5.10 Stringing, Tensioning and Sagging Conductors/Cables

Purpose

The purpose of this instruction is for all Horizon Power workers who undertake the stringing and tensioning of bare overhead conductors under an Electrical Access Permit (EAP) for distribution line work.

Scope

This instruction applies to all Horizon Power Worker engaged in stringing, tensioning and sagging of conductors/cables:

- Working on existing overhead bare conductors
- Stringing new bare conductors above or below live bare overhead conductors
- Tensioning of bare conductors above or below live bare overhead conductors
- Additional requirements when working with existing 3/2.75 and 7/1.6 steel and 7/16 (7/.064) or smaller copper conductors
- Installing line crossover gantries near live overhead lines

This instruction does not apply too:

- Low Voltage (LV) live work methods
- High Voltage (HV) live work procedures for glove and barrier (G&B)
- Distribution stick (DIS)

Safety

Before commencement of work, a risk assessment must be carried out using the Risk Analysis Procedure (OSH-3.6-1-02), to identify and document the hazards and risks associated with the task and ensure appropriate control measures are implemented.

It is important that, appropriate control measures must be identified, documented and implemented in order to control Hazards to Low as Reasonable Practicable (ALARP).

Instruction

It is important that, appropriate control measures must be identified, documented and implemented to lessen or control the identified hazards.

- The stringing of bare (open-aerial) conductors, above or below, to bare live HV or LV overhead conductors is not permitted. If running conductors parallel to live open-aerial conductor’s consideration must be given to maintaining clearance (SAD) from the swing conductors being pulled. In this situation, the live conductors must be isolated, proved de-energised, earthed or short-circuited and an EAP issued

- Always treat all conductors as energised until proven otherwise, and an EAP is issued

- Always ensure there is a portable earth (HV) or shorting kit (LV) between the line workers and any potential source of supply, including induced voltages

- Consider the risk from induced voltages. See Field Instruction 8.3 - Induced voltages
Field Instruction

• Ensure conductor ground clearances are maintained. See Field Instruction 5.11 - Conductor clearances

• Ensure minimum approach distances (SADs) are maintained from energised conductors and apparatus. See Field Instruction 2.17 - Safe Approach Distances (SADs)

• SADs to live HV can never be reduced even if HV insulated mats and covers are applied as a precautionary measure

• Conductors must be controlled at all times and not dragged on the ground, maintain tension during pulling process

• All LV insulated covers and mats must comply with AS 4202-1994 - Insulating covers for electrical purposes and be visually inspected prior to use

• Ensure appropriate PPE is worn according to F.I 2.1 – Glove protection

CAUTION

Pre-formed dead-end wraps must not be used to tension or pull through conductors, use the correct pulling equipment such as pulling sock and swivel or tension come-along

Instruction

Inspection of existing bare overhead conductors and poles

Prior to commencement of any work on existing bare overhead conductors, conduct an inspection of the conductor, pole and its attachments.

The conductors and pole either side of the structure to be worked on must also be inspected.

If stringing more than one bay, all conductors and poles to be worked on must be inspected.

For more on pole inspection, see Field Instruction 5.2 - Poles – Inspection and Support Prior to Commencement of Work

The following must be considered when inspecting conductors and attachments for damage and/or signs of weakness:

• Corrosion and deterioration
• Condition –type terminations
• Check condition- type of joints in mid-span
• Annealing (changing the physical characteristic of the metal)
• Signs of conductor clash and burning
• Damage by lightning
• Damaged or broken strands
• Cracked or broken insulators
• Metal fatigue
• Conductor creep or slippage
• Vibration damage at tie wires and armour rods
• Cracked or broken cross-arms
CAUTION

All damaged conductors must be repaired using full tension compression joint applicable to conductor size and type, dead-end pre-forms and amour rods are not acceptable repair methods.

Stringing equipment

Stringing equipment may consist of but not limited to the following items:

- Tension equipment (Dynamometer, Site board, Beat method tools, Abney level, Theodolite)
- Cable drums and Cable drum stands
- Cable trailers
- Ropes
- Rollers
- Sheaves
- Stockings
- Stringing documentation and support items (e.g. beat charts, thermometer, etc)
- Swivels, and
- Winches.

