HELICOPTER STRINGING MANAGEMENT PLAN

DRAFT

Approvals and Reviews

Helicopter Stringing Plan	
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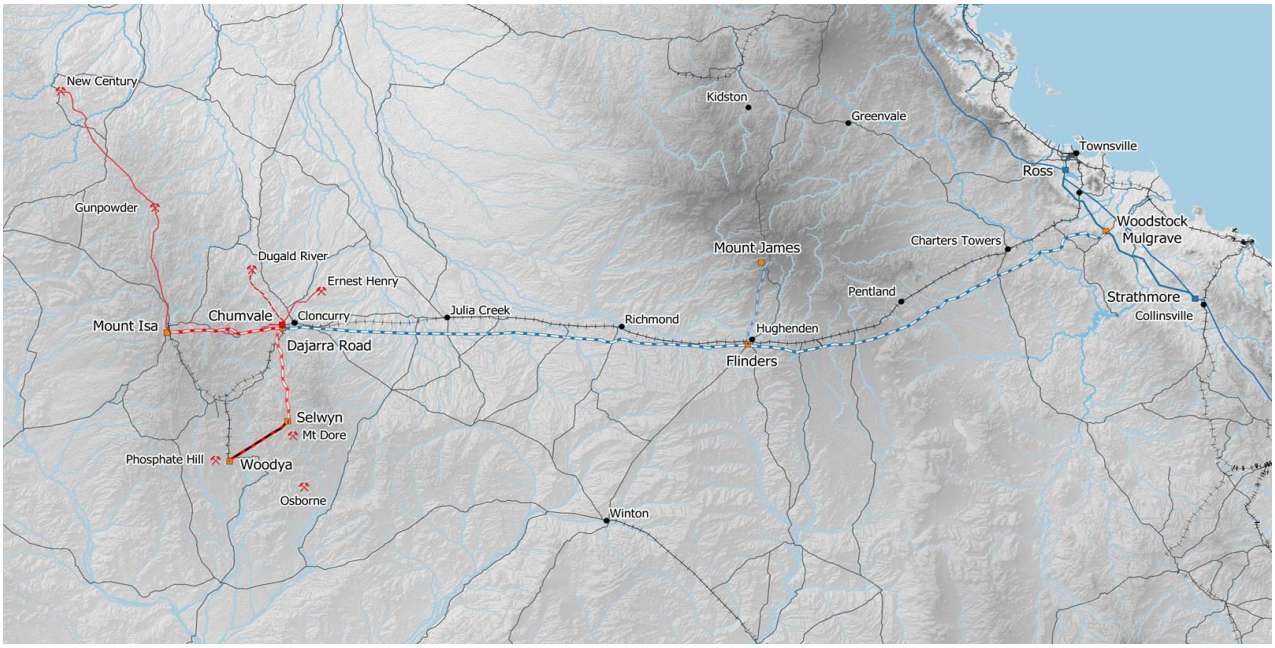
1. Introduction

The purpose of the CopperString 2.0 project is to connect the North-West Minerals Provence (NWMP) of Queensland to the National Electricity Grid. This will not only allow existing loads in the Mt Isa and Cloncurry areas to be fed from the National Electricity Market NEM, but also provide access to new mining loads and opportunity for connection of renewable generation.

1.1 Project Scope

The CopperString 2.0 Project (the Project) is an extra high voltage transmission system intended to connect the North-West Power System (NWPS) near Cloncurry and Mount Isa to the Powerlink network and National Electricity Market (NEM) at Woodstock. Figure 1 below provides an overview of the Project.

Figure 1: CopperString 2.0 Project – Proposed Transmission Lines



CopperString 2.0 will connect into the existing Powerlink 275kV lines at Mulgrave (77 kms south of Townsville) and extend some 1100km to Mt Isa via Hughenden and Cloncurry.

At Woodstock, Powerlink will provide a 275kV switching station (Mulgrave) that will cut into the existing double circuit 275kV lines between Ross and Strathmore. The Mulgrave switching station will be located adjacent to the CopperString 2.0 275/330kV substation (Woodstock).

A double circuit 330kV line (approximately 330km) will then run west to the Hughenden area where a new 330kV switching station (Flinders) will provide reactive power support for the system and a connection point for the Mount James substation approximately 80km North. The Mount James substation services the renewable generation area around Kennedy enabling zone development.

The 330kV double circuit line (approximately 400kms) will then extend to Cloncurry where a new 330/220kV substation (Dajarra Rd) will be constructed. This substation will again provide reactive power support to the system as well as allow connection at 220kV to the following:

- The existing Energy Queensland 220kV system at Cloncurry;
- A new 220kV southern spur to Mount Dore and Woodya; and
- A new 220kV line connecting Mt Isa.

The new 220kV line to Mt Isa (approximately 100kms) will complete the connection to the NWMP where a new 220/132kV substation (Mt Isa) will provide connection to the existing system.

The southern spur will consist of a new 220kV line (approximately 110kms) to a new 220/132kV substation (Selwyn). A further double circuit 132kV will run from Selwyn and connect in to Woodya (50kms). Woodya is a new 132kV switching substation servicing the Phosphate Hill area and other local loads.

Selwyn 220/132kV substation will provide 132kV feeds for loads in the Mt Dore area.

Refer to drawing 3200-0643-DP1-DWG-001 “CopperString 2.0 Overall System Single Line Diagram Initial Arrangement” for further details

1.2 Purpose

The purpose of this document is to detail a safe process of work to control how all aerial works and associated activities are carried out safely with the use of a helicopter on CopperString 2.0 Transmission Line project. The intent is to outline the minimum requirements for aerial works carried out by UGL and CPB JV and its specialist contractors.

This document should be read in conjunction with the following documents:

- Risk Management Plan
- Critical Risk Control Protocol Knowledge document
- Emergency Response Procedure
- Utilities Contractor Handbook
- Utilities Verification of Competency Procedure.

1.3 Scope of Plan

This document covers the site set up, prior to aerial works commencing and the activities required to complete all the works. Aerial works covers all activities that are carried out with the use of a helicopter and includes the following:

Part A: Site Set up and Preparation.
Part B: Helicopter Works:

- Running out draw wire to aid with the pulling of overhead conductors
- Flying of OPGW conductor
- Installation of Insulators and Pulleys
- Installation of vibration dampers
- Installation of Marker Balls
- Lifting of heavy loads with a helicopter.

Part C: Completion of Aerial Works:

- Conductor Run Out
- Catching Off Conductors
- Sag and Tensioning
- Clamping In.

This document also covers the process for selecting a helicopter contractor, managing of the contractor and the emergency response requirements for aerial works.

Responsibilities are detailed in Appendix 1 - 'Responsibilities’

Definitions are detailed in Appendix 2 - 'Definitions’

Description	Voltage (kV)	Circuits (Nos)	Length (km)	Corridor (m)
Woodstock-Flinders	330	Double	327	120
*Flinders-Kennedy	330	Double	83	120
Flinders-Dajarra Road	330	Double	400	120
Dajarra Road - Mt Isa	220	Double	100	60

Dajarra Road - Chumvale	220	3	4	60
Dajarra Road - Selwyn	220	Double	132	60
Dajarra Road-Selwyn tee off to Phosphate Hill	220	Single	66	60
*Selwyn-Cannington	220	Single	26	60
Total	**….**	**….**	**1138**	**….**

Table 1: The CopperString project transmission lines summary

2. Safety Requirements

2.1 Managing and Controlling Risk

Cable pulling under tension and transmission tower erection in remote locations on undulating terrain presents multiple hazards and risks. For example, line of fire, fall from height, suspended loads, remote work, vehicle incidents and manual handling. The hierarchy of control must be considered for this type of work activity.

2.1.1 Hierarchy of Control

- Where can the risk be eliminated?
- Where can the risk be substituted?
- Can the risk be isolated?
- Can the risk be reduced through engineering?

2.1.2 Mitigation

The utilisation of a helicopters for the installation of overhead conductors reduces the exposure to working at heights and manual handling. It mitigates the risk associated with undulating terrain and provides enhanced emergency response capability with the ability to evacuate injured personnel by air.

Administrative controls:

Work practices that will reduce the likelihood of risk occurring include, e.g. SWMS, training, signage, exclusion zones and Engagement of Specialist Aviation sub-contractor.

2.1.3 Engagement of a Specialist Aviation Subcontractor

During the tender phase, “Request for Quotations” (RFQ) shall only be distributed to helicopter companies that are known to the industry and have demonstrated numerous years of experience in Aerial Works. This experience must be specific to the construction and maintenance of Transmission Powerlines.

The selection process is managed through UGL and CPB JV’s Procurement Policies.

The Project Director shall establish that only specialist subcontractors that meet the following criteria can be engaged on UGL and CPB projects:

- Current Air Operating Certificate endorsed for aerial work and charter
- The subcontractor can demonstrate that it has a safety and quality management system which is fit for purpose to the operation proposed to be conducted
- There has not been an accident attributable to maintenance or operation management within the previous 5-year period
- There is evidence that incidents are reported, and actions are taken by the Subcontractor to address that the identified deficiencies have been completed

- CASA audits are available which establish that there are no non-compliances that would impact aircraft safety performance
- The subcontractor can demonstrate that Pilots are licenced to conduct required aerial work operations by CASA and are experienced in this work activity
- Pilots have had no accidents involving poor decision-making or mishandling of the aircraft in the previous 5 years, or 1000 flight hours
- Pilot has completed 'fly the wire' industry safety course
- The subcontractor can demonstrate that their fatigue management and fitness for work policy is complied with
- Maintenance is performed by CASA approved company and there is evidence available to show that equipment is maintained correctly as per OEM requirements.

2.2 Risk Assessment

The Project Director shall ensure that a detailed Risk Assessment for the scope of work is completed and involves the specialist subcontractor. Emergency response capability that is unique to the work location must be identified and confirmed.

The risk assessment shall detail the type of aerial works to be undertaken and associated risks and controls implemented to manage these risks.

A Safe Work Method Statement (SWMS) will be developed based on the risks identified through the HSE Risk Register. The HSE Risk Register will be reviewed by an independent aviation specialist and will be revisited on-site between the Engineer/Company and the Contractor prior to helicopter works commencing.

2.3 Safety Readiness

Prior to commencing work the following are to be in place/performed:

- SWMS are developed
- All stringing tools and equipment have been tagged and tested
- Emergency procedure is developed, communicated and tested
- Emergency Response Authorities have been alerted to the works, as well as how to access areas should they need to respond to an emergency
- All vehicles shall contain first aid and snake bite kits
- Check work areas for wildlife
- Check the site for access to avoid vehicle incidents
- Prior to the commencement of run out activities the Project Director is to ensure that all necessary approvals have been secured from the relevant authorities. This may include (but is not limited to):
  - Department of Transport and Main Roads
  - Local Councils
  - Property Owners
  - Emergency Services
  - Environmental
  - Client contract specific.
- Pre-start with all personnel. The briefing shall include:
  - Review of the SWMS
  - Inspection of Tools and Equipment
  - Review of Run-out Plan
  - Briefing of Emergency Response
  - Communication methods for work crews established; and − U-Take 5.

2.4 Emergency Response

Risk assessed emergency response scenarios will be identified specific for the scope of work and included in the project emergency response plan. They will consider location, emergency services response times, access to equipment such as rescue, first aid, firefighting and personnel training capability. Development of the emergency response capability will be in consultation with the aviation contractor for specialised helicopter scenarios and the local Emergency Services Authorities which include but are not limited to:

- Helicopter crash
- Refuelling fire
- Fall from height or harness suspension rescue
- Loss of contact, missing aircraft

3. Part A: Site Set Up and Preparation

3.1 Considerations – Operational Limitations/Previous Actions

Prior to commencing works the following permits, plans and additional requirements must be in place:

- UGL and CPB Structure Climbing Permit and Working at Height Rescue Plan
- EWP pad compaction test report using DCP method provided by a suitably qualified person
- Environmental/Cultural Heritage requirements specific to the tower site
- Property access authority
- A pre-lift check sheet if carrying out heavy lifts with a helicopter using form UGLMS-4-1543; and
- A pre-stringing check list if running out draw wire or any form of conductor using form UGLMS-4-1544.
- Prior to commencing works each work crew must have the following documents:
  - Materials Installation drawings
  - Run-out Schedule (Stringing)
  - Stringing Schedule
  - Line schedule
  - Damper and Spacer Schedule
  - Phasing Diagram
  - EWP
  - ITP's and check sheet
  - SDS
  - Environmental Work Plan
  - Qualifications and VOC for operators involved in high risk work.

All working at heights shall be carried out as per UGLMS-131-372 Work at Height Procedure.

3.2 Special Safety Precautions

Prior to commencing work the following are to be in place/performed:

- All stringing tools and equipment have been tagged and tested
- All vehicles shall contain first aid and snake bite kits
- Check work areas for wildlife
- Check the site for access to avoid vehicle incidents
- A risk assessment to be completed when working in close proximity of live conductors and delineations in place
- Each tower is to have a rescue kit, available and ready for deployment

- Briefings with all personnel. The briefing shall include:
  - Review of the planned works and methodology
  - Inspection of Tools and Equipment
  - Review of Run-out Plan
  - Briefing of Emergency Response
  - Communication methods for work crews (two-way radios, whistle for crane and dogman)
  - Site Layout
  - Supervisor and Team Leader Prestart
  - UTake 5
- Daily monitoring of weather conditions and lightning activity.

3.3 Establishing Site Access

Vehicles must only use the approved access roads, for essential stringing works LV access may be required along other access routes during run-out to monitor and follow-through headboards. These routes need to be established (and approved) prior to runout and are required to ensure draw wire/conductor/OPGW/OHEW are kept off the ground and clear of any obstructions during the pulling activities.

