

FIELD TEST LV UNDERGROUND CABLE INSTALLATIONS

JOB SAFETY ANALYSIS



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|--|-------------------------------|
| Title: Field Test LV Underground Cable Installations | |
| Purpose and Scope: To provide instruction on the field testing of low voltage underground cable installations | |
| Staffing Resources: Cable Jointer or Electrical Mechanic instructed and competent in LV cable testing techniques. Work crew instructed and competent in LV switchboard rescue and resuscitation techniques, polarity testing, pole top rescue, manual handling. Safety Observer where required.. | |
| Documentation/References: P53 Operate the Network Enterprise Process. P53K55 Manage Low Voltage Switching for De-Energised Access on the Network Procedure. Certificate of Test – Low Voltage Cable Continuity, Insulation Resistances and Phasing Form. Ergon Energy Underground Construction Manual. Work Health and Safety Regulations 2011 (QLD). Electrical Safety Regulation Section 12, 14(2). Electrical Safety Code of Practice for Electrical Work . Electrical Safety Code of Practice for Working Near Live Parts . CS000501F115 Daily/Task Risk Management Plan. | |
| Key Tools and Equipment: Roadway warning signs, barricading. Insulating gloves applicable to task, work gloves, safety headwear where gravitational hazards exist, safety eyewear and footwear, high visibility clothing, protective clothing, hearing protection, sun protection. Confined space monitoring and rescue equipment (where required). Work site communication equipment (e.g. 2 way radio, etc), pole top rescue kit, LV Rescue kit. Test equipment shall comply with Code of Practice for Electrical Work Section 6 and be fitted with fused leads (where applicable). 1.0kV DC insulation resistance tester. | |
| Development Team: Graham Smith, Ken Feltham, Marshall Jones, Don McCormack, Keith Weisse, Stuart Traill | Date Completed: 20 May 2003 |
| Reviewed By: Megan Moncrieff | Date Completed: 18 March 2008 |
| Related SWP No.: SP0405 | SWP Owner Approval: |
| Key Stakeholders: Executive Management Team, Senior Management Team, Area Managers, Project Managers, Supervisors, Field Staff. Network Line Standards Group, Fleet Management | |

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| Task No. | Task Step | Hazard | Most Likely Breakdown Event (Loss Of Control) | Most Likely Outcome (Incident Outcome) | Risk Score | |
|----------|---|---|---|--|-------------------|-------------------------------|
| | | | | | Existing Controls | Additional/Alternate Controls |
| 1 | Preliminary Step <ul style="list-style-type: none"> Selection of all required test equipment for performing earthing resistance, continuity and insulation resistance, voltage, phase rotation and polarity tests. Confirm test equipment in test and operational prior to and after use Assessment of staff numbers required Confirm licensing and competency Ensure ready on site access to dry chemical fire extinguisher where a gas torch is used. | <ul style="list-style-type: none"> Vehicular and pedestrian traffic Uneven ground surface | <ul style="list-style-type: none"> Test equipment out of test date, out of calibration or unserviceable Test equipment operated incorrectly Insufficient staffing resources assigned to safely complete tests Encroachment of traffic into work zone Trip or slip on uneven ground | <ul style="list-style-type: none"> Plant damage Faulty equipment or inaccurate readings Sprains, strain | L | |
| 2 | Confirm isolation prior to test <ul style="list-style-type: none"> Check phase rotation where required Confirm LV fuse carriers open & fuse cartridges removed (where applicable). Confirm LV cables to be tested are de-energised. Place DNOB on all LV isolation points and locked where provision is made. | <ul style="list-style-type: none"> Proximity to exposed live terminals Energised cable in work area Energisation from secondary source of supply Live unterminated cable ends Step and touch potential Working at height Vehicular and pedestrian traffic Uneven ground surface | <ul style="list-style-type: none"> Contact with or movement within proximity to energised terminals Incorrect isolation performed including from secondary sources of supply Failure to implement fall arrest and restraint systems when working at heights Working in drop zone Encroachment of traffic into work zone Inaccurate or absent cable identification labelling Failure to wear all required | <ul style="list-style-type: none"> Plant damage Flash burns, electric shock Sprains, strain, musculoskeletal injuries, lacerations Loss of supply Fall from height Falling objects | L | L |

