



REPORT

# Polesight Installation Guide



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# 1. Background and Introduction

EA Technology is working with Northern Powergrid (NPG) to advance the techniques of LV Pole mounted substation monitoring to develop and test novel pre-fault detection and location techniques.

The purpose of the Polesight project is to capture and investigate events on Northern Powergrid's LV Overhead Line (OHL) network that could signal an imminent fault on the line that could interrupt a customer's supply. EA Technology previously developed equipment and techniques to achieve this for LV underground networks for the Foresight project for Northern Powergrid.

## 1.1 Scope

This guide covers the installation methodology for both the EA Technology ALVIN® Guard and VisNet® hubs within their external enclosures as required by the Polesight Monitoring project.

The installation guide will cover:

- Ensuring site suitability.
- How the devices will be supplied by EA Technology.
- The installation process for the Guard.
- The installation process for the VisNet.

Any documentation, from either EA Technology or Northern Powergrid, referred to within this document will be noted clearly and the document will be supplied alongside this installation guide.

## 1.2 Approach to Installation for the Polesight Project

As directed by Northern Powergrid, installers on the Polesight project will have both Guards and VisNets available to install at sites to which they are directed. Personnel on this project must have completed the appropriate training to install the Guard and VisNet hubs.

# 2. Definitions

**IPC**            Insulation Piercing Connection

**LOA**            Limitation of Access

### 3. Referred Upon Documentation

This document provides instructions for installing Guard and VisNets as provided for the Polesight Monitoring Design Specification. Devices not installed as part of this project may have different installation requirements and should follow the relevant EA Technology provided documentation to ensure full and proper set up.

**Table 1** List of Documents

Name	Author
NSP/004/120 (OHI 20) Guidance on Mounting Overhead Line Plant and Equipment on HV Poles	Northern Powergrid
EA9744-TR01 - Polesight Monitoring Design Specification	EA Technology
3277-MANUL-S001-V01.03.00 -VisNet Hub Installation Guide	EA Technology
3521-MANUL-V0.1.05.00 – Guard Operating Manual	EA Technology
EA9744-TR05 Polesight Installation Checklist	EA Technology

### 4. Northern Powergrid Authorisations

A two-person linesman team is required for Polesight installations. The following authorisations will be required to carry out an install:

- 03 – LV overhead switching.
- 03.4 Fitting of LV monitoring equipment.
  - 03.4 was used in the past for data loggers fitted with Rogowski coils.
- W3 – Live overhead work.
  - W3 is required to install IPCs (Insulating Piercing Connectors).
- Equipment fitted to NPg overhead lines generally needs to be in accordance with NSP/004/120.

For the Polesight project, installations will only be carried out where it is not necessary to take an outage on the HV (11kV or 20kV) network. To avoid requiring an outage there must be a safety clearance of 1.1m between any part of the installer and the nearest exposed live HV conductor at all times during the installation. Some substations are not suitable as the neutral cable between transformer neutral bushing and the LV overhead lines does not drop down the pole far enough so it is not possible to attach the required IPC or Rogowski coil.

The device will be installed above the anti-climbing guard. Where a clearance less than 3m (but greater than 1.1m) is required, an Authorised Person is required to issue a Limitation of Access (LOA). A two-person team with one person being an Authorised Person is the preferred arrangement.

## 5. Site Suitability and Set Up

For the Polesight project, sites have primarily been chosen due to their fault history. A larger number of sites were chosen than will be monitored to account for the fact that upon further inspection some will not be suitable for installing the Guard and VisNet monitors. For this project it has been decided that the installers will make the final decision on whether a site will be suitable for the installation.

Any site intended for Guard or VisNet installation is required to have a suitable strength 4G signal to allow communication between the monitoring system and the server. This is not anticipated to be an issue but to ensure the successful installation of the monitors the signal strength should be checked before installation.

The sites chosen for this project have had the signal strength requirement accounted for and EA Technology have quantified the minimal effect of the Guard or VisNet being situated within the enclosure.

Working in adherence with NPg standard practice for installing equipment on poles, the Guard or VisNet hubs will be installed above the anti-climb guard and below the transformer. The device must be situated in a location that does not infringe on the working and access safety clearances.