3.4 Site Preparation and Machine Setup

The site preparation and machine set up will be completed in accordance with the steps outlined below:

i. Site to be inspected by the Supervisor prior to any equipment arriving on site.

ii. Conduct a Pre-start and process procedure development session.

iii. Conduct a pre-Start Plant Inspection to identify any damage (especially rigging and earthing equipment) to plant and equipment. Tag out any damaged tools or equipment and do not use.

iv. Crane/Franna and EWP operators to pre-start their equipment and mobilise to site. EWP/Crane pad to be pre-checked for suitability for planned works, (size of pad, levelled, compaction) and for any changes that may have occurred from previous inspection/visits, including assessing that there are no loose items along the line route.

v. Crane/Franna & EWP is to be positioned in suitable position to complete planned works. Delineation to be in place to exclude vehicle, pedestrian and other contractor interaction.

vi. Extend stabiliser legs onto pads.

vii. Earth the crane/Franna/EWP to the foundation when working near a live or potentially live circuit. Permit required prior to work commencing when working within close proximity of power line.

viii. Special consideration is to be taken for uneven ground.

ix. Pedestrian interaction shall be considered prior to activities taking place.

x. Spotter required when reversing or in congested areas where there is a risk of damage to plant, property or personnel.

4. Activity Methodology

4.1 Erection of Line Materials

4.1.1 General

The stringing activity is generally the activity most constrained by weather, outages, access, ground conditions etc.

Stringing work shall proceed on a section by section basis in accordance with the approved "Stringing Schedule (Conductor, OPGW and OHEW Run-outs)" which has been prepared under the direction of the Project Manager and submitted to the client for approval. (Hold Point).

The Construction Manager or Project Engineer shall arrange any necessary approvals from the respective authorities where scaffolds/hurdles are to be built to support the draw wire and conductor over roads and rail crossings.

The Project or Construction manager shall be responsible for ensuring that this procedure is understood and adhered to by all personnel involved. The Project Engineer or Quality Coordinator is responsible for the implementation of this procedure and the signing of the documentation as evidence.

Test samples of compression fittings with the compression tools used presented to the client for testing. Stringing may not commence until the results have passed. (Hold Point).

The construction procedure shall be in accordance with the environmental, safety and quality documents for the contract and specification.

4.2 Procedure

The UGL and CPB process on developing the stringing pull schedule is to consider the following methodologies, in priority order;

1. In Line Pull: The tensioner puller machines are set-up behind the structure and positioned in line with the conductors being pulled. Additional easement clearing maybe required if the last structure has a deflection angle.
2. After completion of the pull, the conductor will be terminated at the level of the cross-arm direct using EWP.
3. Hold Point: Additional clearing requires approval.
4. Floating: The machines are set up between the span of 2 towers. Conductors will be joined together from previous pull or from the strain structure with pre-terminated conductors. Conductors will be joined using mid-span joint and will be floated using winch. A concrete block will be used to as anchor point during floating.
5. Hold Point: Additional mid-span joints and mid-span joint locations required approval
6. Back-hanging: The machines are set-up in front of the strain structure. The end of the conductor is pulled up to the Strain Structure using a Square Rig set-up, combined with Draw wires and Anchor blocks and a 3T winch. EWP will be used to terminate the conductors onto structure. This set-up requires more equipment, manpower and is more complex.

4.3 Delivery of Stringing Gear

A crew shall be dedicated to the delivery and setup of the winch and brake sites. They shall be equipped with a Hiab on the trucks and/or Franna/telehandler to assist with unloading to minimise the risks of manual handling and damage to equipment.

Deliveries shall be managed by the Supervisor or Engineer on site.

4.4 Assembling Insulators and Pulleys

In assembling insulator sets special care will be taken in handling the insulator to avoid damage. The equipment is to be carefully checked to ensure the discs are not chipped, cracked and/or damaged.

The assembled sets will be placed on the ground with supporting wooden packaging to keep the equipment from touching the ground.

The hanging crew will then check the assembled insulator sets to ensure the components prior to installation are correct.

For suspension insulator sets the requirements are:

i. Install all socket mouths facing away from the structure body and eye of the security pin towards the structure body for future line maintenance/upgrade.

ii. Where applicable, nuts are to face towards the tower with split pin open end facing down.

iii. Where applicable, nuts are to consistently face towards one end of the line with split pin eye facing towards the tower.

For tension insulator sets:

Install all socket mouths facing away from the structure access climbing corridor and all nuts on vertical bolts facing the ground, for future line maintenance/upgrade.

An allocated crew member checking the insulator sets shall conduct checks in accordance with the principal supplied drawings and manufacturer recommendation and UGL and CPB Procedure. Should any of the insulator sets not comply i.e. wrong position or missing pin or socket mouth, it shall be immediately reported to the leading hand or Supervisor for immediate action.

Attach pulley to the bottom side of the assembly.

4.5 Hanging of Insulators and Pulleys - via Winch

To hang pulleys via Winch, the crew will first assemble the insulator sets on each tower site and position the Pulley Block.

When using a capstone winch, the crew will apply appropriate earthing to the plant. If the equipment is near a steel tower/pole, earth leads will be connected to the tower. If the operator cannot earth to the tower, then earth leads will be connected to an approved earth rod driven into the ground.

The Single Pulley Blocks are for OHEW and OPGW run-out. These pulleys are to be hung on to earth peak cross-arms. The Triple Pulley Blocks are for conductors to be hung on all the rest of the cross-arms of the tower along with insulator assemblies.

The hanging sequence is the Single Pulley Block first on Line 1 or Line 2, then the conductor Pulley Blocks on cross-arms.

Insulator discs shall be washed down prior to be installed and wiped out with rags to ensure they are clear of dirt and/or debris prior to being installed.

When using the Winch, one rigger on each cross arm shall manually climb on to the tower, set up the hang line for the rigging pulley sheave and rope on to one of the horizontal members on the earth peak. The hang line shall be used to lift up the rest of the rigging pulleys and gear as required.

The rigging pulleys will then be set up on to the cross arm in a square rig style to hang the conductor Pulley Blocks. The wire rope will be pulled through the rigging pulleys with one end being attached to the assembly or to the Steel Collar Support, and the other end on to the Winch.

The Winch will wind up the wire rope or braided (nylon) rope through the rigging pulleys to pull up the Pulley Block; the crew on the ground will also connect a tag rope on to the pulley to guide the lift to stop pulley from striking the tower during the lift.

As it reaches the earth peak, the rigger on the cross-arm shall connect the insulator with the pulley to attachment point.

A Linemen/Rigger on the tower shall relocate the rigging pulleys down to the top cross-arm and set up again so the Steel Collar Support will be set onto an insulator assembly and to the end of the wire rope. The Winch will then wind up the wire rope to pull the insulator set, with the ground crew again guiding the insulator set via tag line as it goes up to avoid striking tower members.

The insulator set shall be lifted up first to the level of the pulley block's attachment point. The tower linemen/rigger will then instruct the winch operator to stop and connect the pulley on to the insulator set.

Once connected to the pulley, the Winch will resume pulling the assembly up to the cross-arm of the tower. The aerial rigger on the cross-arm again shall connect it once it reaches the tower cross-arm's attachment point.

4.6 Hanging of Insulator and Pulleys - Using EWP

If using an EWP to hang the insulators and pulleys, a soft sling shall be wrapped around the third insulator disc from the top insulator assembly. The end of the soft sling shall be connected to the rated EWP attachment hook via shackle.

The insulator-stringing pulley assembly shall be lifted onto the crossarm attachment point using the EWP.

The above procedure shall be utilised for the rest of the insulator-stringing pulley assemblies until all required insulator-stringing pulley assembly are lifted and attached on the structure.

Figure 2: Use of EWP

4.6.1 Using Winch

Rigger shall manually climb on to the tower, set up the hang line for the rigging pulley sheave and rope on to one of the horizontal members on the top earth wire maintenance attachment point. (This operation could be done using EWP as well). The hang line shall be used to lift up the rest of the rigging pulleys and gear as required.

The rigging pulleys will then be set up on to the maintenance attachment point on the top section of the tower in a square rig style to hang the insulators and Pulley Blocks. The wire or braided rope will be pulled through the rigging pulleys with one end being attached to the assembly or to the Steel Collar Support, and the other end on to the Winch.

The Winch will wind up the wire rope or braided (nylon) rope through the rigging pulleys to pull up the insulator or pulley block; the crew on the ground will also connect a tag rope on to the pulley to guide the lift to stop pulley from striking the tower during the lift.

As it reaches the earth peak, the rigger on the tower shall connect the insulator with the pulley to attachment point.

A Linemen/Rigger on the tower shall relocate the rigging pulleys down to the top arm of the tower and set up again so the Steel Collar Support will be set onto an insulator assembly and to the end of the wire rope. The Winch will then wind up the wire rope to pull the insulator set, with the ground crew again guiding the insulator set via tag line as it goes up to avoid striking tower members.

The same procedure will be done when installing the middle and bottom insulators assembly and run out pulleys.

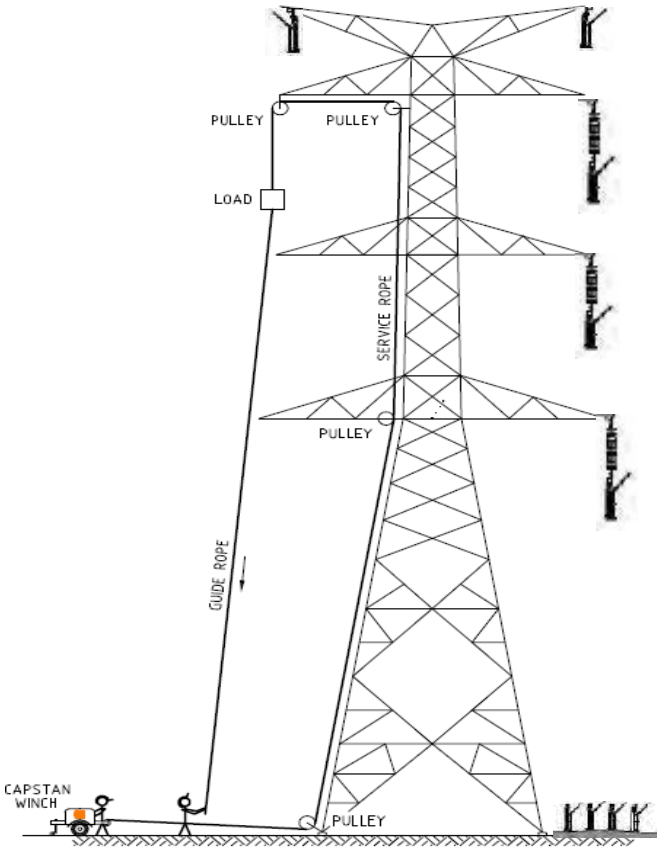


Figure 3: Square Rigging Assembly

4.7 Brake / Winch Setup

As per the designated location on the "**approved stringing schedule**," the brake/winch sites shall be positioned, where possible, at level sites. They are to be a minimum 100m from water courses and located in such a way that all equipment and materials including conductor and draw wire can be placed within the easement i.e. 20m either side of the centre of tower. Minimum size for conductor brake/winch site is 30mx30m whilst for the OPGW/OHEW brake/winch site, it is 20m x 20m.

After obtaining approval the site shall be cleared and levelled as practically possible.

The area shall also be secluded with an outer and inner fence. The fence shall be High Visibility Polypropylene Barrier Fence, tied with GI wire on star picket posts.

The outer and inner fence distance will be defined for the reason of Step Touch potential.

Safety signs shall also be provided along the periphery of the fence, on the entrance and on other specific locations within the work area.

Rubber mats shall also be provided on each entrance to ensure equipotential. Personnel must only enter and exit via these points.

Once completed setting up the earth mat and fence, the crew shall mobilize the stringing equipment along with the stringing tools, anchoring materials and conductors and OHEW reels for Brake Site.

The stringing equipment shall be arranged and positioned within a distance created by a ratio of 1 vertically to 3 horizontally, from any structure.

Anchoring the machine using the correct sequence will ensure it is stable during the stringing process.

- Align the machine with the first running sheave
- Position plough
- Apply wheel brakes
- Anchor the machine using the designated anchor points and required angle.