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| Task No. | Task Step | Hazard | Most Likely Breakdown Event (Loss Of Control) | Most Likely Outcome (Incident Outcome) | Risk Score | |
|----------|--|---|--|--|-------------------|-------------------------------|
| | | | | | Existing Controls | Additional/Alternate Controls |
| | | | PPE including class 00 gloves <ul style="list-style-type: none"> Short circuit initiated between different sources of potential using test equipment Failure to ensure all members of working party sign on LV Isolation Section of Daily/Task Risk Management Plan. | | | |
| 3 | Prove Mechanical and Electrical Integrity of LV Cable Installations <ul style="list-style-type: none"> Confirm by sample (at intervals no greater than 6 pillars apart) that cable terminations at pillars and poles are tight and phase colours correct. Disconnect all Multiple Earth Neutral connections of cable section under test. Remove street light fuses and disconnect neutrals at street light poles. Conduct earth tests and record results Perform continuity test between each phase and neutral conductor combinations with a bridge connected between applicable conductors at cable end and confirm similar resistance values between tests (e.g. A-B, B-C, A-C, Ø-N). | <ul style="list-style-type: none"> Proximity to exposed live terminals Energised cable in work area Energisation from secondary source of supply Live unterminated cable ends Working at height Falling objects Vehicular and pedestrian traffic Uneven ground surface High fault level Encroachment of public into work zone | <ul style="list-style-type: none"> Failure to confirm phasing Short circuit initiated between different sources of potential using test equipment Failure to control access to work zone Incorrect isolation performed including from secondary sources of supply Contact with or movement within proximity to energised terminals Failure to implement fall arrest and restraint systems when working at heights Working in drop zone Failure to wear all required PPE including class 00 gloves Failure to confirm LV system neutral correct Failure to reinstate neutral conductors after polarity tests Failure to remove street light fuses and disconnect neutrals at street light poles. | <ul style="list-style-type: none"> Sprains, strain, musculoskeletal injuries Plant damage Flashover, electric shock, burns Explosion Falling objects Fall from heights Loss of supply | L | L |

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| Task No. | Task Step | Hazard | Most Likely Breakdown Event (Loss Of Control) | Most Likely Outcome (Incident Outcome) | Risk Score | |
|----------|--|--|--|--|-------------------|--------------------------------|
| | | | | | Existing Controls | Additional/ Alternate Controls |
| | <ul style="list-style-type: none"> Perform insulation resistance test between each phase and neutral conductors to earth and record insulation resistance reading. | | | | | |
| 4 | <p>Energise Cable and Confirm Polarity</p> <ul style="list-style-type: none"> Remove DNOB from LV cable isolation point Replace fuse cartridges and close. At last pillar of each circuit and at sample locations (at intervals no greater than 6 pillars apart): <ul style="list-style-type: none"> Check polarity and record (Phase to phase, phase to neutral, phase to independent earth) Check phase rotation. Phase out to other supply across existing LV open point (where applicable) Conduct polarity test at street lights and reconnect streetlight neutrals Reconnect all Multiple Earth Neutral connections of cable section under test. | <ul style="list-style-type: none"> Proximity to exposed live terminals Energised cable in work area Energisation from secondary source of supply Live unterminated cable ends Working at height Falling objects Vehicular and pedestrian traffic Uneven ground surface High fault level | <ul style="list-style-type: none"> Failure to confirm phasing Short circuit initiated between different sources of potential using test equipment Encroachment of public into work zone Incorrect isolation performed including from secondary sources of supply Contact with or movement within proximity to energised terminals Failure to implement fall arrest and restraint systems when working at heights Working in drop zone Failure to wear all required PPE including class 00 gloves Failure to confirm LV system neutral correct Failure to reinstate neutral conductors after polarity tests | <ul style="list-style-type: none"> Sprains, strain, musculoskeletal injuries Plant damage Flashover, electric shock, burns Explosion Falling objects Fall from heights Loss of supply | L | |
| 5 | <p>Final checks</p> | <ul style="list-style-type: none"> Proximity to exposed live terminals Energised cable in work | <ul style="list-style-type: none"> Contact with or movement within proximity to energised terminals | <ul style="list-style-type: none"> Flashover, electric shock, burns Explosion | L | |