All stringing equipment should be in good working order e.g. free-running pulleys, free from cracks and chips and metal fatigue, safety catches working correctly, brakes functioning, calibrated tensioning equipment. A functioning brake on conductor/cable payout equipment must be installed to prevent conductor/cable runaway and to also control the slack (tension) of the conductor/cable.

The weight carry-capacity (WLL) of all equipment designed to carry load should be rated for the desired job. This should include the equipment’s anchoring device (sling) and the structure on which the equipment is to be anchored too.

When loading cable drums onto cable drum stands or specifically design self-loading winch drum trailers correct loading methods shall be adhered to, with consideration given to the weight of the full cable drum (gross weight), direction of feed-in or feed-out of conductor or cable, correct securing method of both the cable stand/trailer to vehicle and cable drum to stand/trailer.

 Loads should never be lifted over personnel and risk mitigation should include exclusion zones.

Stringing methods

The stringing of conductor or cable can be completed by the following methods:

- Layout,
- Conductor/Cable Pull through, or
- Pilot rope Pull through.

These methods are documented in trade qualification training material associated to UETTDRIS54 – Install and maintain poles, structures and overhead conductors and cables.

When using one of these stringing methods the crew must adhere to the following requirements:
• When running out conductor’s (Layout method) it is necessary to protect the conductor against abrasions and picking up contaminants. You must **not** drag conductors along the ground (Layout method), or over hard surfaces such as cross-arm or other pole hardware (Pull through method).

• Damage to conductor/cable via external effects e.g. vehicles, damaging surfaces, cable drum surfaces, excessive tension, kinking conductor/cable.

• When running conductors/cables it is important to keep the sagging conductor/cable free from vehicle and pedestrian traffic. This can be mitigated through traffic and pedestrian management or a gantry structure.

• Clear and concise communication between all relevant parties string conductors and cables e.g. conductor/cable party-end, Winching party-end and Personnel walking the line (Cable/conductor stocking joint). The distribution worker walking the line ensure the joint does not get snagged up on rollers, trees or other obstructions.

The following control measures can be used to control the risk of contact with energised conductors and / or apparatus:

• Isolate all or part of the bare live overhead mains and obtain an EAP
• Apply insulated covers and mats *(Secured to prevent covers, sleeves and or tiger tails moving and exposing the live apparatus)* to the adjacent live LV conductors and / or apparatus
• Maintain SADs
• Use safety observers
• Remove live line taps / clamps or drop out fuses
• Remove solid taps to increase SADs

LV tee-offs and conductor crossings above and below the length of the new conductor pull must also be isolated and the work carried out under an EAP, unless controls can be implemented to mitigate any risk.

Controls may include:

• Application of insulated covers and mats *(Secured to prevent covers, sleeves and or tiger tails moving and exposing the live apparatus)* to the live conductors and apparatus
• Use of temporary LV cross-arms to increase clearances
• Use of captive rollers
• Use of safety observers
• Use of radios for communication and monitoring
• Installation of gantries
• Installation of scaffold and netting

Tensioning of the conductors is **not** permitted from any structure containing live conductors or apparatus; however back hanging on a live structure is permitted.

A pulling sock and swivel mechanism must be used between the winch rope and the new conductor. Back to back pulling socks with a swivel mechanism must be used when using existing conductor to pull through conductor. When pulling through the new conductor using the existing conductors to a split drum cable winch extra care will need to be taken due to the risk of:

• Existing conductor joints snagging in the rollers during the pull
• Existing conductor joints failing during the pull
• Existing conductors failing due to age and deterioration

Bird-caging at the split drum due to loss of tension and/or lack of flexibility of the old conductors

**Tensioning bare conductors**

Tensioning bare conductors above live LV conductors is **not** permitted unless using approved glove and barrier (G&B) High Voltage Live Work procedures.

