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GUIDELINE FOR WORKING WITH CRANES AND MECH AIDS AT MF SITES

bai communications

[SEC=PROTECTED]

CONTENTS

1 About this document

Purpose:	The purpose of this document is to guide construction agents, either internal to BA or external client subcontractors, on the mitigation of risk for both RF Field overexposure and RF shocks and burns that may be encountered when using mechanical lifting aids in construction at these types of sites.
Scope:	This document primarily outlines the guidelines that can be used when work on Medium Frequency (MF) sites that require the use of Cranes and other mechanical lifting devices such as Cherry Pickers and winches. This guideline can also be used for work on other sites that have active High Frequency (HF) and Very High Frequency (VHF) high power transmission services.

2 Definitions

The following definitions are used in the body of this document.

Term	Definition
EME	Electromagnetic Emission
RF	Radio Frequency
MF	Medium Frequency
ARPANSA	Australia Radiation Protection & Nuclear Safety Association
RPS3	Radiation Protection Standard Number 3
Crane	Mobile Lifting Mechanical Aid
Cherry Picker	Mobile Lifting Mechanical Aid with Bucket
Induced	Objects being influenced by RF voltage in this context
RFHCD	RF Hazard Control Document
Jumper	Cable used for electrically bonding conductive objects

3 Responsibilities

Role	Responsibility
Rigging Supervisors and Staff	Working knowledge of RF voltage induction earth bonding techniques
Managers	Responsibility for risk mitigation
Third Party Contractors	Working knowledge of RF voltage induction earth bonding techniques

4 Overview

4.1 Precautionary Note

The best practice in mitigating RF induction issues at MF, HF and VHF high power transmission sites is to avoid the installation of additional structures in the first instance. If this approach is not feasible, stringent risk mitigation Methods of Procedures must be put in place to eliminate and/or reduce known affects to appropriate levels.

It is also intended that tasks identified in this document be completed by qualified RF Workers. All mechanical aid operators are also to be qualified RF Workers or under direct supervision of a qualified RF Worker.

Mechanical aid operators shall be interviewed to determine if any internal medical devices such as Cardio Pacemakers are being used. It is recommended that operators with Cardio Pacemakers be restricted from these tasks.

4.1.1 Electromagnetic Emission (EME)

EME levels surrounding re-radiating objects is the physical area around these objects that may be high enough in magnitude to create an exclusion area distance from the object. The exclusion area levels can be described in two ways, as a General Public (non-occupational) exclusion area and an RF aware worker (occupational) exclusion area.

4.1.2 RF shocks and burns

Instances may occur when physical contact is made with a re-radiating object while simultaneously in contact or partial contact with the ground.

4.1.3 Risk of fire ignition (grass lands)

In extreme cases, the risk of rolled RF feeders, cabling, antenna tilt control cables, electrical leads may induce enough RF energy to create large quantities of heat that may combust surrounding flammable fuels such as dry grass, wood, petroleum, explosives. Rolled inducting objects enhance the heating affects as they are tightly bound.

It is important to note that the risk of this is small, but precautions shall be made to minimise this phenomenon by ensuring flammable fuels as those listed above are not present and that if possible or practical, that tightly bound inductive objects should be unrolled.

4.1.4 RF Interference

RF Interference may affect unshielded electronics, this may affect vehicle crane controls, cherry picker controls and other electronic devices near to an active antenna if not properly shielded or earthed. Machines or mechanical aids are required to be function tested to working conditions prior to active works being undertaken.

4.2 Interactions of MF HF and VHF Transmissions

The nature of these services produces RF wavelengths that may be comparable to the physical length of conductive objects. Objects such as Crane booms and associated haul cables, winches and lines can be susceptible to induced energy from distant RF sources.

In simple terms, the mechanical aid may start to mimic an active radiator (antenna) if its physical and electrical properties approach a resonant wavelength of the active services.

Active service frequencies generally differ from site to site, this then creates variations in resonant frequencies and wavelengths that may affect different types of mechanical aids being used.

4.3 Factors Affecting RF Induction

The parameters that determine the amount of induced RF energy are well known, but they vary from different scenarios and are generally site specific.

The main factors are:

- Service type (frequency of operation)

- Type of active radiator (antenna)
- Polarity of active radiator
- Transmission power of active service/s
- Proximity of mechanical aid to active radiator
- Size and shape of mechanical aid
- Position of mechanical aid in the RF Field environment

The many parameters affecting the level of induction from RF Fields is variable, this results in the need for general guidelines that will suit most applications.

RF induction is commonly referred to as re-radiating; this term will be used frequently within this document.

4.4 Mitigation of Known Issues

It is difficult to predict the amount of energy induction that is likely to occur in the many differing scenarios that may be proposed. Below are methods used to reduce associated risks:

- Select appropriate structure installation position in planning stage of build if building at MF, HF and VHF high power transmission sites.
- Switch transmission *OFF* to eliminate RF energy induction and if applicable, conduct works at night, or reduce service transmission power to an acceptable level to minimise RF energy induction.
- Detuning of structures to minimise RF induction.
- Connecting conductive leads between mechanical aid vehicle body, boom, lifting hook, cage and load to earth to discharge RF voltage induction.
- Ensure that crane or cherry picker vehicle electronic controls are well shielded (refer manufacturers specifications) as this may cause electronic controls to cease working or work in an abnormal manner.
- Use fully hydraulically controlled cranes and other mechanical lifting aids if possible.
- Minimise the hauling cable length to reduce RF voltage induction.
- Unrolling of long lengths of feeder cables, antenna tilt control cables.
- Removal of flammable fuels from the vicinity of the works area.
- Use of insulated rubber soled footwear and electrical or sturdy leather gloves (PPE).