Check this is the latest Process Zone version before use

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| Task No. | Task Step | Hazard | Most Likely Breakdown Event (Loss Of Control) | Most Likely Outcome (Incident Outcome) | Risk Score | |
|----------|-----------|---|--|--|-------------------|-------------------------------|
| | | | | | Existing Controls | Additional/Alternate Controls |
| | | area <ul style="list-style-type: none"> • Live unterminated cable ends • High fault level | <ul style="list-style-type: none"> • Failure to confirm LV system neutral correct • Failure to reinstate neutral conductors after polarity tests | <ul style="list-style-type: none"> • Loss of supply • Plant damage | | |

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Existing Control Measures

| Task No. | Elimination | Substitution | Engineering | Administration | Personal Protective Equipment | Risk Ranking C = Consequences E = Exposure P = Probability | | | |
|----------|-------------|--------------|-------------|--|-------------------------------|---|---|---|------------|
| | | | | | | C | E | P | Risk Score |
| 1 | | | | <ul style="list-style-type: none"> As constructed drawing supplied to work crew along with construction folder. Confirm all test equipment within current test date, calibration and operational. Ensure all persons required to use test equipment are competent in its operation. Assign adequate staffing resources with required competencies to safely complete tests. Use roadway warning signs/ barricading to control vehicle and pedestrian traffic around work zone and relevant exclusion zones around live parts. Ground conditions and potential slip/fall hazards in travel path considered in Daily/Task Risk Management plan. Reinforce requirement to wear all required PPE including applicable class of gloves. Identify locations defined as confined spaces and ensure compliance with confined space entry requirements. | | 1 | 3 | 5 | L |
| 2 | | | | <ul style="list-style-type: none"> Reinforce requirement to wear all required PPE including applicable class of gloves. Ensure class 00 gloves, and insulated mats are used while working on or near exposed live parts. Isolate LV cable to be tested from all sources of supply and tagged, and locked where provision is made, in accordance with LV isolation requirements. Ensure all members of working party sign on and understand requirements of LV | | 2 | 3 | 4 | L |

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JOB SAFETY ANALYSIS



| Task No. | Elimination | Substitution | Engineering | Administration | Personal Protective Equipment | Risk Ranking | | | |
|----------|-------------|--------------|-------------|--|-------------------------------|---|---|---|------------|
| | | | | | | C = Consequences E = Exposure P = Probability | | | |
| | | | | | | C | E | P | Risk Score |
| | | | | Isolation Section of Daily/Task Risk Management Plan. <ul style="list-style-type: none"> Comply with Work Health and Safety Regulations 2011 (QLD), "Falling Objects", "Falls". Ensure ground based persons are clear of drop zone while work is performed aloft. | | | | | |
| 3 | | | | <ul style="list-style-type: none"> Position Safety Observer where testing is performed in vicinity of exposed live parts. Test to confirm LV system neutral correct at last pillar of each LV cable run, MEN locations and at sample locations. Confirm street light fuses removed and neutrals at street light poles disconnected. Confirm phasing to other LV system at all open points. | | 2 | 3 | 4 | L |
| 4 | | | | <ul style="list-style-type: none"> Confirm all neutral and MEN conductors are reinstated after polarity tests. | | 1 | 3 | 4 | L |
| 5 | | | | <ul style="list-style-type: none"> Ensure all final tests have been carried out and completed works have been built to the design plan &/ construction standards. Check that the cabinet / padmount is locked, or the pillar lid is replaced and securely bolted down, where work has been carried in these areas. Make the site electrically and mechanically safe and tidy the area before leaving. | | 2 | 3 | 4 | L |

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Additional/Alternative Control Measures

| Task No. | Elimination | Substitution | Engineering | Administration | Personal Protective Equipment | Risk Ranking C = Consequences E = Exposure P = Probability | | | |
|----------|-------------|--------------|-------------|---|-------------------------------|---|---|---|------------|
| | | | | | | C | E | P | Risk Score |
| 2 | | | | <ul style="list-style-type: none"> Ensure insulated tools are used while working on or near exposed energised terminals. Ensure test equipment suitable for task. Live work on LV including testing is only to be performed where a documented safe system of work is implemented. Persons performing electrical testing must ensure electrical equipment is tested to confirm electrical work performed is electrically safe and all persons not necessary for testing are electrically safe. | | 2 | 3 | 4 | L |
| 3 | | | | <ul style="list-style-type: none"> Perform continuity test between each phase and neutral conductor combinations with a bridge connected between applicable conductors at cable end and confirm similar resistance values between tests (e.g. A-B, B-C, A-C, Ø-N) – a maximum variation of 10% between readings. Apply 1.0kV phase to neutral insulation resistance test on all LV cables until a steady value is achieved (minimum allowable resistance on new cables is 100MΩ, minimum allowable resistance prior to energisation of aged cables is 1MΩ) and record readings. | | 2 | 3 | 4 | L |