- Select correct anchors capacity
- Select correct anchoring slings

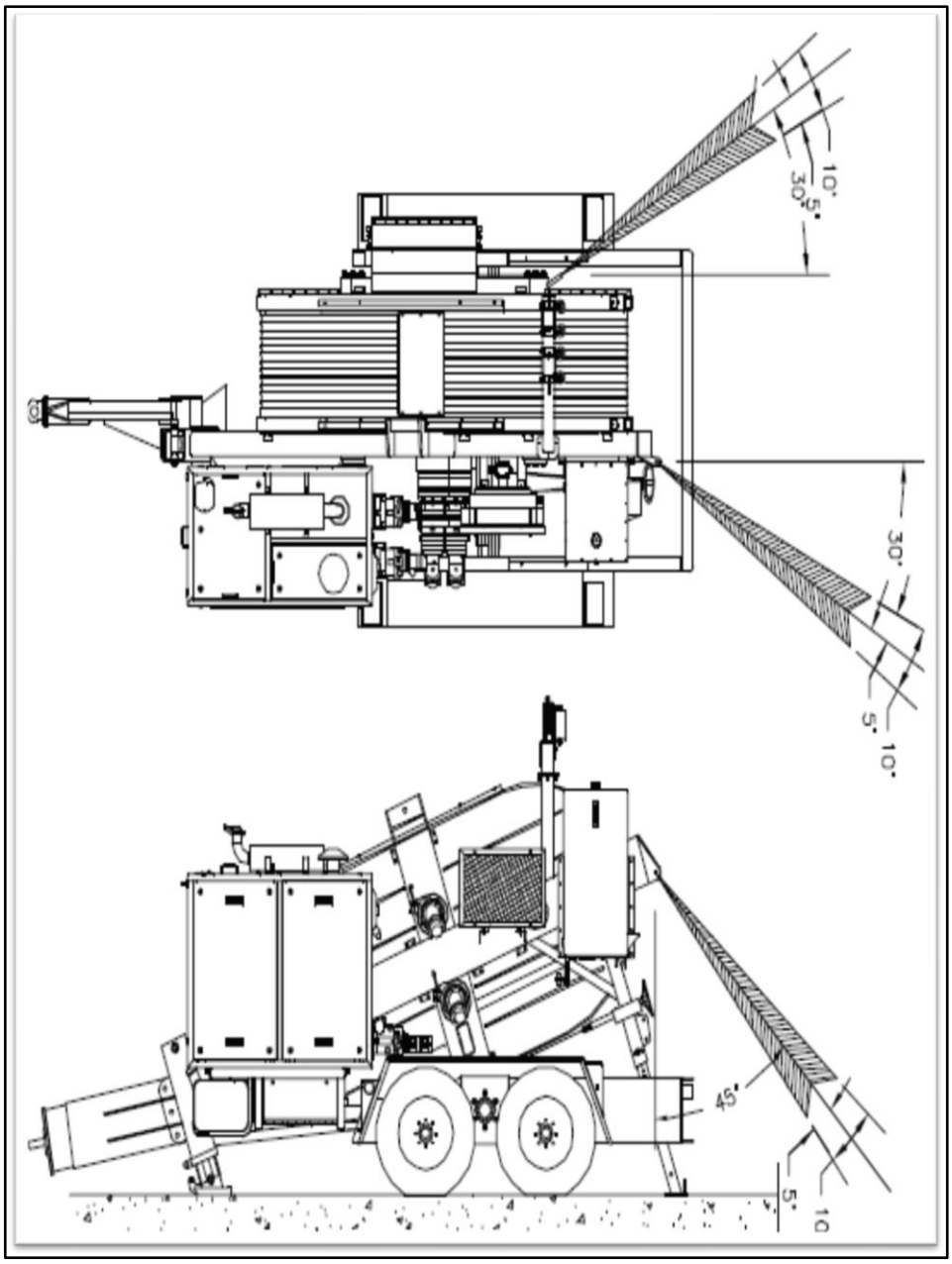


Figure 4: Machine anchoring scheme

All equipment that will be used on either the Winch or Brake sites shall be earthed using 95mm² Insulated Earth leads to the closest Copper Clad Steel Rod that is bonded with the mat.

Earthing Arrangement for the Winch and Brake sites utilises 7/2.75 Copper cable buried 400 mm in soils and ø14 Copper Clad Steel Earth Rod 2.4m long. The rods shall be bonded to buried earthing cable with grounding clamp ALM Type STG15 or Equivalent. The intersections of the cables shall be bonded with the same type of grounding clamp.

Alternatively, concrete reinforcing mesh shall be used in the area where site conditions for installing the above cable cannot be used. Installation shall be in accordance with the engineering design drawings

No bonding of earth leads by clamp to clamp connections shall be allowed. All leads are to be individually bonded to the copper clad steel rods.

For **Draw wire and OPGW** machine sites, a concrete reinforcing mesh, size 100x150x6mm sheet will be used. The Concrete Reinforcing Mesh comes in pieces of about 2.4 metres by 4.0 metres and to cover the Draw Wire or OPGW site work area. The mesh will be joined with U-bolts. The rods and mesh shall be bonded with grounding clamp, ALM Type STG-15 or approved equal. Refer to appropriate drawing **for Earthing Arrangement.**

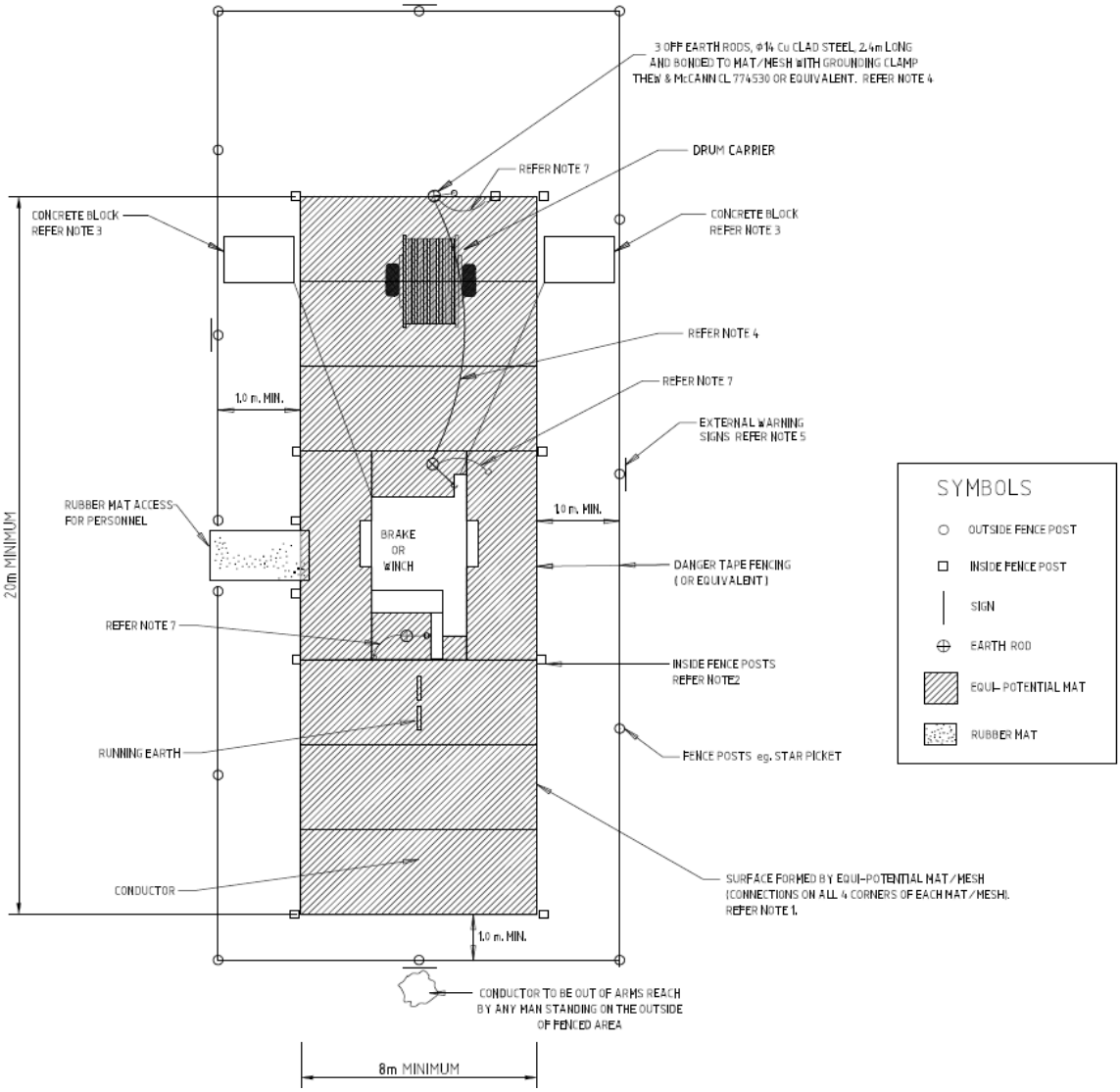


Figure 5: Brake/Winch site setup

4.8 Protection and Signage

Protection and signage will be installed to meet these requirements:

- Approved access tracks to be clearly sign posted at each delivery and pole erection point
- Identify and install temporary signage around proximity pipelines location prior to Poles installation works
- Where access is required crossing over buried gas pipelines; temporary bog mats shall be installed to access site
- Where the hurdles are set up close to roadside, provide two sets of flashing lights to make safe incoming traffic with barricade surrounding poles.

Hurdle installation won't be required when traffic is minimal, and approval received. However, traffic management controllers or Flagman should be in place to control any traffic during stringing activity.

5. Part B: Helicopter Works

Prior to commencing a stringing operation, the Pilot in Command (PIC) should obtain an aviation approved weather forecast and make a visual weather assessment of the weather to ensure that the conditions are suitable for the safe operation of the aircraft whilst stringing. The weather conditions shall include:

- Cloud not below 500ft above GL
- Visibility greater than 5km
- No lightning within a 10km radius
- No approaching thunderstorms
- Wind speed not greater than 12.5m/s as this is maximum wind speed that EWP can work in.

The weather shall be monitored throughout the operation with updated forecasts every three hours. At any stage the weather reduces below the minimums or becomes unsuitable, the PIC is to cease operations.

Other factors the PIC should also consider in flight preparation are:

- Calculation of the required fuel for the task which shall include enough fuel for the proposed flight time to complete the task plus 30% of the total capacity of the helicopter
- Calculation of the weight and balance of the aircraft and confirm that the aircraft's weight and centre of gravity are within the prescribed limits for all stages of the proposed flight
- Determine the weight of the aircraft and proposed weight to be pulled are within the aircraft's performance limits
- Prepare the aircraft and equipment for the task and complete required checks and that all the equipment is functioning correctly.

5.1 Pre-Flight Inspection

The helicopter pilot is to carry out pre-flight inspections prior to the commencement of works. Inspections shall include (but are not limited to):

- Conduct a briefing for all personnel involved in the operation outlining specific safety requirements for working around a helicopter and the method of work to be employed (briefing may be conducted by pilot-nominated ground crew)
- Conduct a briefing for the brake operator stating the terminology to be used during communications;
- Check that the cargo hook, swivels, attachment hooks and the equipment and materials needed to conduct the works are serviceable and in good working condition
- Shall check that the cargo hook, swivels, attachment hooks and any other equipment and material to conduct the work is in a serviceable order
- Shall "zero" the load cell meter, to ensure an accurate weight reading
- Shall obtain from UGL and CPB a clear indication of the lines and structures to be included in the operation and all known areas of public concern
- Shall obtain from UGL the maximum allowable "run-out" tension that can be applied to the cable
- Ensure an anti-rotating device is installed on the cable to prevent the cable rotating
- Shall review airborne emergency procedures
- Shall undertake an inspection of the flight route to identify any objects which could affect the rotors of the helicopter whilst operating (e.g. loose plastic, fence panels, etc), as well as any objects which could impede the flight (e.g. raise crane booms, EWPs, etc.).

5.1.1 Communication Requirements for Stringing:

Positive communication is a fundamental requirement in helicopter support of powerline operations. Two-way radio systems must be used for communication between the pilot and brake operator. If radio communication fails, the operation shall stop immediately.

To avoid confusion particularly at maximum range, instructions should be one or two words only and clearly different for ease of recognition. The brake operator should repeat back to the pilot confirmation of instructions.

For example:

SPEAKER	WORDS	MEANING
PILOT	" RUN"	(Release brake tension)
BRAKE OPERATOR	" RUNNING"	(Brake tension released)
BRAKE OPERATOR	"RUN STEADY"	(Slow Down)
PILOT	"RUNNING STEADY"	(Slowing Down)
BRAKE OPERATOR	"STOP"	(Stop Running)
PILOT	" BRAKE"	(Apply Tension)
BRAKE OPERATOR	"BRAKE"	(Breaking)
PILOT	" STOP"	(Stopping)

Figure 6: Communication requirements

5.1.2 Direction of Cable Pull for draw wire Runout:

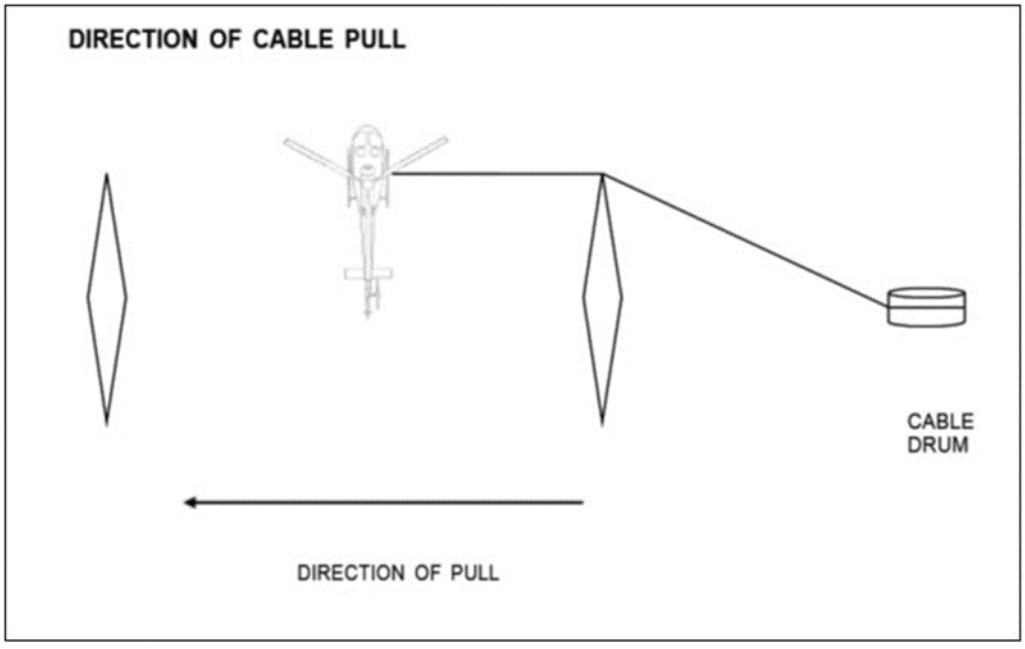


Figure 7: Direction of Cable Pull

5.2 Environmental

All Cultural Heritage sensitive locations have been demarcated as per Cultural Heritage Management Plans (CHMP) to prevent unauthorised access.

Caution and avoidance where possible will be taken when Fauna and wildlife is observed near the activity taking place.

Vehicle activity will be minimal (Supervisor to inspect the area) during inclement weather to avoid environmental impacts.