Conductors must be tensioned using the relevant sag charts, see Stringing Tables for Aluminium and Steel Conductors for Distribution Lines: http://dm.horizonpower.com.au/otcs/lisapi.dll/properties/255045

• In conjunction with a thermometer, dynamometer or conductor beat charts and a distance wheel or range-finder

• The final tensioning of the conductors must be carried out using a rated mechanical tensioning device (e.g. strap-hoist, canker, pull-lift etc.) along with the correct come-along clamp

**Back-hanging of bare conductors on live structures**

Back hanging of any conductor above live HV is **not** permitted. When back hanging **below** live HV, ensure the following:

• SADs are maintained

• SADs can be maintained when the conductors are pulled up to tension conductors are controlled at all times

• HV – there must be a portable earth between the line worker and all possible points of supply (e.g. bottom of the HV fuse holder)

• LV – there must be an LV shorting kit between the line worker and all possible points of supply

• Conductors to be back-hung must have any attachments (e.g. jumpers or live line taps/clamps) properly secured (bent back and secured to the main conductor using cable ties or tie wire) so that there is absolutely no risk of them becoming free during the back-hanging process

• Back-hanging above bare live LV conductors is not permitted unless the bare live LV conductors and apparatus can be fully insulated and/or covered

**Collecting Samples of Aged Conductors**

Collecting samples of aged conductors is an important and necessary work task as it helps to estimate the years of remaining life left in the conductor before it fails due to corrosion or age. Samples should be collected when the opportunity arises or when the conductor is suspected of being of substandard quality.

Examples of opportunities when it may be possible to collect samples:

• During a repair of a broken conductor
• Capacity upgrades of existing overhead conductors
• Demolition of existing overhead feeder
Field Instruction

- Fault conditions where new conductor is required

Collection of samples for analyses should be coordinated and recorded at the local depot. Each sample collected should not be less than 1 metre in length.
Ensure the following information is attached to each sample:

- Feeder name / number
- Date of sample collection
- Pole pic ID numbers (sample taken between)
- Conductor sample size (e.g. AAAC 19/3.25)
- Year conductor installed (if known)
- Number of prior faults (if known)
- Environmental description (coastal, agricultural, industrial high pollution area)
- Reason for removal (e.g. fault, conductor upgrade, demolition)

**Additional requirements for 3/2.75, 7/1.6 steel and 7/16 (7/.064) or smaller copper conductors**

Due to the corrosive nature and reduced tensile strength of these conductors, extra care must be taken when tensioning existing conductors.

The following must be done prior to commencing any work that will affect the tension and/or mechanical loading of these conductors:

- A normal inspection, as previously described in the ‘Inspection of existing bare overhead conductors and poles’ section
- An inspection of the conductor and fittings on the pole to be worked on and for two spans either side
- From the inspection, determine the degree of deterioration of the conductor and fittings and establish whether the conductor is safe to work on

If the inspection determines that the conductor could break during the work:

- Do not carry out any work if there are energised conductors or apparatus on the same poles
- Notify Network Operations (HPCC)
- Arrange for an outage of all energised conductors or apparatus prior to making the repairs

**Tensioning bare 3/2.75, 7/1.6 steel and 7/16 (7/.064) or smaller copper conductors**

There is an increased risk of conductor slippage within the come-along clamp when tensioning these smaller size conductors. A come-along clamp with a locking grip mechanism can be used to help reduce this risk, as shown in Figure 1, below.
Figure 1: Come-along clamp with locking grip mechanism and safety latch

References

- Occupational Safety & Heath Act 1984
- Occupational Safety & Health Regulations 1996
- SHMS OSH-3.6-1-02 Job Risk Analysis (JRA) Procedure
- SHMS OSH-3.6-1-26 Personal Protective Equipment
- Horizon Power Electrical Safety Standards
- Field Instruction 2.6 Worksite Clothing / Personal Protective Equipment Requirements
- Field Instruction 2.17 Safe Approach Distances
- Field Instruction 2.23 Job Hazard and Risk Management (JRA)
- Field Instruction 5.2 Poles – Inspection and Support Prior to Commencement of Work
- Field Instruction 5.11 Conductor Clearances
- Field Instruction 8.1 Portable Earthing Requirements
- Field Instruction 8.3 Induced Voltages
- High Voltage Live Work Manual
- AS 4202-1994 Insulating covers for electrical purposes