5 Methods of earthing Conductive Objects

5.1 Working with Mobile Cranes

It is advisable that crane positioning, prior to setup, is under supervision by an appropriate qualified RF worker. It is envisioned that BA personnel be given this role to guide the crane operator.

IMPORTANT NOTE: At no time is a mechanical lifting aid to come into contact with an active radiator (antenna).

5.1.1 Function Tests

It is important to verify the type of cranes that should be used, cranes are to be function tested at site under working conditions to verify that crane controls are not suffering from RF interference. If operation is abnormal then a review of onsite conditions shall be conducted and/or the crane will require replacement to a full hydraulic controlled model.

5.1.2 Crane turrets, booms and vehicle body

All the major parts of the crane must be temporarily connected to a number (minimum 4, one for each stabilizer) of earth stakes driven into the ground approximately 1200mm. Copper clad earth rods are the best solution, but galvanised star pickets can be used as a substitute. Note that painted stakes/rods are not sufficient as the painted surface negates contact with the ground.

Cable from the stakes/rods should be a minimum of 16mm^2 surface area depending on length, if longer lengths are required, a larger cable size (35mm^2) should be used. Cables are to be bolted or clamped to the stakes/rod to ensure a firm connection.

Common (600Amp) automotive jumper cables and alligator clamps will suffice if no other products are available as a temporary measure.

IMPORTANT NOTE: All connections must be made at the earthed end of the cable first and then to the object to be earthed, otherwise the operator will be the earthing route instead of the cable/stake and may result in an RF shock or burn.

5.1.3 Steps to earth crane body, boom and turret

Step 1: Using insulating gloves and footwear, connect the pre-installed earth stakes/rods to the crane body, by attaching one cable to each of the crane stabilisers (usually 4) by connecting to the earth stake/rod first and then to the crane body.

Step 2: Using insulating gloves and footwear, connect the crane body to the crane turret by attaching a cable by connecting to the crane body first and then to the crane turret.

Step 3: Using insulating gloves and footwear, connect the crane turret to the crane boom by attaching a cable by connecting to the crane turret first and then to the crane boom.

Refer figure 1.

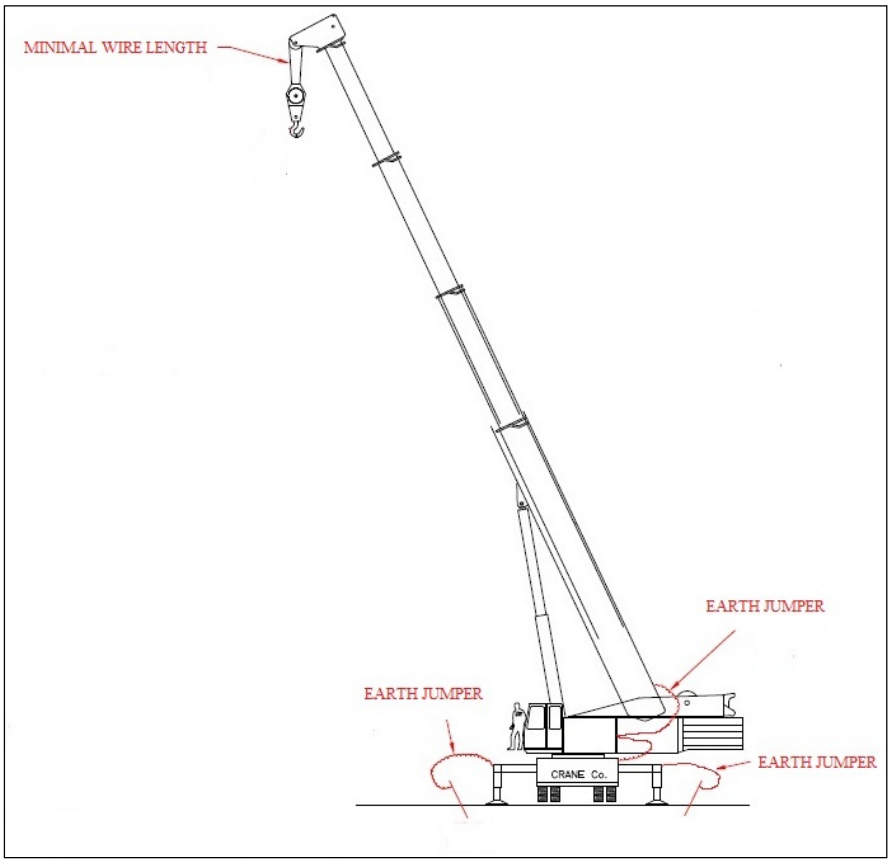

Figure 1

5.1.4 Crane lifting hook and loads

The crane lifting hook requires to be earthed, this can be achieved by attaching an earthing cable to a ground earth stake whilst loads are attached. This will allow handling of the hook and sling/chains to affix load.

An additional earth cable is required to connect the load (only if load is of a conductive nature) to the lifting hook, this will extend the RF induction to the load, which will be once again earthed when lifted into position.

Once the load is affixed to the lifting hook and the load earth cable is in place, then the hook earth cable to ground stake/rod can be removed at the hook end only to enable the lift.

5.1.5 Steps to earth crane lifting hook and loads

Step 1: Using insulating gloves and footwear, connect the pre-installed earth stake/rod to the lifting hook by attaching a cable by connecting to the ground stake/rod first and then to the lifting hook.

Step 2: Using insulating gloves and footwear, connect lifting hook to the load by attaching a cable by connecting to the lifting hook first and then to the load.