Stringing of draw-wire and conductors over Cultural Heritage areas will likely utilise 'Stringing under Tension' methodology to de-risk the need for personal to enter the heritage areas:

- 'Stringing under tension" methodology involves pulling the draw wire or conductor under tension to keep it elevated above the ground and prevent it from coming into inadvertent contact with any vegetation in the heritage or sensitive area
- Once the draw wire or conductor has been run out over the heritage area, it is then secured on both ends with a come along or clamp. To minimise the risk of any slippage of the conductor or draw wire, two clamps/come along are installed
- The risk of a conductor or draw wire breaking whilst being installed is very low, however in the event of this occurring over a heritage site, the work will be stopped, contractor site environmental representative will be contacted and then with client permission conductor/draw wire will be removed from the area by hand.

5.3 Spotters

Spotters must complete a check of the area beneath the helicopter flight path to ensure it is clear of any operatives or third parties, as well as to ensure that loose items are secured and that obstructions such as crane booms and EWPs are lowered and moved out of the flight path. Personnel should be positioned throughout the section to prevent (as far as reasonably practicable) the movement of personnel or third parties beneath the flight path for the duration of run out activities.

Spotters are to be positioned such that the full length of the section can be observed throughout the duration of run out activities (as far as reasonably practicable). They should never be positioned directly under the flight path of the helicopter or in such a way that they could be impacted should the helicopter, conductor or any other items fall to the ground.

Spotters are to be aware of trees and/or other obstructions which may hinder or damage the wire being run out. Works are to cease until the obstruction has been removed.

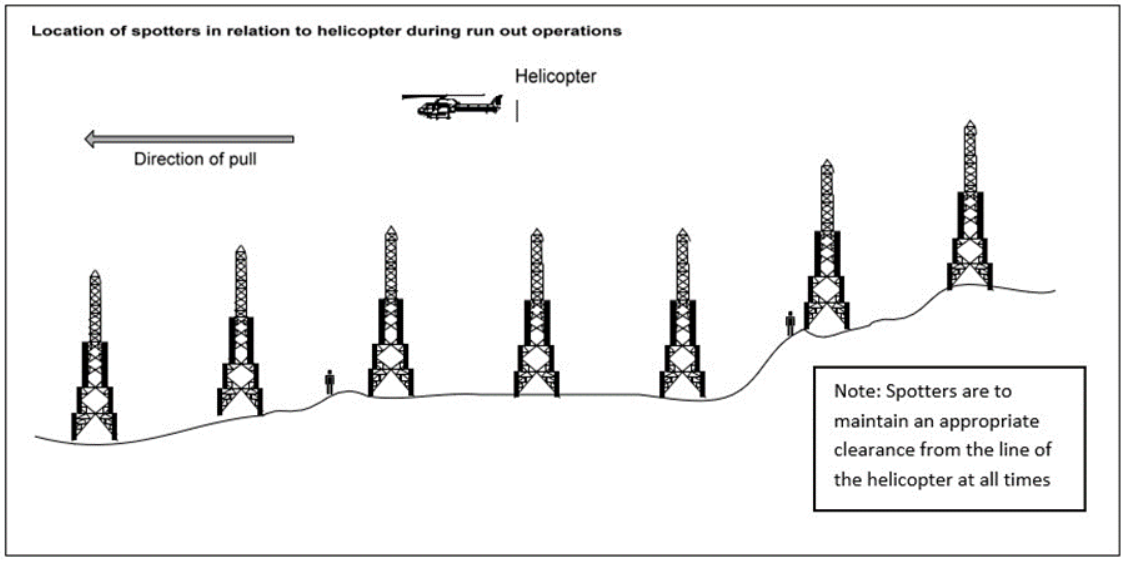


Figure 8: Example of Spotters placement during run out by helicopter

5.4 Helicopter Refuelling

Where a helicopter is required to be refuelled with aviation fuel from a trailer tanker the following responsibilities are required:

Pilot:

- Identify a suitable safe landing area for refuelling prior to work commencing
- Land the helicopter not less than 8 meters on the right-hand side of the refuelling trailer tank. Tank is positioned on the left-hand side of the helicopter

- Advise the refuelling operator of the amount of fuel required and when refuelling may commence
- When fuelling is completed by the refuelling operator, ensure that the all lines and hoses are disconnected and that the fuel cap has been installed
- Advise the refuelling operator to stand clear for take-off
- Switch engine off during refuelling and remove hands from the controls. Visually confirm that engine is switched off and hands have been removed to the Refueller prior to the refueller recommencing.

Tanker Driver:

- Prior to the helicopter landing, establish the trailer in the pre-identified refuelling location. At a minimum, the tank trailer containing aviation fuel must be positioned a minimum distance of 50 meters from the general public and allows for safe helicopter landing with 8 meters of the tank
- A clear area of 20 meters x 20 meters, with a slope no greater than 5 degrees is required. The area must be clear of any loose items that could be picked up by the helicopter rotor wash, powerlines and tree branches
- If the trailer is to be unhitched from the vehicle, ensure the trailer's park brake is applied and wheels are chocked.

Refuelling Operator:

- Ensure the area remains clear of all non-essential personnel
- Inspect the refuelling tanker prior to refuelling. Check the following:
  - The fire extinguisher is in position and serviceable
  - The spill kit is readily available
  - Check fuel for contaminants and water. Take a fuel sample from the sump and filter using a fuel sample kit
  - Inspect the condition of the electrical discharge static line and fuel pump, hoses and fittings.
- Connect the electrical discharge static line to the earth point on the helicopter when authorisation from the pilot to commence refuelling is given
- Unroll the fuel hose, ensuring the nozzle remains below head height. Beware of rotor blades overhead
- Zero the fuel flow meter on the pump
- Remove the fuel cap on the helicopter
- Start the pump and check for leaks
- Commence refuelling and provide the amount advised by the Pilot
- Upon completion of refuelling, remove the nozzle and install fuel cap
- Turn off the pump and position the hose clear of the helicopter
- Remove the electrical static line
- Advise the pilot of the amount of fuel added and that refuelling is complete
- Once Helicopter has left the location, pack up hoses and static line
- Is not smoking at the time of refuelling or whilst in the vicinity of refuelling equipment.

Personal Protective Equipment for the refuelling operator requires a hard hat with chin strap, steel capped boots, class 5 earmuffs and gloves (as per aviation fuel SDS).

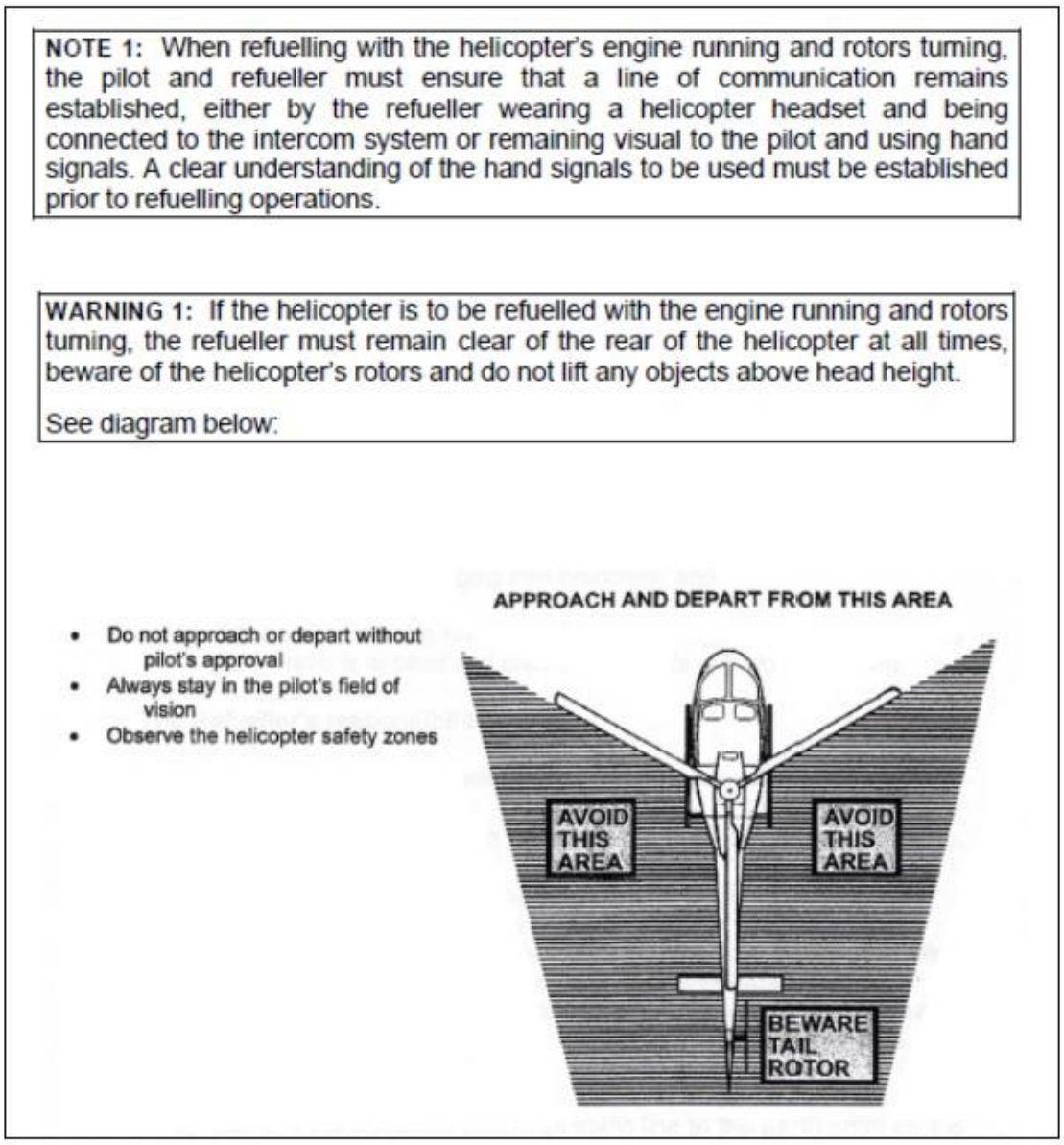


Figure 9: Notes for Refuelling

5.5 Running of draw-wire via Helicopter

Once the hanging of the pulley/insulator sets has been completed for a section, the run-out of draw wire can commence. The draw wire will be used to pull conductors and earth wires across the section.

The type of cable which shall be used as draw wire shall be Anti-twisting Galvanized Steel rope with nominal diameter of 13mm, 20 and 24mm diameter.

The 20 mm diameter draw wires are in 1000 metres reels, the 24 mm in 800 metres reels and 13 mm in 1500 – 1600 metres reels.

The Helicopter Brake Site shall be prepared prior to run-out and the required number of reels of draw wire for the runout shall be delivered to site.

Radio communications shall be checked between the Helicopter and the Brake Operator and all the personnel involved in the operation. The draw wire reels will be loaded with one reel on each brake using a Hiab Truck or Franna Crane. The use of two brakes for the run-out is to enable continuity of run-out while changing empty reels.

When running draw wire in tension (10-13mm), running earth shall be fitted on the draw wire at the front of the helicopter brake at all times. The running earth can be manually fitted and removed from the draw wire only when wearing HV gloves and a temporary earth shall be installed in front of the running earth position.

The earth shall be proven with the use of a Voltage Detecting Unit. The connection of temporary static earth shall be completed with the use of an earth stick and High Voltage gloves. After the running earth has been attached, the operator must ensure that the temporary static earth lead is removed. A VDU must be used to prove the running earth is zero voltage before starting the pull.

The end of the draw wire shall be pulled manually towards the section to be strung at a distance far enough to ensure the Helicopter will not interfere with the brake site.

The Helicopter will fly up and hold its position to let the linemen/rigger on the ground hook the draw wire end on to the attachment point of the Helicopter.

Once the end of the draw wire has been attached, the ground Rigger shall use both hand signals and two-way radio to communicate to the Pilot to proceed with the run-out.

During the run-out only the Machine Operators are allowed to be in the vicinity.

The Brake Operator in contact with the pilot via two-way radio will momentarily apply the brake as the Helicopter starts to pull the draw wire.

Where accessible by public, Signage or spotter shall be placed at entry points to prevent entry to the section being pulled by the helicopter.

When the Helicopter passes each tower, he will manoeuvre high up and across toward the tower to align the draw wire with the pulley. He will then manoeuvre downward to facilitate positioning of the draw wire onto pulley.

A dedicated monitor shall travel along the line monitoring the run-out and shall liaise with the Pilot via two-way radio to pull the draw wire slowly or the Brake Operator to apply more brake as required.

The monitor shall supervise the draw wire to ensure as it lands on ground it's lined up with the fence hurdles does not become entangled.

The Helicopter will then proceed to the next tower and pull the draw wire into the next Pulley Block and so on.

When running out draw wire in close proximity to existing parallel energized lines, the run-out shall be setup to pull the draw wire with head of the Helicopter facing the live line. This is to ensure that the Pilot can check and maintain a safe distance from the live line. The run-out shall commence on the line closest to the live line first, so that there will be no wire on the tail of the Helicopter in any run-out.

Personnel are to face away from the helicopter when taking off and landing. A clear zone area shall be put in place when draw wire is being pulled. Monitors will ensure no one is able to enter the run-out zone, particularly those areas around the draw-wire and its rockets and pulleys.

The draw wire shall be pulled until two layers are left on the reel. The brake operator shall instruct the pilot to commence slowing down in preparation to stop for the changing of reels.

When one layer is left, the run-out shall be stopped and the remaining draw wire shall be drawn out manually on to the ground. There shall be no tension on the draw wire once it is lowered onto the ground.

The draw wire reels shall be replaced via Hiab truck or Franna/telehandler. The new full draw wire reel shall be connected to the end of the draw wire that has been run-out via a draw wire connector. The Brake Operator shall notify the Pilot to resume pulling once the connection is complete.

