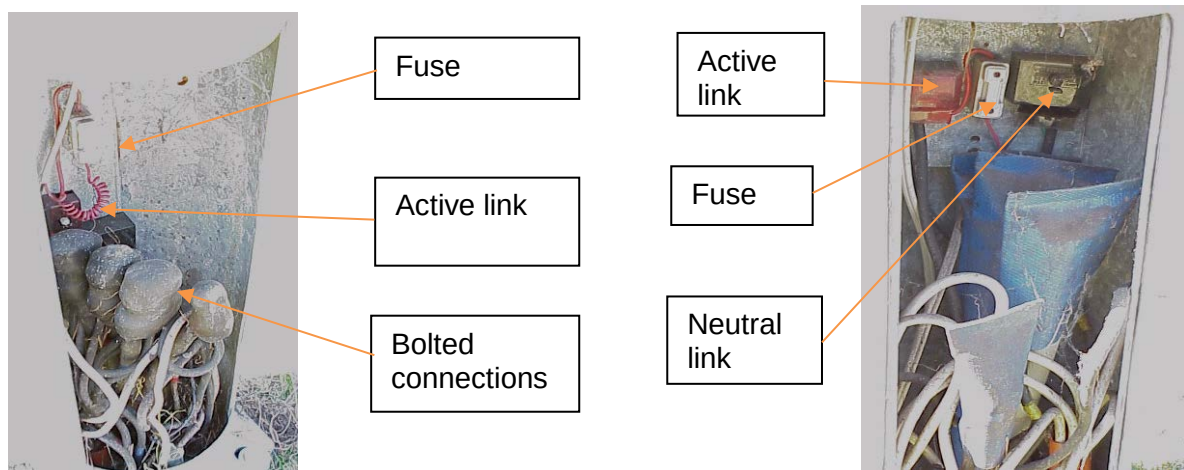


Figure 8: Illawarra street light column terminations with heatshrink caps and marble bags – CONSAC and XLPE cables