Step 3: Using insulating gloves and footwear, disconnect the lifting hook from the ground earth stake/rod by disconnecting the cable at the lifting hook only and lay aside by the earth stake for use for reloads or for when hook it at rest or at ground level.

Refer figure 2a & 2b.

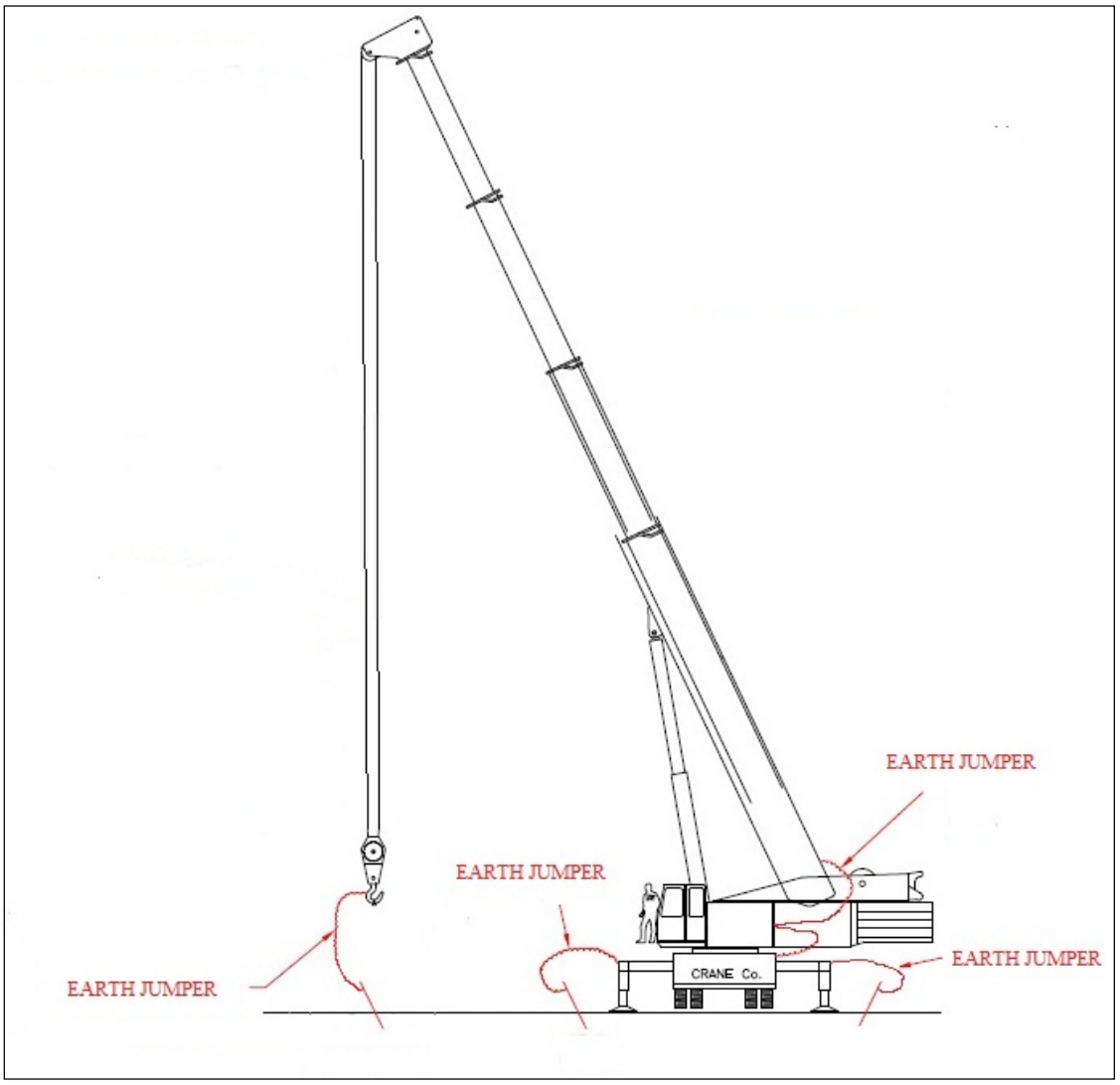

Figure 2a

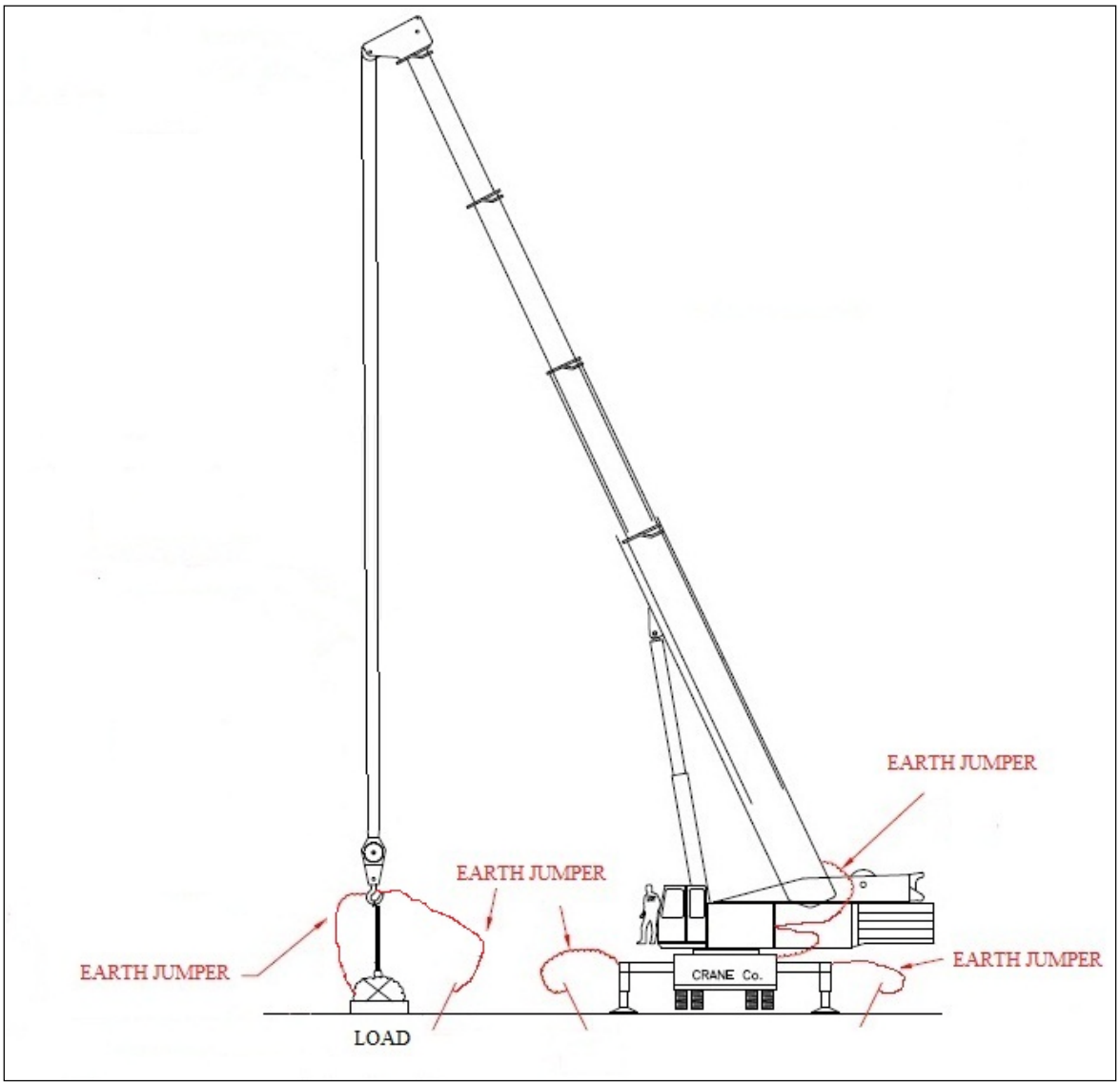
EARTH JUMPER
EARTH JUMPER
EARTH JUMPER
EARTH JUMPER
CRANE Co.
LOAD

Figure 2b

5.1.6 Crane lifting hook and load at working height

The lifting system is now totally earthed at all appropriate points, the load now requires earthing to the structure. When the load gets near the structure a worker is required to earth it to the structure by using another cable attached to the structure first and then the lose end is attached to the load.

This will allow the load to come into contact with the structure and be unhitched, once this is complete, the "hook to load" cable will need to be disconnected from the lifting hook so that the hook is released and the lifting system can be removed from the structure.

5.1.7 Steps to earth crane lifting hook and load at working height

Step 1: Using insulating gloves and footwear, connect the structure to the load prior to handling the load, by attaching a cable by connecting to the structure first and then to the load.

Step 2: Using insulating gloves and footwear, secure the load on the structure.

Step 3: Using insulating gloves and footwear, unhitch the load at the lifting hook and then disconnect the "hook to load" cable at the hook end only.

Step 4: Using insulating gloves and footwear, disconnect the "structure to load" cable at the load end first as this is no longer required.

Step 5: If additional lifts are required, repeat steps 1 to 4 above.

Refer figure 3.