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1: DETERMINE CONSEQUENCE: - The most likely outcome of a potential incident resulting from exposure to the identified hazard.

| Level | Descriptor | Definition |
|-------|--------------|--|
| 5 | Disaster | Fatality; toxic release off-site with detrimental effect; financial loss (>\$1,000,000). |
| 4 | Very Serious | Extensive injuries (e.g. permanent disability, amputation) requiring medical treatment, hospitalisation and long term rehabilitation; off-site release with no detrimental effects loss of production capability; financial loss (\$500,000 to \$1,000,000). |
| 3 | Serious | Disabling injuries requiring medical treatment and rehabilitation (e.g. broken limbs, hospitalisation); on-site release contained with outside assistance; financial loss (\$50,000 to \$500,000). |
| 2 | Substantial | Medical treatment required (e.g. stitches, removal of foreign body); on-site release immediately contained; financial loss (\$5,000 to \$50,000). |
| 1 | Minor | First aid treatment; negligible environmental damage; financial loss (<\$5,000). |

2: DETERMINE EXPOSURE: - How often a person interacts with a hazard.

| Level | Descriptor | Definition |
|-------|------------|-----------------------------|
| 1 | Continuous | Many times a day. |
| 2 | Frequent | Daily. |
| 3 | Occasional | Weekly. |
| 4 | Infrequent | Between weekly and monthly. |
| 5 | Rare | Between monthly and yearly. |
| 6 | Very Rare | Less than once a year. |

3: DETERMINE PROBABILITY

The likelihood of the breakdown event and nominated consequences occurring once the person is exposed to the hazard.

| Level | Descriptor | Definition |
|-------|--------------------------|--|
| 1 | Almost Certain | Breakdown event will almost certainly occur from exposure to hazard. |
| 2 | Quite Possible | Not unusual for breakdown event occurring, even 50/50 chance. |
| 3 | Unusual but Possible | Unusual for breakdown event to occur but possible. |
| 4 | Remotely Possible | Remote possibility of breakdown event occurring but history of occurrence exists within industry. |
| 5 | Conceivable but Unlikely | No known history of breakdown event occurring after years of exposure but is conceivably possible. |
| 6 | Practically Impossible | Practically impossible for breakdown event to occur. Has never occurred before and is not likely to occur. |

4: RISK ASSESSMENT MATRIX

| Consequences (How Bad?) | Probability x Exposure | | | | |
|-------------------------|---------------------------|----------------------------|----------|-----------------------|--------------------|
| | 1 to 2 | 3 to 5 | 6 to 10 | 11 to 23 | 24 to 36 |
| | Likelihood (How often?) | | | | |
| | Almost certain will occur | Quite possible could occur | Possible | Unlikely but possible | Extremely unlikely |
| 5. Disaster | Extreme | Extreme | Extreme | High | Moderate |
| 4. Very Serious | Extreme | Extreme | High | Moderate | Low |
| 3. Serious | Extreme | High | High | Moderate | Low |
| 2. Substantial | High | Moderate | Moderate | Low | Low |
| 1. Minor | High | Moderate | Low | Low | Low |

5: RISK TREATMENT STRATEGY

| Risk Score | Required Actions |
|------------|--|
| Low | Implement control measures and verify compliance by routine monitoring. |
| Moderate | Action required within agreed timeframe to minimise risk to "As Low As Reasonably Practicable" (ALARP). Further action may be required and management responsibility specified to take this action. The ALARP principle implies that controls have been determined such that the level of risk-reducing action is in proportion to the benefit obtained. |
| High | Action as soon as possible to minimise risk to acceptable level. Requires attention by senior management and measures should be put in place to reduce the probability, exposure and/or consequence of the outcome occurring to ALARP. |
| Extreme | Same treatment as for high risks however immediate action required to minimise risk to acceptable level. |

(Adapted from AS/NZS 4360:1999 Risk Management and NSCA Risk Score Calculator, 2001)