Once the draw wire has reached the end of the section pull, the Pilot shall drop the draw wire on to the designated point with the release control on the Helicopter.

The same procedures shall be followed for the rest of the draw wires.

Special care shall be taken when running 13mm draw wire in tension. Anchor points (concrete blocks) shall be installed in the designated location prior the run-out to anchor the draw wire when the run out complete.

In case of emergency for unplanned helicopter releasing the draw wire, the pilot shall contact and communicate to the brake site operator and ground personnel via on the radio to alert them that the draw wire will then be released from the chopper. Immediately further, the pilot will ask confirmation from all aerial and ground stringing crews for a clearance to safely release the draw wire onto the ground

Prior to recommencing helicopter activities all draw wires shall be checked, inspected and verified to be free from damages. Any damaged draw wires shall be immediately removed from site and contained in quarantine area.

Application of Crane/telehandler/Franna hurdle will be used on mostly on road crossing where normal hurdle could not be installed. After the draw wires/ conductors or OPGW has been run out a SAFETY COMEALONG (Anchor) will be fitted to the draw wires or cables and anchor to the nearest tension tower, to the under arm of suspension tower or to the ground using approved anchor point.

Application of SAFETY COMEALONG will be installed on completion of each phase run out. The crane/Franna hurdle will remain in place until safety come along have been installed.

5.6 Optical Fibre Ground Wire runout via Helicopter

The OPGW running method shall be done via helicopter. However, it shall be pulled under tension.

Woven wire cable hauling grips shall be used for pulling out the OPGW. Each Grip shall be attached to the Helicopter pilot wire with a swivel to permit the pilot wire and cable to rotate independently of each other at all hauling tensions.

Counterweights shall be applied to the OPGW at the swivel position to stop it from rotating when being pulled through the sheaves.

The speed of the cable run-out shall not exceed 5km/hr. And, the tension in any span along the run-out shall not exceed 17% CBL at 20° C.

On completion of the run-out, the OPGW tails shall be installed to the outside face of the tower down to a non-climbing leg from the earth wire peak. Sufficient lengths (minimum of 15 metres) of cable shall be provided at ground level at both ends of the pull. The cable shall be secured by down lead clamps, with nominal two metre spacing between assemblies. The tails are coiled and fastened to the structure body at least five metres above ground level before installation of the joint enclosure.

The OPGW reel numbers shall be recorded per run, and the reels will be marked as to whether surplus cable will be scrapped or re-used on the succeeding pulls.

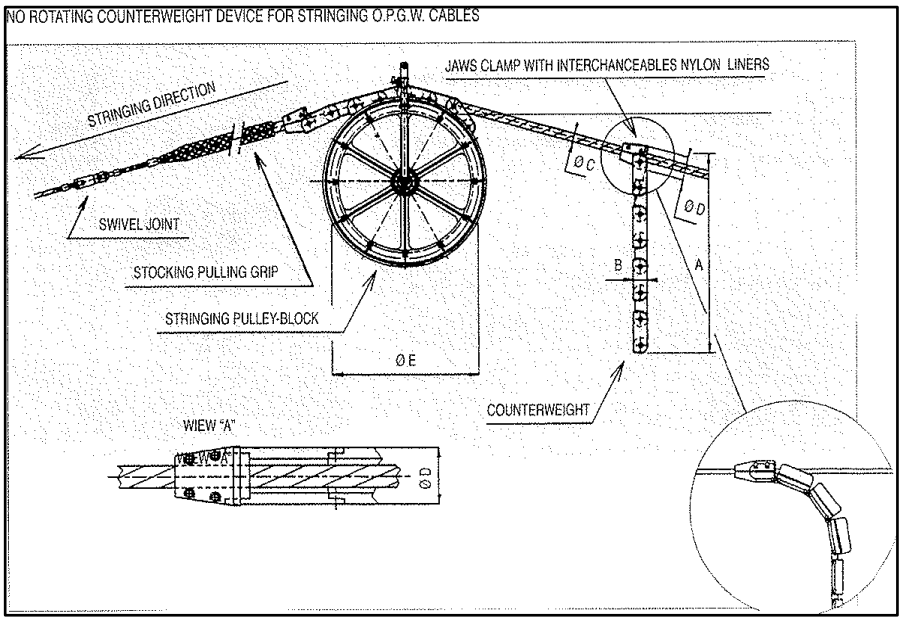


Figure 10: No Rotating Counterweight Device for Stringing OPGW Cables

Tandem pulleys shall be utilised where the angle from horizontal to the cable at the sheave is greater than 25 degrees. The tandem sheaves shall be positioned to ensure approach and departure angles of the cable from the sheaves is minimised.

The OPGW run-out tension shall depend on the terrain, length of pull, number of angled structures on the stringing section. Typical run out tension is around the 300 – 500 kgf or as low it can be that cable sag along the run-out section shall not touch any obstacles or drag on the ground.

OPGW maximum run-out tension shall not exceed 17% of the cable RBS or half of the sagging tension.

Come-along that shall be used in hauling the OPGW cable is of sliding type with jaw liner specifically for OPGW cable.

The OPGW run-out tension, speed and timing shall be monitored and recorded by Digital Line Recorder (DLR) device installed at Brake machine used for OPGW run out.

Whilst run-out of OPGW is in operations, ensure spotters are located along the line at least on every 5th structure.

Under no circumstances when winch operation is on-going that any person will be in front of the stringing machines.

During the run-out all calls on the radios related to the on-going activity must be acknowledged.

In case of emergency for unplanned helicopter releasing the OPGW, the pilot shall contact and communicate to the brake site operator and ground personnel via on the radio to alert them that the OPGW will then be released from the chopper. Immediately further, the pilot will ask confirmation from all aerial and ground stringing crews for a clearance to safely release the OPGW onto the ground

Prior to recommencing helicopter activities all OPGW shall be checked, inspected and verified to be free from damages. Any damaged OPGW shall be immediately removed from site and contained in quarantine area.

Good communication is a fundamental requirement in cable run out operation. To avoid confusion, specially at long range, radio instruction shall be limited to one or two words only and precise for ease of recognition.

The receiver of the command shall repeat the instruction back for confirmation of command. Communication protocol shall be established for easy understanding of commands and instruction during cable run out. The standard radio commands during cable run out are as follow;

Radio Command	Definition
RUNNING	Start OPGW/cable pulling
ALL STOP	Stop OPGW/cable pulling and put machines in idle
RUN STEADY	Slow down the cable pulling speed
RUN NORMAL	Average cable pulling speed
COME UP	Increase cable tension
COME DOWN	Lower cable tension

5.7 Conductor Cable Stringing via Helicopter

The procedure below applies when the helicopter is used to directly pull out the conductor through a brake tensioner to support cable stringing operations.

Pre-flight actions shall be carried out by the pilot prior to commencing the following procedure to directly pull the conductor cable i.e.

a. conduct a briefing for all personnel involved in the operation concerning safety around the helicopter and the work method to be used
b. conduct a briefing for the brake operator on the terminology to be used when communicating
c. shall obtain from the power authority/contractor a clear indication of the lines and structures to be included in the operation and all known areas of public concern
d. ensure that the “Boom-Hook” is installed correctly, by confirming that the inboard belly attachment pin is in place and safety pin is installed and the links are attached to the skid lugs and secured

The pilot shall position the helicopter to allow personnel either on the ground, in an EWP or on top of a tower/pole, to attach the cable to the helicopter remote hook.

The pilot shall gently take up the tension on the cable and advise the Brake Operator that he/she is ready to “Run”.

The Brake Operator shall advise the pilot to “Run”.

The pilot shall pull the cable out sideways, to ensure adequate vision can be maintained in the direction of travel and the cable. The optimum position for heavier pulling is to have the cable positioned at 45° to the longitudinal axis.

The pilot shall pull the cable at a speed of approximately 5kph and monitor the “Load Cell” to ensure the cable is pulled out smoothly and slowly to avoid jerking the cable and so that the maximum allowable ‘run-out’ tension is not exceeded.

The pilot shall fly up over the first tower at a height that ensures the tail and skids clear the tower safely, this can be confirmed by the mirrors, and once clear of the tower descend gently to the required roller.

The cables should always be pulled in such an order to have the already strung cables either in front of or below the height of the aircraft rotor system, but at no point should you have a cable behind the aircraft at the same height as the one that is being pulled.

The pilot should prevent the cable from touching the ground or any obstacles under the line by advising the Brake Operator to increase the tension on the brake.

The pilot shall place the cable in the appropriate roller at each tower.

On reaching the end of the run, the pilot shall advise the brake operator that he/she is stopping and that the run is finished. The brake operator shall apply maximum brake to hold the cable.

The pilot shall hold the tension on the cable whilst tower personnel attach a come along or attach the ‘dead end’ or shackle. Once the cable is secured, the tower personnel will indicate so to the pilot and

The pilot will gently back off the tension, confirming that there is no slippage on the cable, if secure, the pilot will release the cable, ensuring the end does not fall onto personnel and equipment.

In case of emergency for unplanned helicopter releasing the conductor, the pilot shall contact and communicate to the brake site operator and ground personnel via on the radio to alert them that the conductor will then be released from the chopper. Immediately further, the pilot will ask confirmation from all aerial and ground stringing crews for a clearance to safely release the conductor onto the ground

Prior to recommencing helicopter activities all conductor shall be checked, inspected and verified to be free from damages. Any damaged conductor shall be immediately removed from site and contained in quarantine area.

Good communication is a fundamental requirement in cable run out operation. To avoid confusion, specially at long range, radio instruction shall be limited to one or two words only and precise for ease of recognition.

The receiver of the command shall repeat the instruction back for confirmation of command. Communication protocol shall be established for easy understanding of commands and instruction during cable run out. The standard radio commands during cable run out are as follows;

Radio Command	Definition
RUNNING	Start Conductor/cable pulling
ALL STOP	Stop Conductor/cable pulling and put machines in idle
RUN STEADY	Slow down the cable pulling speed
RUN NORMAL	Average cable pulling speed
COME UP	Increase cable tension
COME DOWN	Lower cable tension

5.8 OHEW cable stringing via Helicopter

The OHEW will be directly pulled by the helicopter and it shall be pulled under tension.

Pre-flight actions shall be carried out by the pilot prior to commencing the following procedure to directly pull the OHEW i.e.

a. conduct a briefing for all personnel involved in the operation concerning safety around the helicopter and the work method to be used
b. conduct a briefing for the brake operator on the terminology to be used when communicating
c. shall obtain from the power authority/contractor a clear indication of the lines and structures to be included in the operation and all known areas of public concern
d. ensure that the “Boom-Hook” is installed correctly, by confirming that the inboard belly attachment pin is in place and safety pin is installed and the links are attached to the skid lugs and secured
e. check that the cargo hook with load cell is attached to the boom hook correctly with cargo release cable, cargo release electrical cable and load cell electrical cable connected and functioning
f. attach wire rope sling with electrical swivel and remote hook to cargo hook on Boom Hook and connect electrical lead to outlet on helicopter and check serviceability
g. confirm the load cell is functioning correctly and ‘zero’ the cockpit readout
h. carry out a radio check with brake operator and any other personnel involved with operation and
i. shall review airborne emergency procedures.

The pilot shall position the helicopter to allow personnel either on the ground, in an EWP or on top of a tower, to attach the OHEW cable to the helicopter remote hook.

Once the personnel “hooking up” is clear, the pilot shall gently take up the tension on the OHEW cable and advise the Brake Operator that he/she is ready to “Run”.

The Brake Operator shall advise the pilot to “Run”.

The pilot shall pull the cable out sideways, to ensure adequate vision can be maintained in the direction of travel and the cable. The optimum position for heavier pulling is to have the cable positioned at 45° to the longitudinal axis.

The pilot shall pull the OHEW cable at a maximum speed of approximately 5kph and monitor the “Load Cell” to ensure the OHEW cable is pulled out smoothly and slowly to avoid jerking the cable and so that the maximum allowable ‘run-out’ tension is not exceeded.

The pilot shall fly up over the first tower at a height that ensures the tail and skids clear the tower safely, this can be confirmed by the mirrors, and once clear of the tower descend gently to the required roller.

The OHEW cables should always be pulled in such an order to have the already strung cables either in front of or below the height of the aircraft rotor system, but at no point should you have a cable behind the aircraft at the same height as the one that is being pulled.

The pilot should prevent the cable from touching the ground or any obstacles under the line by advising the Brake Operator to increase the tension on the brake.

The pilot shall place the cable in the appropriate roller at each tower.

On reaching the end of the run, the pilot shall advise the brake operator that he/she is stopping and that the run is finished. The brake operator shall apply maximum brake to hold the OHEW cable.

The pilot shall hold the tension on the cable whilst the tower personnel attach a come along or install a dead end. Once the OHEW cable is secure the personnel will indicate so to the pilot.

The pilot will gently back off the tension, confirming that there is no slippage on the cable, if secure, the pilot will release the cable, ensuring the end does not fall onto personnel and equipment.

5.8.1 Making an OHEW Joint

There are 2 options for making a Joint in the OHEW. Option 1, the preferred method, is the helicopter holding the cable whilst the joint is made. Option 2 is necessary if the helicopter will need to refuel prior to finishing the pull, which is to release the cable whilst the joint is made.

Option 1:

a. When the end of the drum is approaching, the brake operator shall advise the pilot to “Run Steady” and when the drum is empty tell the pilot to “Stop”, and the brake operator shall apply maximum brake.
b. The pilot shall hold the tension on the cable while a sock is used to connect the new drum to the tail of the old drum.
c. Once the new drum is connected to the tail of the old drum the brake operator shall release the brake and tell the pilot to “Run Steady”.
d. The pilot shall gently pull the cable drawing the sock through the brake until the sock is in a position to press the joint, whereupon the brake operator shall advise the pilot to “Stop” and then apply maximum brake.
e. The pilot shall stop and hold the tension on the cable while the joint is pressed and
f. Once the joint is finished being pressed the brake operator shall release the brake and advise the pilot to “Run Steady”.