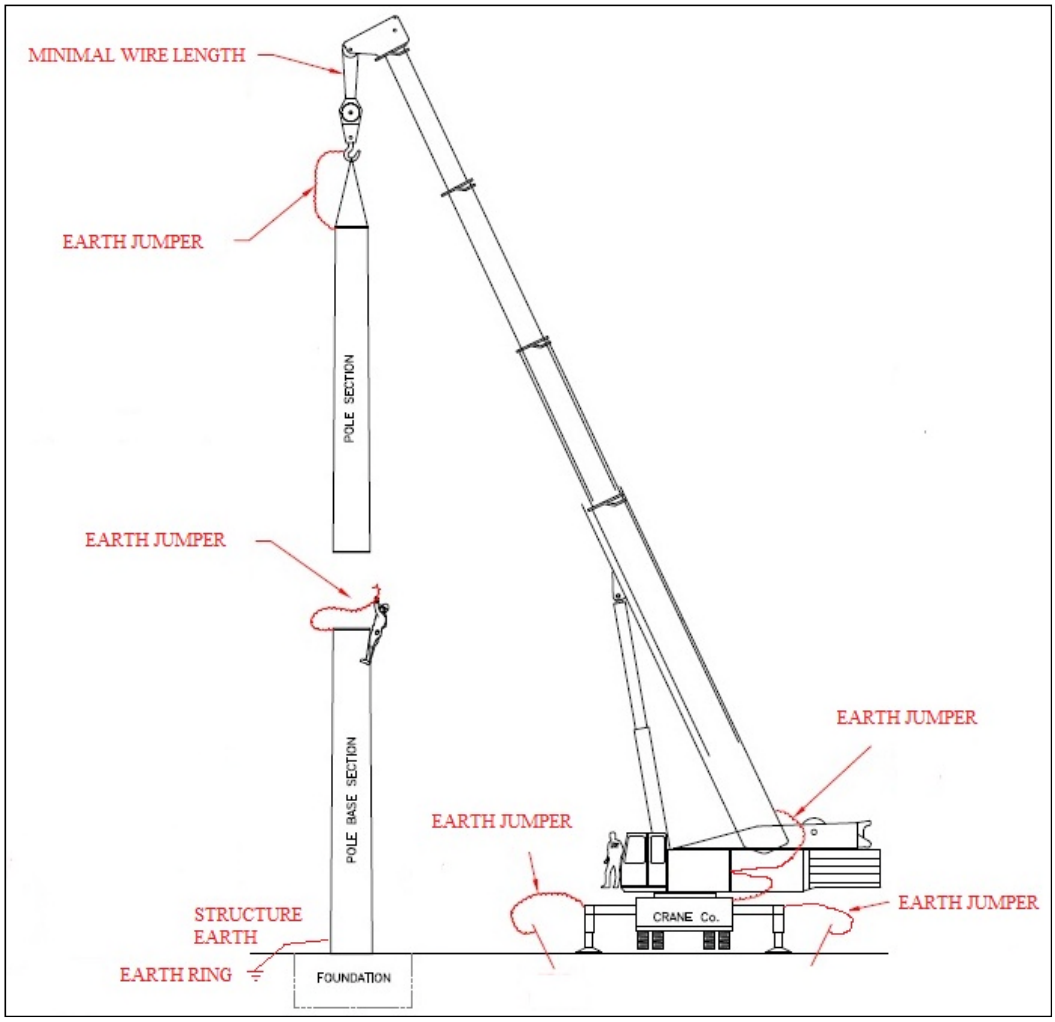

Figure 3

5.2 Working with Cherry Pickers

It is advisable that cherry picker positioning, prior to setup, is under supervision by an appropriately qualified RF worker. It is envisioned that BA personnel be given this role to guide the operator.

IMPORTANT NOTE: At no time is a mechanical lifting aid to come into contact with an active radiator (antenna).

5.2.1 Function Tests:

It is important to verify the type of cherry picker that should be used, cherry pickers are to be function tested at site under working conditions to verify that the controls are not suffering from RF interference. If operation is abnormal then a review of onsite conditions shall be conducted and/or the cherry picker will require replacement to a full hydraulic controlled model.

5.2.2 Cherry Picker booms, cages and vehicle body

All the major parts of the cherry picker must be temporarily connected to a number (minimum 4 or one for each stabilizer) of earth stakes driven into the ground approximately 1200mm. Copper clad earth rods are the best solution, but galvanised star pickets can be used as a substitute. Note that painted stakes/rods are not sufficient as the painted surface negates contact with the ground.

Cable from the stakes/rods should be a minimum of 16mm^2 surface area depending on length, if longer lengths are required, a larger cable size (35mm^2) should be used. Cables are to be bolted or clamped to the stakes/rod to ensure a firm connection.

Common (>200Amp) automotive jumper cables and alligator clamps will suffice if no other products are available as a temporary measure.

IMPORTANT NOTE: All connections must be made at the earthed end of the cable first and then to the object to be earthed, otherwise the operator will be the earthing route instead of the cable/stake and may result in an RF shock or burn.

5.2.3 Steps to earth Cherry Picker body, boom and cage

Step 1: Using insulating gloves and footwear, connect the pre-installed earth stakes/rods to the cherry picker body, by attaching one cable to each of the stabilisers (usually 4) by connecting to the earth stake/rod first and then to the cherry picker body.

Step 2: Using insulating gloves and footwear, connect the cherry picker body to the cherry picker boom by attaching a cable by connecting to the cherry picker body first and then to the cherry picker boom. The cherry picker cage should be well connected electrically to the boom due to the physical attachment to the boom.

This will allow the cherry picker to be raised and lowered and used as independently stand alone or in conjunction with an at height works area on a structure.

Refer figure 4.