Figure 9: Early Illawarra pillar

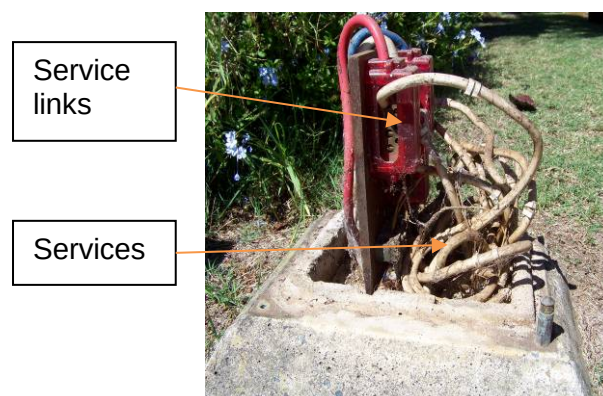


Figure 10: Service pillar

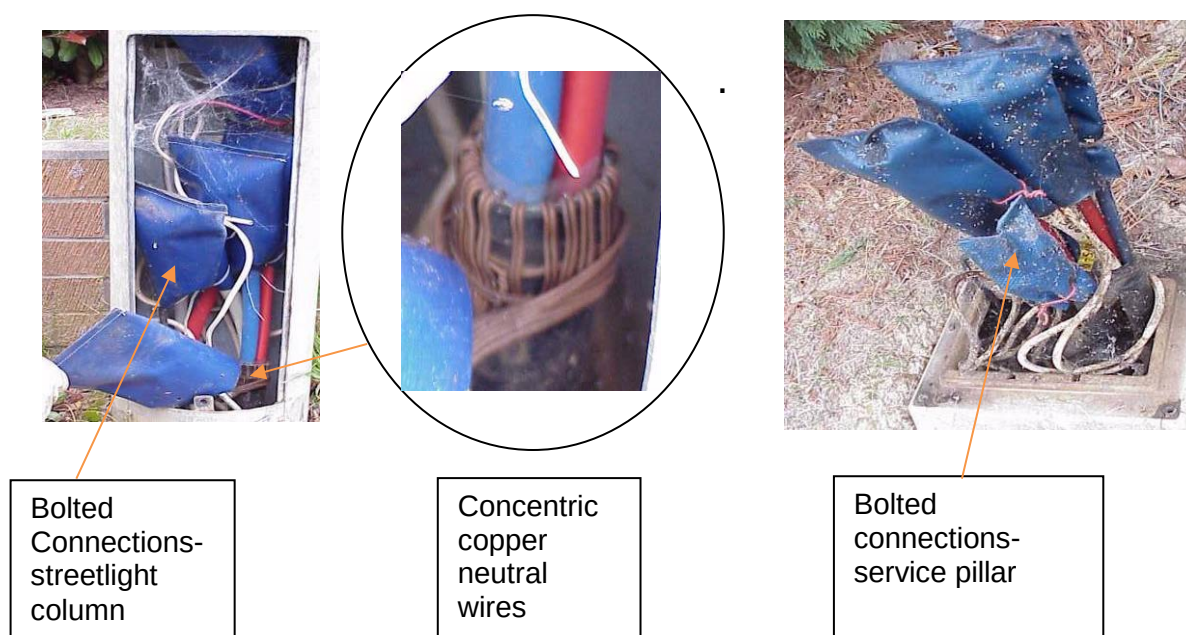
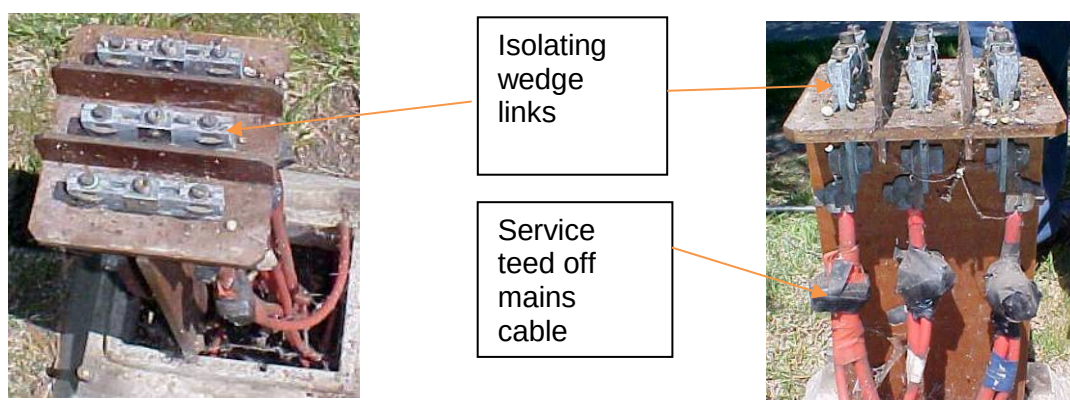


Figure 11: Bowral area, 3c XLPE with concentric neutral



Covers removed for clarity

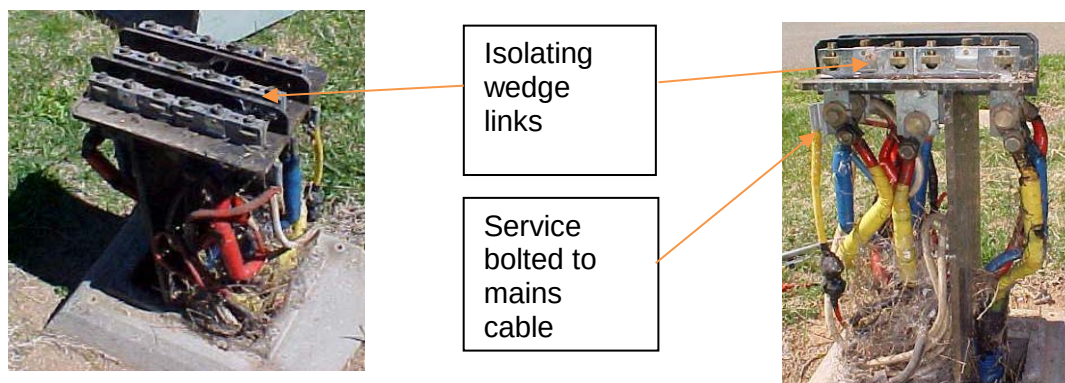


Figure 12: Hartley LV panels, 3-way and 2-way.



Figure 13: Typical DFP with cover off and cover replaced
(internal switchgear may vary)

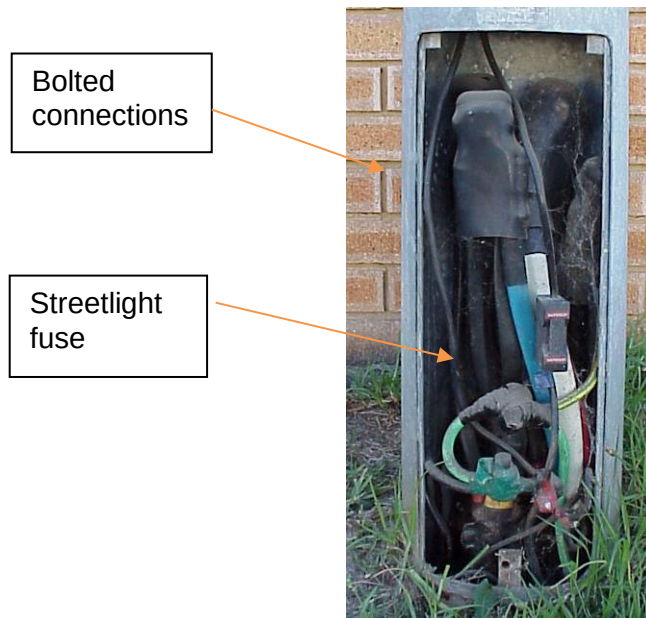


Figure 14: Nepean River, CONSAC cable

There are various types and sizes of LV cable in use in the commercial and URD sections of the network. Typically an internal inspection of streetlight columns or LV pillars and cubicles will find either one or more of the following:

Cable type	Type of conductor	Conductor cores	Conductor size
Paper insulated lead sheath armoured	Copper	3.5	0.1 to 0.4 sq in
Paper insulated lead sheath armoured	Aluminium	3.5	0.1 to 0.4 sq in
CONSAC	Aluminium	3	0.06 to 0.4 sq in.
XLPE	Aluminium	4	150 to 240mm ²
XLPE with concentric copper neutral	Aluminium	3	150 to 185mm ²
Direct buried SDI	Copper	1	2.5 to 16 mm ²
Single insulated cables in conduit	Copper	1	2.5 to 16mm ²
Bare conductors (earths)	Copper	N/A	Various
Consumer mains	Various	1	Various

Note: 3.5 core cables contain three (3) active conductors and a neutral conductor. The neutral conductor has a substantially smaller cross sectional area than the active conductors.

A.1.3 Endeavour Energy column arrangements

Various Endeavour Energy column LV panel and street light arrangements are shown below.

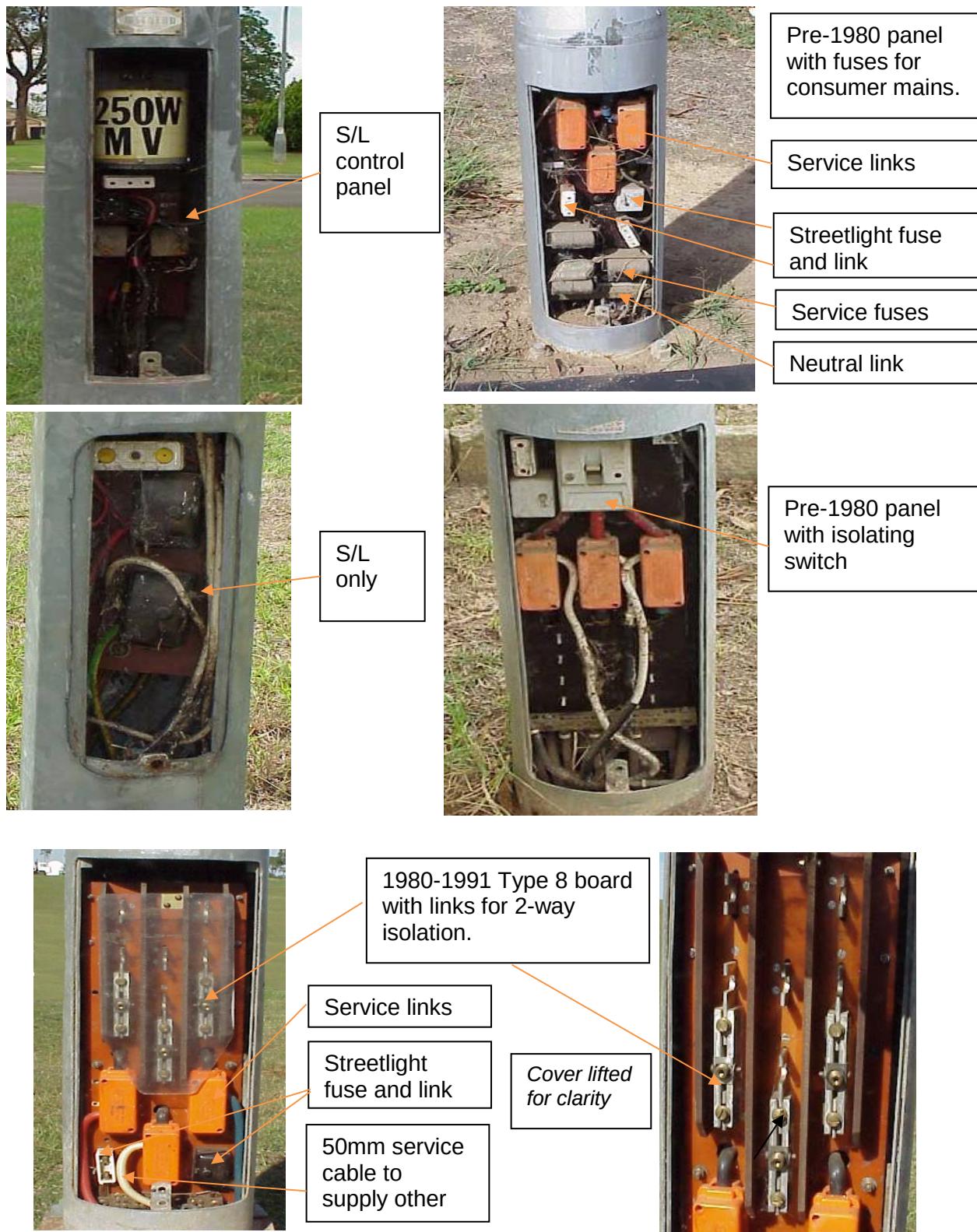


Figure 15: Typical column panel arrangements

A.1.4 Endeavour Energy pillar and LV panel arrangements

There are various LV panel configurations. Some examples are shown below:

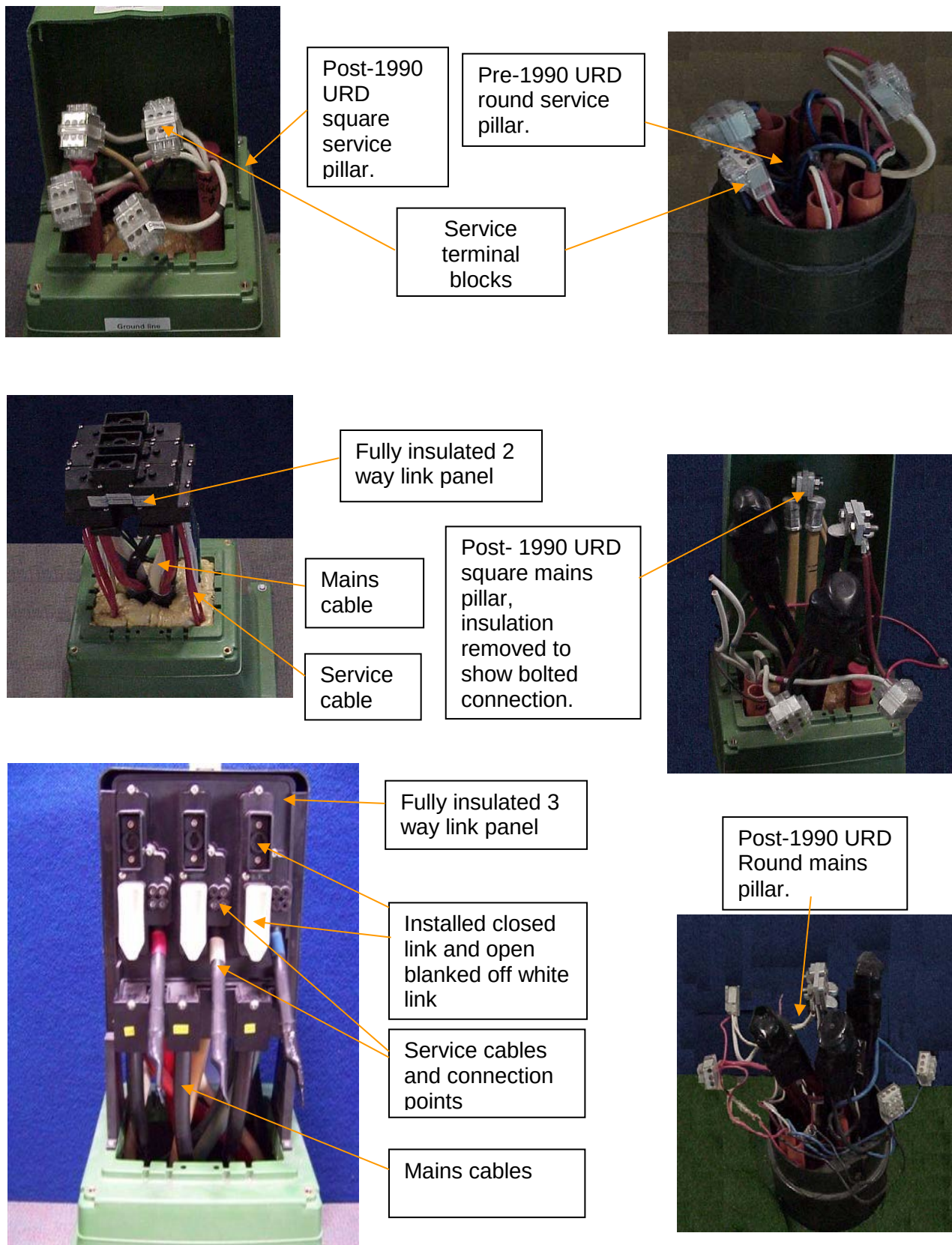


Figure 16: Typical pillar panel arrangements.