Option 2:

a. When the end of the drum is approaching, the brake operator shall advise the pilot to “Run Steady” and when the drum is empty tell the pilot to “Stop”, and the brake operator shall apply maximum brake.
b. The pilot shall hold the tension on the cable while a sock is used to connect the new drum to the tail of the old drum.
c. Once the new drum is connected to the tail of the old drum the brake operator shall release the brake and tell the pilot to “Run Steady”.
d. The pilot shall gently pull the cable drawing the sock through the brake until the sock is in a position to press the joint, whereupon the brake operator shall advise the pilot to “Stop” and then apply maximum brake.
e. The pilot shall stop and hold the tension on the cable.
f. Once the cable has stopped running, a linesman on the last tower that the cable has passed through, shall attach a come-along to the cable to secure it to the tower.
g. Once the cable is secured, the linesman shall advise the pilot so and the pilot shall either take to tail back to the rigger to release or if the ground is suitable place the tail gently on the ground and release.
h. The helicopter can then refuel whilst the joint is being pressed.
i. Once the joint has been completed and the helicopter refuelled, the pilot shall return to reconnect the cable to the helicopter.
j. When the cable is reconnected to the helicopter hook the pilot shall take up the tension and the linesman shall remove the come-along and advise the pilot and brake operator that the cable is released
k. The pilot shall advise the brake operator that he/she is ready to “Run” and the brake operator shall release the brake and advise the pilot to “Run”

In case of emergency for unplanned helicopter releasing the OHEW, the pilot shall contact and communicate to the brake site operator and ground personnel via on the radio to alert them that the OHEW will then be released from the chopper. Immediately further, the pilot will ask confirmation from all aerial and ground stringing crews for a clearance to safely release the OHEW onto the ground

Prior to recommencing helicopter activities all OHEW shall be checked, inspected and verified to be free from damages. Any damaged OHEW shall be immediately removed from site and contained in quarantine area.

Good communication is a fundamental requirement in cable run out operation. To avoid confusion, specially at long range, radio instruction shall be limited to one or two words only and precise for ease of recognition.

The receiver of the command shall repeat the instruction back for confirmation of command. Communication protocol shall be established for easy understanding of commands and instruction during cable run out. The standard radio commands during cable run out are as follow;

Radio Command	Definition
RUNNING	Start OHEW/cable pulling

ALL STOP	Stop OHEW/cable pulling and put machines in idle
RUN STEADY	Slow down the cable pulling speed
RUN NORMAL	Average cable pulling speed
COME UP	Increase cable tension
COME DOWN	Lower cable tension

5.9 Draw-wire cable stringing under tension

The procedure below applies when the helicopter is used to pull out the draw wire through a brake tensioner under tension to keep the cable off the ground to maintain clearances and to support powerline stringing operations.

Pre-flight actions shall be carried out by the pilot prior to commencing the following procedure to pull the draw wire under tension i.e.

a. conduct a briefing for all personnel involved in the operation concerning safety around the helicopter and the work method to be used
b. conduct a briefing for the brake operator on the terminology to be used when communicating
c. shall obtain from the power authority/contractor a clear indication of the lines and structures to be included in the operation and all known areas of public concern
d. ensure that the “Boom-Hook” is installed correctly, by confirming that the inboard belly attachment pin is in place and safety pin is installed and the links are attached to the skid lugs and secured
e. check that the cargo hook with load cell is attached to the boom hook correctly with cargo release cable, cargo release electrical cable and load cell electrical cable connected and functioning
f. attach wire rope sling with electrical swivel and remote hook to cargo hook on Boom Hook and connect electrical lead to outlet on helicopter and check serviceability
g. confirm the load cell is functioning correctly and ‘zero’ the cockpit readout
h. carry out a radio check with brake operator and any other personnel involved with operation and
i. shall review airborne emergency procedures.

The pilot shall position the helicopter to allow ground personnel to attach the draw wire cable to the helicopter remote hook.

The pilot shall gently take up the tension on the draw wire cable and advise the Brake Operator that he/she is ready to “Run”.

The Brake Operator shall advise the pilot to “Run”.

The pilot shall pull the draw wire cable out sideways, to ensure adequate vision can be maintained in the direction of travel and the cable. The optimum position for heavier pulling is to have the cable positioned at 45° to the longitudinal axis.

The pilot shall endeavour to keep the cable clear of the ground and all obstacles and if necessary, will advise the brake operator to apply more brake to keep the cable clear.

The pilot shall pull the cable out a maximum ground speed of 8kph.

The pilot shall fly up over the first tower at a height that ensures the tail and skids clear the tower safely, this can be confirmed by the mirrors, and once clear of the tower descend gently to the required roller.

The cables should always be pulled in such an order to have the already strung cables either in front of or below the height of the aircraft rotor system, but at no point should you have a cable behind the aircraft at the same height as the one that is being pulled.

The Brake Operator shall advise the pilot when the end of the drum is approaching by advising the pilot to Run Steady, whereupon the pilot shall slow down.

The Brake Operator shall advise the pilot to Stop when the end of the drum is reached and apply maximum brake and the ground personnel shall make the joint with a new rocket.

Once the joint is made, the Brake Operator shall advise the pilot to Run Steady, until he/she is satisfied that the cable is running normally, and then advise the pilot to Run Normal.

This procedure shall continue until the run is completed.

On reaching the end of the run, the pilot shall advise the brake operator that he/she is stopping and that the run is finished. The brake operator shall apply maximum brake to hold the cable.

The pilot shall hold the tension on the cable whilst the tower personnel attach a come-along or install a dead end. Once the cable is secure the personnel will indicate so to the pilot.

The pilot will gently back off the tension, confirming that there is no slippage on the cable, if secure, the pilot will release the cable, ensuring the end does not fall onto personnel and equipment.

Good communication is a fundamental requirement in cable run out operation. To avoid confusion, specially at long range, radio instruction shall be limited to one or two words only and precise for ease of recognition.

The receiver of the command shall repeat the instruction back for confirmation of command. Communication protocol shall be established for easy understanding of commands and instruction during cable run out. The standard radio commands during cable run out are as follow;

Radio Command	Definition
RUNNING	Start Draw Wire/cable pulling
ALL STOP	Stop Draw Wire/cable pulling and put machines in idle
RUN STEADY	Slow down the cable pulling speed
RUN NORMAL	Average cable pulling speed
COME UP	Increase cable tension
COME DOWN	Lower cable tension

5.10 Specifications

The work shall be done in conjunction with the Client Specifications for the Erection of Line Materials, and cable manufacturer instructions manual.

5.11 Dampers, Spacers and Aerial Ball Marker installation

The Vibration dampers will be installed at the same time that the conductor, earth wire or OPGW is terminated or clamped in.

To start the damper installation, the-Stringing Schedule and Damper schedule shall be checked for the number of dampers and spacing required each span.

Aerial Marker Ball will be installed using Elevated Work Platform (EWP). The Stringing Schedule and Aerial Ball schedule shall be checked for the number of Aerial Balls and spacing required each span.

The Aerial Ball, Dampers and Spacers installation shall be done in accordance with the manufacturer installation manual and Client requirements.

5.12 External Load Lifting Operations

Where the helicopter is used to move loads from one position to another position by suspending the load from the helicopter cargo hook the following responsibilities are defined:

The Pilots responsibilities are

- For controlling the helicopter with enough accuracy to ensure that all required clearances are maintained;

- For confirming the helicopter's cargo hook mechanical and electrical release mechanisms are all operational;
- For confirming serviceability of all lifting equipment with the "load master";
- To conduct a radio check prior to commencing operations with the load master;
- To conduct a work site inspection prior to commencing, as to be aware of the proximity of obstacles whilst carrying out lifting operations; and
- Completing a lift study.

The load master's responsibilities are:

- Ensuring the area remains clear of all non-essential personnel;
- Ensuring the loads are rigged correctly;
- Ensuring the loads are secured to the helicopter long line hook correctly; and
- Communicating with the pilot and advising him/her of any anomalies.

The ground personnel responsibilities are:

- Rigging the loads ready for lifting;
- Attaching the load to the long line hook;
- Guiding the load clear of the ground;
- Stabilising and guiding the load for landing; and
- Releasing the load from the long line hook.

5.12.1 Methodology:

The following methodology will be used to conduct external load lifting operations:

1. The load master shall be positioned where they can oversee the operation.
2. The pilot shall position the helicopter to allow ground personnel to attach the rigged load to long line hook.
3. Once the load is ready to lift the pilot shall lift the load clear of the ground to a safe height and fly away.
4. The pilot shall fly to the landing area and manoeuvre the helicopter so that the load approaches the landing area slightly higher.
5. When possible, the ground personnel shall take hold of the load and guide in into position using tag lines.
6. Once the load is in position, the load master shall inform the pilot and advise to release the weight so that the ground personnel can release the load from the long line hook.
7. The pilot shall then move clear of the area and reposition to pick up the next load.
8. At no time shall any personnel position themselves under a suspended load

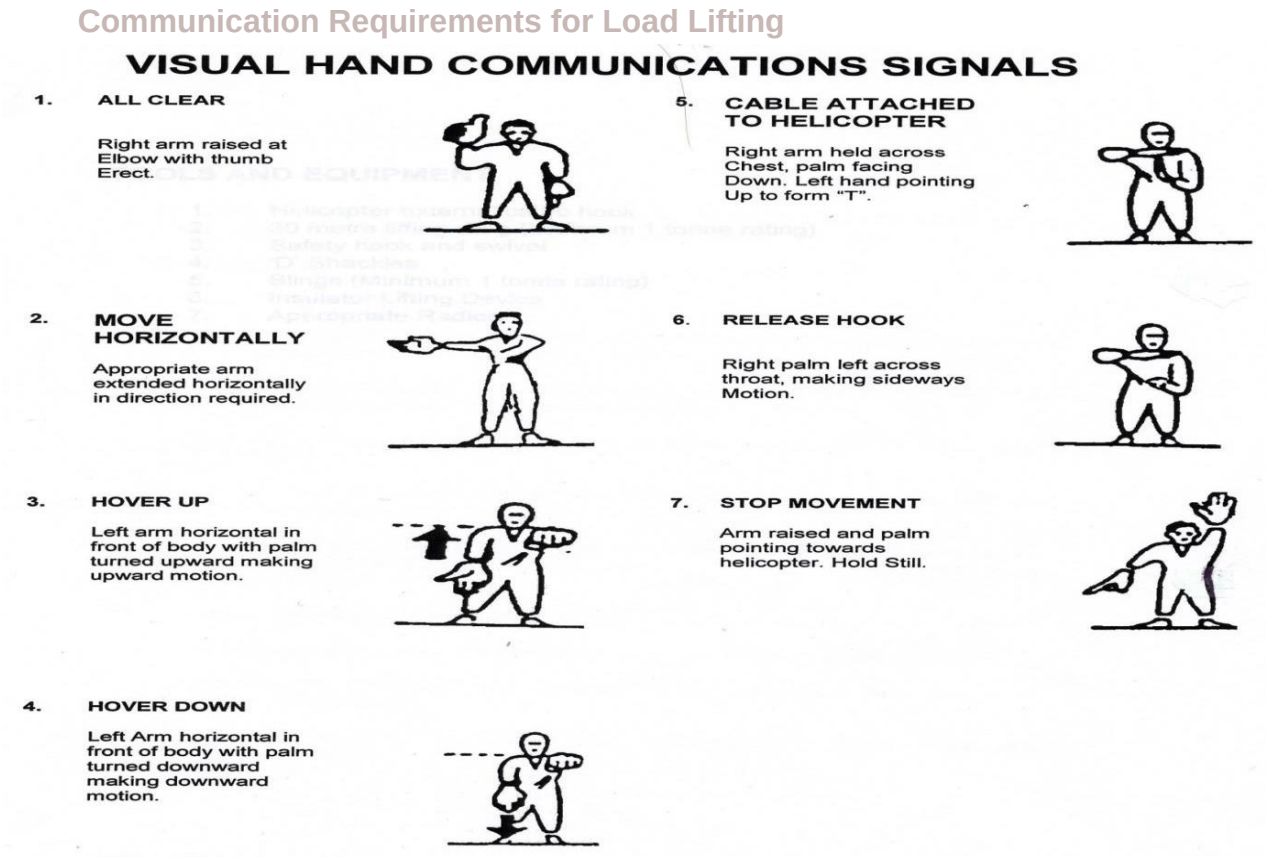


Figure 11: Hand Communication Signals for Load Lifting

6. Part C: Completion of Aerial Works:

6.1 Conductor Runout

The Winch and Brakes are to have pre-start checks conducted, which includes all corresponding equipment such as anchoring systems on the equipment, the earthing, reel winder, drum carriers.

The conductor ends of each reel on a drum carrier shall first be run through the Brake via rope.

All the conductors shall be run through the equipment (two conductors via dual capacity Winch/Brake machines). Woven Wire Cable/Wire Baskets/ Stockings shall be installed on each end of the conductors.

Each conductor end shall be secured to a Stocking with tie wire tightly wrapped around the end of each Stocking and taped with fibre glass braided tape.

Once all the conductors are ready, each Stocking shall be connected to the draw wire using sets of Swivels.

The end of the draw wires from each phase shall then be connected to the top end attachment point of the counterweight through another set of Swivels.

During the run-out, running earths are to be fitted at all times on the draw wires and conductors in front of the Winches and Brakes. The running earths can be manually fitted and removed from the draw wire when wearing HV gloves only when a temporary earth leads has been attached in front of the running earth position and it has been proven properly earthed with the use of a VDU. The connection of the temporary earth shall be installed with the use of an earth stick/hot stick and HV gloves. After the running earths have been attached, the temporary static earth leads can now be removed.