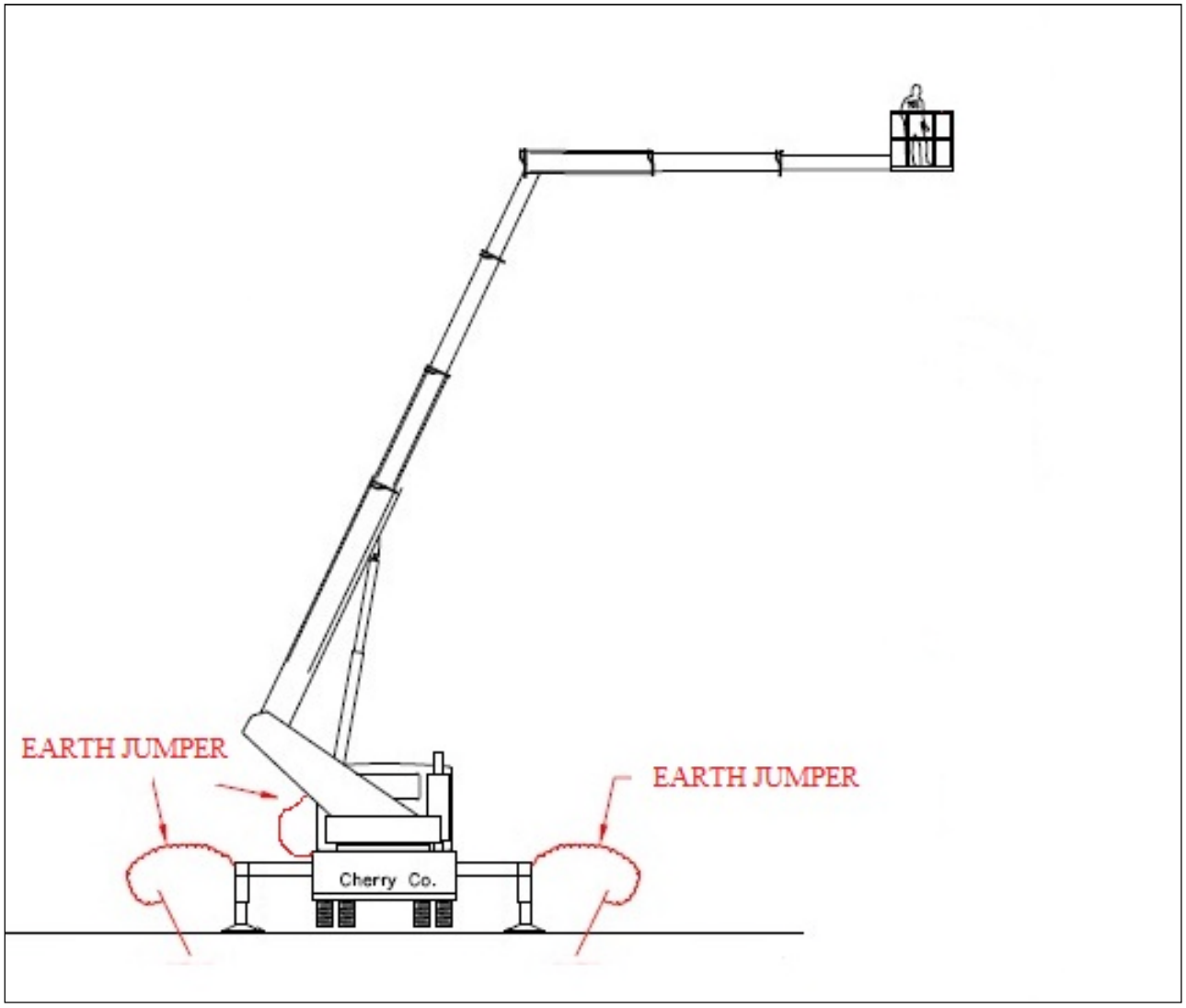

Figure 4

5.2.4 Cherry Picker cage at working height

The lifting system is now totally earthed at all appropriate points, the cage now requires earthing to the structure. When the cage gets within near the structure a worker is required to earth it to the structure by using another cable and attaching it to the cage first, and then the lose end is attached to the structure. This will equal bond the cage to the structure if desired.

5.2.5 Steps to earth cherry picker cage at working height

Step 1: Using insulating gloves and footwear, connect the cage to the structure prior to contacting the structure, by attaching a cable by connecting to the cage first and then to the structure.

Step 2: When tasks are complete, using insulating gloves and footwear, disconnect the "cage to structure" cable at the structure end only in preparation for lowering.

Step 3: If additional lifts are required, repeat steps 1 and 2 above.

Refer figure 5.

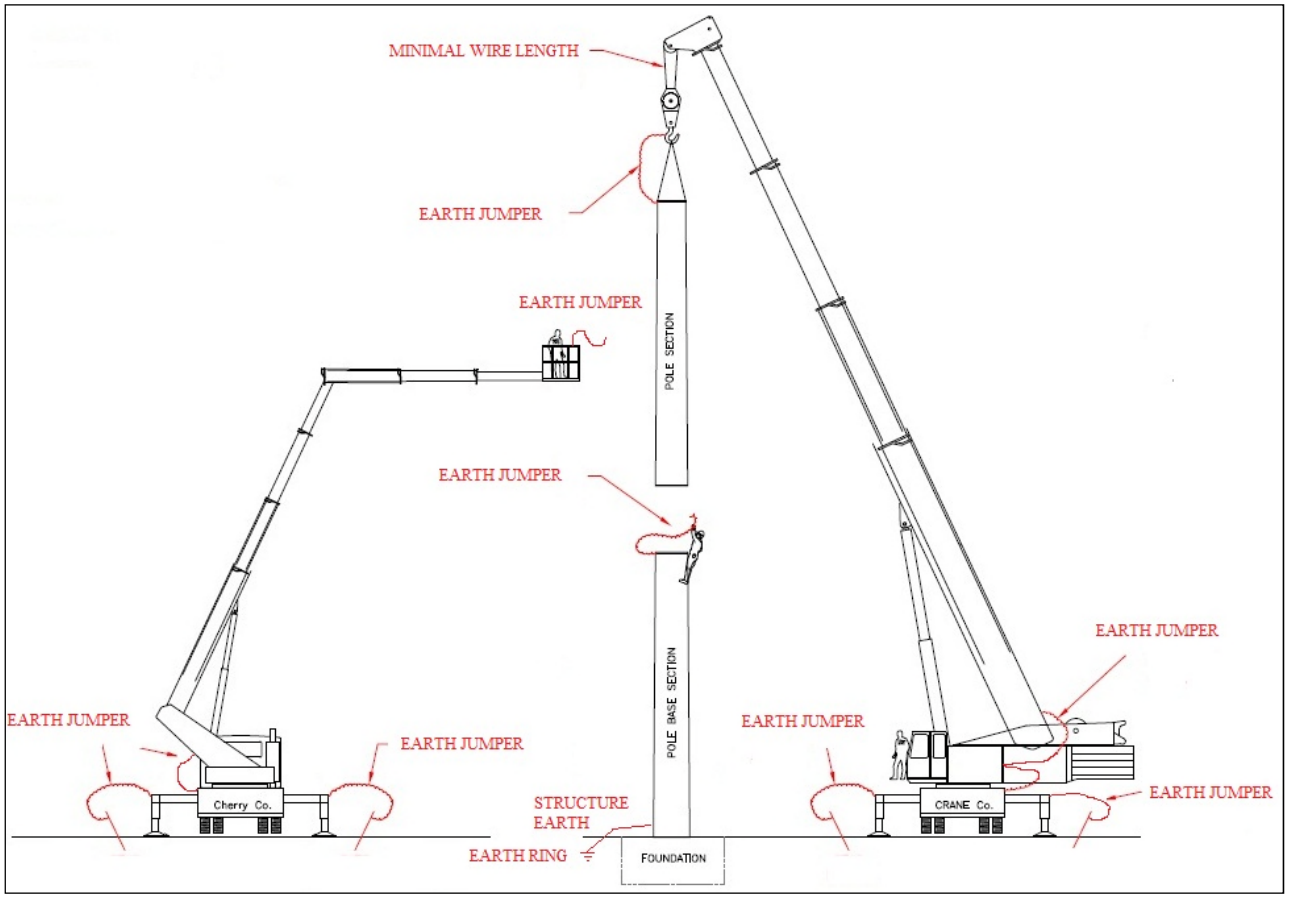

Figure 5

1.1 Working with Winches

It is advisable that winch positioning, prior to setup, is under supervision by an appropriately qualified RF worker. It is envisioned that BA personnel be given this role to guide the winch operator.

The use of winches is common to haul objects to heights for installation, the winch wire when extended may be subject to induction of RF energy the same way that happens to crane booms and cable. To negate this, earthing techniques can eliminate or reduce this to acceptable levels.

IMPORTANT NOTE: At no time is a mechanical lifting aid to come into contact with an active radiator (antenna).

5.2.6 Function Tests:

The electronics in winches do not routinely require function testing, as they do not have electronics that are susceptible to RF interference.

5.2.7 Winch at ground level and at working height

The winch body must be temporarily connected to an earth stake/rod driven into the ground approximately 1200mm. Copper clad earth rods are the best solution, but galvanised star pickets can be used as a substitute. Note that painted stakes/rods are not sufficient as the painted surface negates contact with the ground.

Cable from the stakes/rods should be a minimum of 16mm^2 surface area depending on length, if longer lengths are required, a larger cable size (35mm^2) should be used. Cables are to be bolted or clamped to the stakes/rod to ensure a firm connection.

Common (600Amp) automotive jumper cables and alligator clamps will suffice if no other products are available as a temporary measure.

The haul wire requires earthing if it is constructed from a conductive material, it is earthed to the structure at the working height prior to handling by using a cable to the structure.

IMPORTANT NOTE: All connections must be made at the earthed end of the cable first and then to the object to be earthed, otherwise the operator will be the earthing route instead of the cable/stake and may result in an RF shock or burn.

5.2.8 Steps to earth winches and cable at working height

Step 1: Using insulating gloves and footwear, connect the pre-installed earth stake/rod to the winch body, by attaching a cable by connecting to the stake/rod first and then to the winch body.

Step 2: Using insulating gloves and footwear, connect the structure to the lifting hook at the end of the haul wire by attaching a cable by connecting to the structure first and then to the winch wire hook.

Step 3: When load is secured (both lifted or descending) and the winch wire hook is no longer required or another lift is necessary, disconnect the earth cable from the winch wire hook first and put aside ready for the next lift.

Step 4: If additional lifts are required, repeat steps 2 and 3 above.

Refer to figures 6a & 6b.