At the Winch, the end of the draw wire shall run through the bull wheel and onto the empty draw wire reel on the reel winder.

Once everything has been set-up on both ends, the radio communication shall then be re-checked. This is to ensure that the Winch and Brake operators, the monitor, the observers at critical points and all parties involved in the run-out are able to communicate clearly and quickly.

The radio system shall have a channel that is free from outside interference and failure of any radio in the system shall cause immediate stoppage of the pulling operation.

During the run-out all calls on the radios related to the on-going activity must be acknowledged.

Once all checks are in place the Winches shall commence taking up the slack on the draw wires.

The nominated monitor and the crew on the run-out check points shall monitor the draw wires and provide instruction to stop if the wires become entangled.

Once the cable starts to travel through the Brake, the floating draw wires shall be checked along the section for any tangles, and to ensure there is ample clearance on each span.

Trees that may cause the draw wires to become caught, shall be removed prior to starting the run-out, provided the environmental approvals to remove will be in place.

Proceeding with the run-out, the Brake Operator shall start applying the brake as the Winch pulls, to keep the run-out in tension and to maintain the height of the wires being pulled.

During the operation no one will access the no- go zones on winch and brake sites, the reels being run-out shall be checked periodically and shall only be checked in the “Special Access Zone”.

There shall be a minimum four Crew members at the winch site and six crew members at the brake site during the run out. While in the “Special Access Zone” one shall keep clear of all pinches and crush hazards and stay clear of the moving and rotating parts.

In order to remove the brake/winch operator from the line of fire, remote control winch shall be utilized. The remote control will be set up in the centre of the machines and will be connected through an umbilical cord.

The run-out shall maintain a slow speed until the cable being pulled is through the first tower, and then the speed may increase up to a speed 5 km/hr. maximum. The tension in any span along the run-out shall not exceed 17% CBL at 20°C. The Conductor and Earth wire shall be run out under constant tension at approximately 50% of the required sagging tension.

The nominated monitor shall follow the headboard through the pull, to enable changes in speed and tension to be applied. The pull rate is slowed down as the counterweight passes the pulley.

Sufficient tension shall be maintained on the cables at all times to prevent them from dragging on the ground. The pulleys on tension towers with deviations/angle shall be continually monitored by designated observers during the runout to ensure that the cable remains in the centre of the pulleys at all times. If the load on the winch increases rapidly, the pull on that particular run-out shall be stopped immediately until the cause has been found and rectified.

As the draw wire rockets/reels at winch become full, the winch shall stop the pull to swap the reel after notifying the brake and run-out crew via the two-way radio. Once confirmation is received, the pull shall be stopped and a come along is attached to the winch to secure the cable. The tension is then released from the winch and disconnected at the end of the draw wire from the joint. The full draw wire rocket/reel is then replaced with an empty rocket/reel using a Franna Crane or Hiab truck.

The end of the next section of draw wire is then connected to the empty rocket and rolled manually for approximately two cycles.

The tension is then taken back off the reel winder and released from the come-along at the winch. The tension is then taken up again on to the draw wire until the come-along at the back of the winch can be released.

The Winch operator shall then inform the brake and run-out crew that the run-out is ready to resume.

This procedure shall be repeated throughout the pull. When pulling conductor along sections that require more than one set of drums, mid span joints shall be used to join the cables together.

Just before the Conductor drum is empty, the pull shall be stopped and the safety come-along is now applied to anchor the conductor at the Brake.

The empty drums on the drum carriers shall be removed from behind the Brake and replaced with full drums using a Crane/Franna. The new drums should be prepared with cable stockings pre-installed on the ends of the cable to avoid delaying the run-out.

The cable stockings from the new drums shall be joined to the cable stockings on the ends of the cables which have been run out using sets of Swivels.

Once connected the safety come-along at the back of the Brake can be removed. The Brake Operator will then contact the Winch Operator and request to slowly pull the cable stockings through the Brake until it reaches the front of the equipment. A Come-along can then be re-installed in front of the Brake to ensure the conductor be loaded in a direct line pull. Four tonne mooring cables shall be connected to the Brake anchoring point using shackles.

The tension can then be released from the Brake until the cable is slack enough to make the join.

The come-along shall be visually checked from a safe distance to ensure it has been loaded correctly.

The Stockings can then be removed from the ends of the conductors for jointing to commence.

After the removal of the hauling devices, the conductor in the vicinity of the device shall be thoroughly inspected and any damage shall be repaired as directed by the client. The conductor ends shall be cut square and neat, wire brushed and greased with Alminox or Utilux (or as stipulated by the client's specifications) along the length to be covered by the aluminium joint. Both ends of the cable shall be inserted into the aluminium sleeve and compressed using the Hydraulic Press Machine. A press will be made firstly on either side of the start mark in the centre of the sleeve, then proceed in along the length of one side to the end and repeat on the other side.

When pressing the mid-span joints, the conductors shall be supported and held straight as the dies of the press close. It should be in such a position that there will be no strain on the sleeve as the dies close. Presses should overlap the half previous press to ensure uniformity and strength. The hydraulic press shall be operating to the required pressure.

Utilux/alminux electrical jointing compound (ID# H2397) shall be used in all compression joints, ball socket joints and bolted palm joints.

Once the jointing has been completed it will be protected by an oversleeve. The oversleeve or steel covers and rubber ends shall be connected on to the joint and secured in place using fibre glass braided tape.

When all the covers are in place and equipment moved out of the way, the cables can be brought back to tension by releasing tension on the brake machine. The mooring cables can then be disconnected and come-along removed when tension is released (they become slack).

The same procedure shall be repeated as required for further changing of drum.

The run-out shall then continue again until the conductor reaches in front of the winch.

6.2 Catching-up Conductor from completed pull (in-line Pull)

Once the conductor pulling has been completed, an EWP will be used to catch up the conductor from the pull. This catch-up could be made by using come-along and slings and then temporary anchor conductors onto cross-arms, or directly pressing the dead-end terminals and connect to cross-arm termination point.

Sequence is from top to bottom or vice versa.

6.3 Joining Conductor from previous pull (Floating)

Once the cables being pulled reach the Winch, the pull shall be stopped and come-along and mooring cables shall be installed to anchor the cables to the front of the Brake or Winch machines.

A come-along and draw wire shall be installed on to the cable in front of machine, ensuring the come-along is loaded in a direct line pull. The come-along can then take the load off the conductor to allow the tension to be taken off the machine.

When handling cable outside of the running earths, static earth leads shall be applied first. Earths are to be installed using a hot-stick and HV gloves.

The tension on the cable shall be slackened using the Transfer Winch with the 13 mm draw wire until the mooring cable can be released and the come-along can be removed in front of the machine.

The conductor shall be removed from the Brake/Winch and the ends of the cable joined from the current pull to the cable from the previous pull using a mid-span joint.

A mid-span joint in a conductor or earth wire shall not be closer than **15 metres** to a suspension clamp or closer than **15 metres** to a tension clamp to avoid interference with the vibration control equipment and no mid-span joint shall be located in spans crossing railway lines. There shall be no tension joints at adjacent spans or in sections between tension positions of less than 3 spans.

Once the joints are complete, the tension shall be slowly released from the transfer Winch while taking up tension on the far end Winch allowing the cable to transfer sideways across to the cable anchor blocks.

A Floating Pulley and 2 x webbing slings shall be installed onto the cable directly above in front of the cable anchoring blocks.

The cable will be pulled down using the Side Winch to release the tension on the mooring cable by anchoring it from the previous pull. A minimum 3.2t chain full shall be required to pull enough slack to release the mooring cable.

The Floating Pulley Winch rope shall be slowly released, allowing the cable to float up in the air whilst winching the cable at the other far end Winch site to maintain the required tension.

Insulators on the last clamped suspension tower shall maintain plumb following total release of the cable.

Sequence is strictly from top to bottom cross-arms.

6.4 Anchoring or Termination of Conductor (Back-hanging)

6.4.1 Brake/Tensioner Site

Upon the completion of the pull, secure the conductors in front of the brake machine anchor points using come-along and mooring cable.

Unroll the cables from the drums, cut tails to required length, and remove them from the tensioner/winch. Secure conductors on the ground and then pressed dead end terminal.

Remove the cable drum/drum carrier and other equipment behind the winch/brake as required.

Set up 3T winch1 near the tower or behind the machine (transfer winch), ensuring a clear view is maintained between the front machine and the winch. Set up 2.5T concrete block in front of the brake as conductor anchor and release/flotation block.

Set up another 3T winch2 for lifting and back hanging of conductors. This winch shall form part of a square rig set up from the winch through to the tower. Attach the rope and come-along at least 1m away from the pressed dead-end then attach tag line onto conductor.

Install floating Pulley onto floatation block, run winch1 rope through pulley and then connect to webbing slings. Install slings onto the cable directly above the front of the cable anchoring blocks. The cable then shall be pulled down using winch1 to release tension on the mooring anchoring the cable.

Slowly raise the cable using winch2 until tension is safe enough to remove the mooring cable. Once mooring cable removed, continue lifting of the cable while the floatation winch1 is gradually releasing the tension. Two-way radio is required for proper communication.

Where the conductor reaches the required level, an EWP shall be used to back hang/terminate the conductor and to remove the come-along/draw wire and tag line.

Throughout the back hanging operation, no men will be inside the working area (which shall be barricaded using flagging or webbing) except the puller operator who is positioned away from firing line.

The same procedure shall be used to the rest of the conductors to be back hanged.

Sequence is from top to bottom or vice versa.

6.4.2 Winch/puller site

Attach come-along/mooring cable to conductors and anchor them onto the Puller. Remove socks/stockings and draw wire. Cut the conductor with enough tail then press dead end terminals.

Attached a snatch block onto the puller transport lifting point and run the draw wire onto snatch block. Install a come-along onto conductor at least 3m away from pressed dead-end connect to draw wire.

Set-up the winch rope on a square rig positioned on the side of the tower and attaches the rope with a shackle onto the come-along (already connected to conductor). Secure the dead-end terminal onto the winch rope using Parramatta rope. Pull up the conductor slowly with the Puller, gradually releasing the tension/load. Communication between operators shall be by way of radios only (a radio check is required prior lifting conductor). Once conductor tension is off from the mooring cable, remove come-along and mooring cable.

When the conductor is up to the level of the cross arm, an EWP will be used to terminate the conductors and to remove the come-along and other materials temporarily attached to the conductor.

The same procedure will be used with the rest of conductors.

Sequence is from top to bottom cross-arm or vice versa.

6.5 Final tensioning and sagging of earthwire and conductor

An initial condition method shall be used to sag the conductor, OHEW and OPGW within **10 days** of the completion of the run out. This will be done using the approved sag/tension data. Conductor creep allowance is already incorporated into sag and tension tables. Temperature correction shall be also applied as deemed required during final stringing sag and tensioning. No individual phase sub-conductor, OPGW or OHEW remains at its pre-sag condition longer than a total of **14 days,** determined from its recorded installation date. *Hold Point.*

Before tensioning the conductor, the earths shall be installed on each conductor being worked on. The EWP shall be bonded to the line using an earth lead after the earths on the tower have been proven with a VDU. A UGL earthing permit form must be completed.

A drop/exclusion zone shall be set up before any work at heights begins. The final tensioning of the conductor requires the cables to be first terminated on to one tension tower/pole.

Once terminated or anchored at one end, another Crew will set up tensioning assemblies onto the next tension tower.

In both set ups, all the conductors shall be earthed using the standard insulated earth leads before working on any of the strung cable. /hot stick must be used to install the earth lead.

The earthed OHEW or conductors shall be checked with VDU. If any of the conductors still have voltage, the connections shall be checked using hotstick or replace the earth lead. Works can proceed only when voltage has been dropped to zero.

The tensioning assembly shall be connected to the conductor with a come-along.

The operation shall be tensioning on one side of the tower and back hang at the other side. The pulling assembly with the Winch shall be on the tensioning side and chain pulls with slings on the other side.

A Square rigging pulling assembly shall be setup to tension the conductor

A Theodolite shall be setup on each specific designated location where the sag is going to be observed. Communication between the field engineer (or his delegate) on the Theodolite and linemen shall be via two-way radio

The cable temperature shall be measured at their installed average elevation above ground level, while exposed to the sun and wind. The thermometer shall be freely suspended from a tower in the sagging span at middle cross arm level parallel to route centreline and clear of any shadow.

The Field Engineer (or his delegate) shall then calculate the correct sag to which the cable should sit based on its core temperature and data on Stringing Schedule/ sag table.

The tensioning operation should be stopped if rain or strong wind is incurred at velocities in excess of 10 metre/second or 20 knots.

Once all is set, sagging/tensioning shall commence while the sag is observed.

After allowing the conductor to sit to the correct sag on one span, a second observer shall commence to sag on the next span and then compare if conductor is still on sag.

Once the cable on all the spans observed is on sag, the Field Engineer (or His delegate) shall confirm to proceed to terminate the cable. *(Hold point).*

The conductors shall be cut with Utilux Grease (or approved substitute) applied equally on the conductor ends. Each end shall be inserted on to the Dead-end Terminals and spliced with a Portable Hydraulic Press Machine. After splicing the terminals on to the conductor ends, the conductors shall be terminated on to the insulator set.

6.5.1 Sagging Logic and Method

If tensioning has not been completed by the end of the working day, a sling and come-along shall be installed from the cross arm to the line. A second safety sling and come-along shall be installed in front of the first come-along on each conductor. The tension shall be released from the winch and transferred onto the slings and come-along.

The Stringing Engineer (or his delegate) shall check that the stringing chart/table title and tensions agree with the particular conductor being used and the line schedule.

Within each section to be strung, the following criteria shall be used to determine which spans shall be utilised for sag measurements:

The number of spans between strain towers. More sag positions are necessary when the number of suspension towers between strain towers increases. As a general rule on sections with 10 or more spans, every fourth or fifth span shall be sagged.