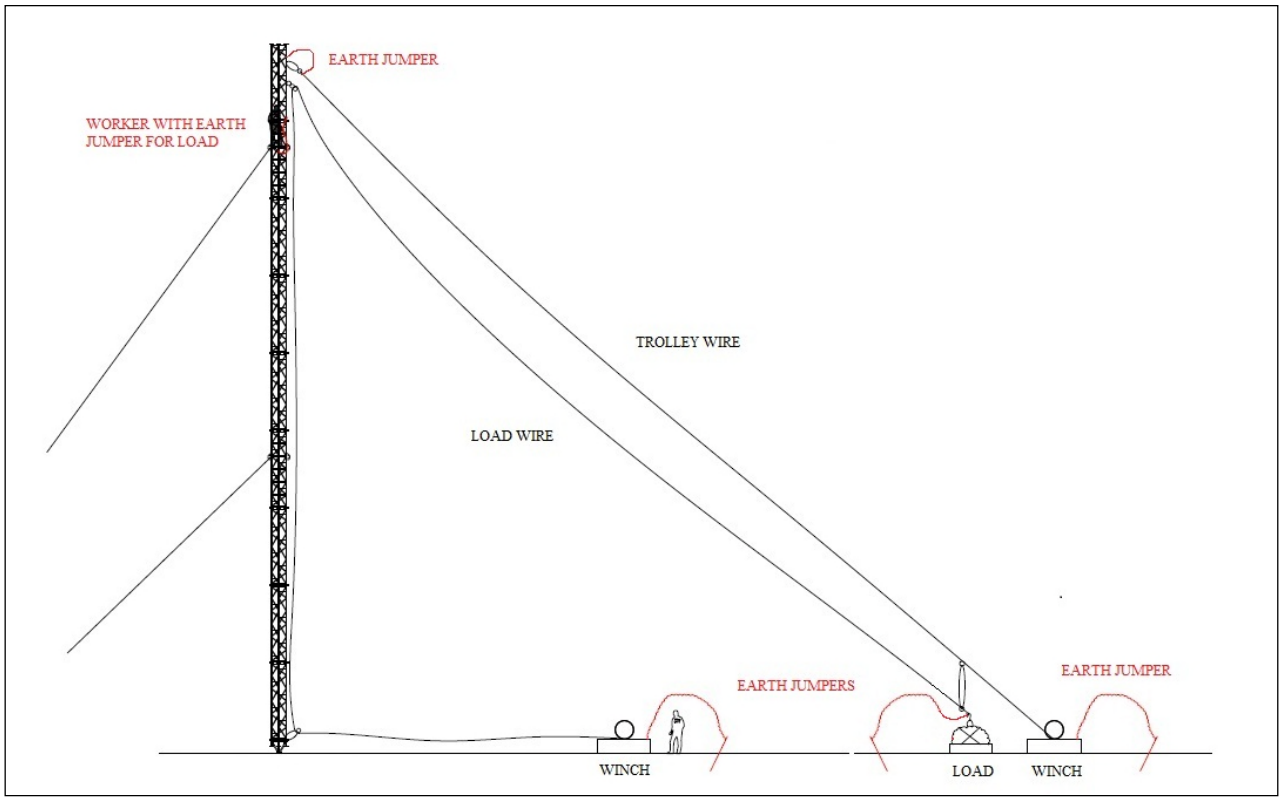

Figure 6a

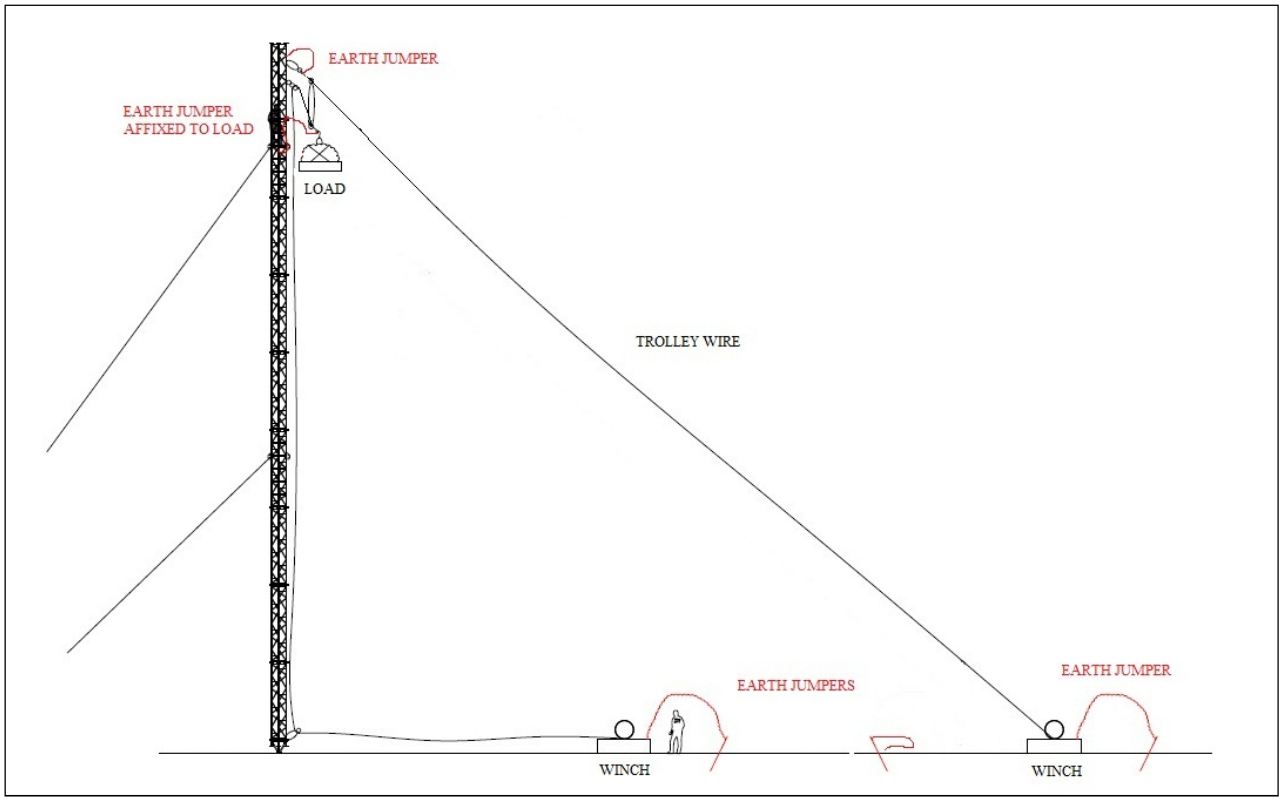

Figure 6b

6 Related Documents

6.1 Internal Documents

Document Number	Document Title
HSEQ-PRS-0013	EME Hazard Management

6.2 Compliance Requirements

Applicable	Document Title
ARPANSA RPS No. 3	ARPANSA Radiation Protection Standard Number 3 Maximum Exposure Levels to Radiofrequency Fields 3kHz to 300 GHz

7 Document Control

7.1 Approval

The following table lists personnel who are responsible for authorising the document:

	Title	Name	Signature	Date
Approver	Antenna and Structures Manager	Grant Shapcott	*Maintained on file*	27/09/2019

7.2 Document History

The following table lists the changes made to this document:

Version	Date	Amended by	Comments
R1	10/08/2019	Lincoln O'Grady	Initial Release
D2.1	27/09/2019	Lincoln O'Grady	Draft for Review
V3.0	08/11/2019	Lincoln O'Grady	Version for Release