If the terrain where sagging is to occur is extremely hilly, more sag check positions may be required.

The span which is either the "Longest Span" or approximates the "Equivalent Span" shall be a primary target.

$$\text{Equivalent Span} = \sqrt{\frac{\text{Sum of (spans)}^3}{\text{Sum of spans}}}$$

The physical location of the two towers in the span being sagged shall be considered as it may be easier to sight from Tower A rather than Tower B or vice versa.

If more than one span has been selected for sag measurement, the span furthest from the tower being pulled through shall be sagged first.

For the span under consideration, its horizontal span distance shall be obtained from the line schedule and the current ambient temperature shall be taken and recorded.

The date when the particular conductor about to be sagged was originally strung shall be obtained from the Stringing Diary. The number of days between stringing and sagging shall be used to read from the Stringing chart the equivalent temperature reduction for the span.

The above equivalent temperature shall be subtracted from the ambient air temperature and the result used as the Ruling Temperature.

The Ruling Temperature along with the span distance shall be used on the stringing chart/table to determine the sag measurement.

6.5.2 Alternative 1 - Single Span Method

The theodolite shall be set up directly vertical under the conductor of the sag span. The vertical distance from the top of the stringing sheave to the sighting level at the theodolite shall be determined.

For the tower at the other end of the sag span, the vertical distance from the top of the stringing sheave to the tower centre peg shall be determined.

Based on the reduce levels of the centre pegs of the two towers, the height difference between their stringing sheaves shall be calculated.

The sag measurement determined previously and the span length "l" shall be used in the following formula to obtain the vertical angle θ to which the theodolite is to be set.

$$\text{Tan } \theta = \frac{H + 4d - 4\sqrt{hd}}{l}$$

(when sagging from the lower structure, H is negative).

The Stringing Engineer (or his delegate) shall then set the telescopic sight on the theodolite at the vertical angle θ and sight through, adjusting the horizontal alignment to view the conductor being sagged.

Using the two-way radio, the engineer shall direct the winch operator to raise or lower the conductor until it is tangential with the line of sight.

After completing the first sag, the same procedure shall be adopted to sag span B. After span B has been sagged, span C shall be checked, using the most suitable sagging procedure for that span.

If the sag in span C differs significantly from the line of sight, it shall be adjusted and then span B re-sagged. The remaining conductors (and earth-wires) in the section shall be sagged using the same method as described above.

After the completion of the sagging exercise, the conductors shall be lifted out of the running blocks and clamped to the bottom of the insulator assembly after the blocks have been lowered to the ground.

Sagging of the remaining sections of the line shall be performed sequentially in the same manner as above until the line is completely sagged.

6.5.3 Measurement of Sag

Sags shall be measured in the following locations in spans approved by the Principal:

a. Longer level spans in a sag section;

b. At least, one location per drum length;

c. Spans adjacent to a total line deviation angle exceeding 15 degrees; and

d. All spans greater than the ruling span by 150 metres or more.

No more than two nominal drum lengths or twenty spans, whichever is the lesser, shall be final sagged at any time without approval of the principal

When sight boards and sighting telescopes are used for sagging, they shall be accurately located with respect to the conductor, OHEW or OPGW and shall be firmly attached to the structures.

Should the conductor, OHEW or OPGW be over tensioned by more than 10 percent during sagging, the Contractor shall reduce the applicable tensions to approximately 15% CBL and sagging shall be repeated.

For the span under consideration, its horizontal span distance shall be obtained from the line schedule and the current ambient temperature shall be taken and recorded.

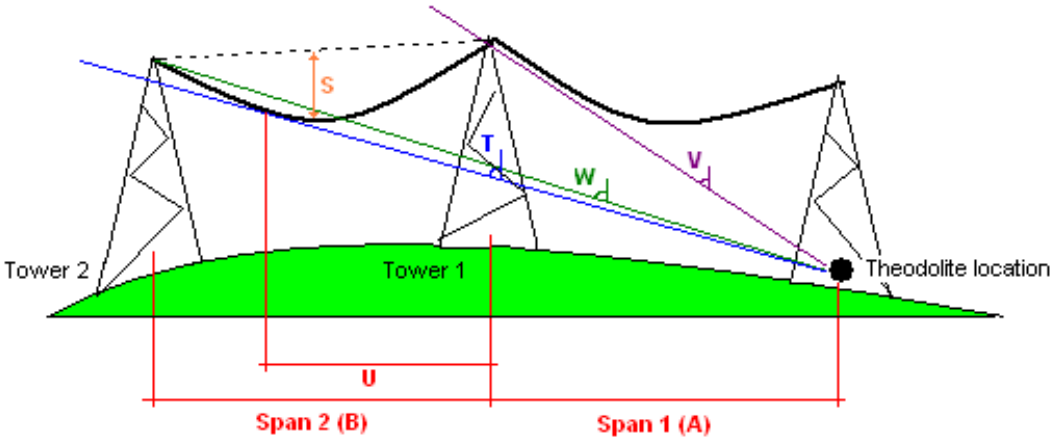


Figure 12: Theodolite-Sag setup

Conductor Sag Tolerances:

Unless otherwise approved, the sag of any one (1) conductor shall not differ from the lowest sag by more than 2%. In any one (1) span the maximum permissible difference in the sag shall not differ from the mean sag of all phase conductors by more than 50mm.

Where there is more than one sub-conductor per phase, the greatest difference in sub-conductor spacing for a vertical or horizontal bundle, shall not exceed one conductor diameter

6.6 Clamping-in of Conductors, Earthwire and OPGW

After completing the tensioning and sagging of the conductors, overhead earth wire or OPGW the cables shall be transferred from sheaves to suspension assemblies and clamped within **7 days** after completion of sagging and permanent tensioning off at tension supports.

HOLD POINT

The linemen/Riggers shall proceed with the clipping in of OPGW and AAAC on each suspension pole. The Linesman/Riggers with the help of the Engineer will first check the Stringing Schedule for the offset in clipping-in. The offset is measurement from the centre where the cable is currently suspended on to the pulley to the centre where it should be clipped.

6.6.1 Use of EWP

Prior to setting up the EWP, a ground stability check shall be done to ensure stability to sit on working site.

The Linesman/Riggers with the EWP shall then mark the cable on the centre where it sits. Before marking the conductor, the Linesman/Riggers shall earth each conductor with standard earth leads to the tower/pole cross-arm which shall earthed through the conductor prior to start clamping-in The Linesman/Riggers shall, work in between two earth leads and they will install the earth leads using hot sticks.

They will also test the conductor with a VDU prior to marking and will only proceed only when the voltage has been dropped to zero. Once the conductors are all marked on all suspension tower/poles, the linesman/Riggers shall start clipping-in.

Clipping-in conductors shall be in accordance with the line fittings and materials manufacturer's recommendation or supplier's instructions. In clipping-in, the Linemen on EWP will start the activity by earthing each conductor, test using the VDU and proceed only when the voltage has been dropped to zero. The Linemen on EWP shall set up the pulling assembly which consists of slings and chain pulls. Min. 1.6t capacity

The conductor shall be pulled up simultaneously on both sides using the chain pull.

Once the conductor is off the sheave of the pulley, a rigging assembly made up of a sling, small single pulley block and long rope which will be installed to the cross-arm of tower. The end of the rigging assembly is attached to the pulley, which then detaches the pulley to the insulator and lowers the stringing single pulley block to the ground.

The Linemen will then wrap the armour rods to the conductor while ensuring that the centre of the rods goes in line with the offset marking. After wrapping all the rods, the Riggers shall connect the suspension clamp to the middle of the armour rods and attach it to final attached point of the insulator using assembly Of aluminium grip suspension unit (AGSU)

The same procedures shall be observed for the rest of the conductors on all suspension towers.

6.7 Offset Clipping

A separate document for conductor offsets clipping will be provided to reference the offset installation as maybe required in some towers prior to clamping-in works.

Following marking on the conductor on the centre where it sits, measure the offset based on the stringing offset schedule provided by the principal.

Based on the schedule, check the offset and determine on the details which side is positive and negative.

The offset marking will be the centre of armouring. Put on the rubber armour grip, make up the structural rod, attach the suspension unit on the centre of armour rod and join them to insulator set

Offset clipping not required if less than 100mm -VE towards the one Sub; +-VE towards the other Sub or as per the approved Stringing Schedule.

6.8 Removal of midspan joint cover

Removal of midspan joint protective oversleeve shall be removed prior to sagging the conductors. An EWP shall be set up and utilised in the removal of conductor midspan joint cover.

On spans where access and set up of EWP is difficult, midspan joint cover shall be removed at the structure before the said span.

6.9 Bridging assemblies and jumper loop installation

The bridging assemblies shall be done after all conductors have been completely terminated to the structure and all the vibration dampers have been installed.

The pre-cut conductors shall be delivered to site with enough length required for the bridging loop.

One end of the pre-cut conductor shall be fitted with jumper palm connector and pressed.

Attached the conductor end with jumper palm connector onto the compression dead end connector flag of the strain insulator assembly.

Temporarily bolt in the jumper palm connector onto the compression dead end connector flag.

Measure the required loop, ensuring that the required electrical clearance is met.

Once the correct conductor loop is determined. Cut the conductor, fit the jumper palm connector and press.

Vertical square rigging technique shall be used to lift and hang the bridging insulator. When lifting the pre-cut conductor for jumper a single pulley will be used with the ropes pulled manually or with the use of winch

6.10 OPGW joint splicing, enclosure installation and commissioning

The OPGW shall be Optical Time Domain Reflectometer (OTDR) tested immediately upon delivery from factory to site. Following the completion of stringing of a section and prior to splicing and jointing another OTDR test shall be conducted on the installed cable.

The OPGW shall be OTDR tested during splicing activity to ensure that the installation methodology or hardware components have not caused attenuation changes to the fibre cable.

All fibre is to be OTDR tested at both 1310nm and 1550nm in one direction.

After the completion of the splicing and jointing of all optical fibre within the joint enclosure, the joint enclosure shall then be lifted and secured to its final position on the structure.

The installation and final positioning of the enclosure shall be as per Client's requirements or in accordance with the cable manufacturer's or supplier's instructions.

During commissioning, OPGW shall be OTDR tested at 1310nm, 1550nm and 1625nm in both directions.

7. Quality Assurance

7.1 Inspection and Test Plan

- ITP-Stringing Conductor, OPGW and OHEW
- Cable Run-out Record
- Insulator and OPGW/OHEW Assembly Installation Record
- Compression Joint Resistance Test Record
- Puller-Tensioner Winch Inspection
- Tower Structure Earthing Record

- Temporary Earthing Record
- Winch-Brake Site Earthing Checklist
- Cable Final Sag and Height Record
- Compression Connection Pressing Record

Appendix A - Responsibilities

Position	Responsibilities
Project Director	• Shall be responsible for ensuring that this procedure is understood and adhered to by all personnel involved; • Subcontractors engaged are trained and competent; and • A risk assessment shall be carried out for all activities in line with the established risk management procedures.
Supervisor	• A formal safe Work Method Statement (SWMS) and a U Take 5 shall be undertaken for high risk tasks; • Personnel engaged in the work activity are trained and competent for the directed tasks; Where required Safe operating procedures are developed for equipment; and • Provide supervision during the work activity to ensure compliance with procedure and SWMS.
Pilot	• To control the helicopter with enough accuracy to ensure that all required clearances are maintained throughout the sequence of work; • To confirm the mechanical and electrical release mechanisms on the helicopter cargo hook are fully operational and in good working condition; • To confirm the serviceability of all stringing equipment to be used in the operation with the brake operator; • To conduct a radio check prior to commencing operations with all personnel with whom communication is required during the operation; • To conduct a work site inspection prior to commencing work in order to identify the proximity of all obstacles / obstructions relevant to the conducting of stringing operations; • To nominate the location of Helicopter Landing Sites (HLS), refuelling locations and emergency set down locations; and • To establish communication protocols will all involved working parties.
Brake Operator	• To communicate with the pilot and advise of any anomalies; • To ensure serviceability of brake and associated equipment; • To control the cable drum to prevent over-running of the draw wire, conductor, earth wire or OPGW as applicable; • To apply or release the brake as per instructions from the pilot; • To ensure the brake is set up in correct alignment with the helicopter flight path; and • To ensure the brake and associated equipment are anchored in accordance with an approved design.
Equipment Operators	• Equipment shall be inspected prior to use to ensure that it is in a safe condition. The equipment shall be checked for damage. Periodic inspections shall be conducted by a competent person and records kept. All equipment is to be fitted with a colour coded tag to indicate the “in service” testing date. Different colours are used quarterly, and equipment operators are to ensure that a current tag is fitted prior to use. If unsure, **DO NOT USE**. Faulty equipment and other items are to be marked or tagged **“FAULTY – DO NOT USE”** and stored separately from useable equipment until repaired or fully destroyed.

	• Plant and Equipment Checklists and Pre-Starts are to be completed daily prior to work commencing.
Load Master	• Ensuring the area remains clear of all non-essential personnel; • Ensuring the loads are rigged correctly; • Ensuring the loads are secured to the helicopter long line hook correctly; and • Communicating with the pilot and advising him/her of any anomalies.
Ground Personnel	• Rigging the loads ready for lifting; • Attaching the load to the long line hook; • Guiding the load clear of the ground; • Stabilising and guiding the load for landing; and • Releasing the load from the long line hook.

Appendix B - Definitions

Term	Definition
OPGW	• Overhead Protection Ground Wire
UGLMS	• UGL Management System for Health Safety Environment and Quality
HSE / HSEQ	• Health Safety Environment / Quality
HLS	• Helicopter Landing Site
SWMS	• Safe Work Method Statement

Appendix C - Stringing Runout Plan

To be provided at a later stage