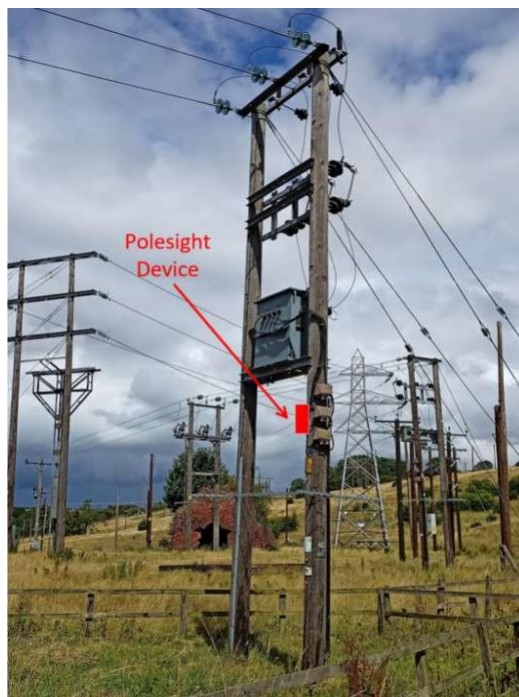


Figure 1 Polesight Monitor General Location

Both types of monitors will be attached using coach bolts embedded into the pole as supplied by NPg in line with existing ways of working for installing devices to poles. The first bolt will be placed in the desired location and the monitoring device will be securely hung from it while the second bolt secures it to the pole.

If there is not enough room on the pole(s) to safely attach the monitor then that site will not be used in this project.

## 6. Safety Information



Completely isolate the monitor prior to replacing any fuses. **Changing a fuse whilst other phases are still connected could result in electric shock.** Refer to the maintenance and service for instructions on how to safely replace the fuses.



Follow safe electrical working practices as specified in local and national work instructions and codes. Use appropriate PPE as required.



Inspect all equipment for damage. Do not install a component if it is visibly damaged.



The monitor should be installed in the vertical orientation, with cable entrance to the enclosure facing down, to maintain IP Rating.



Always connect the neutral supply before any phase. Always disconnect the neutral last.



Ensure excess cabling is secured if necessary.



It is not intended for use as a metering device or in safety-critical applications.



All voltage terminals should be considered live when any terminal is connected, including neutral.



Any modification to the leads presents a risk of electric shock and therefore requires appropriate precautions to be taken.



Without additional precautions, do not apply Rogowski Current Sensors around or remove from UNINSULATED HAZARDOUS LIVE conductors, which may render electric shock, electric burn, or arc flash.

When installation on or removal from HAZARDOUS LIVE conductors that cannot be de-energised is necessitated, the operator must conduct a risk assessment and use appropriate PPE to avoid risk of electric shock.



## 7. ALVIN<sup>®</sup> Guard Installation

The Guard will come pre-installed in an external enclosure ready to be fitted to the desired pole. The voltage cables will be attached and connected to the fuses within the enclosure.



Figure 2 Polesight Guard with voltage cables connected

### 7.1 Initial Set Up

The exterior of the Guard displays its current operating status, indicating faults with communication, power supply or general operation.



Figure 3 Guard External Label.

**Table 2** Guard Indicators

Indicator	Status
<b>Power</b>	Off: unit not powered Red: unit is powered
<b>Status</b>	Green: all systems working Green flashing: An event is being sent
<b>Comms</b>	Amber: communication link is OK Amber flashing: Attempting to establish a communication link Off: no communication link
<b>Signal Strength</b>	Green: Excellent signal strength Amber: Medium signal strength Red: Bad signal strength Off: no signal connection
<b>Channel 1-8</b>	Green: Current channel connected Flashing: Error while trying to read the calibration Off: Channel disconnected

For safe operation, the following requirements exist for devices installed as part of the Polesight Project:

1. The Brown, Black and Grey leads of the Voltage Cable will be supplied connected to the fused terminals in the external enclosure.
  - a. The fuses used will have a breaking capacity of 50kA. Replacement fuses must be of the same type and rating.
2. The inrush and surge current of the Guard has been carefully controlled to ensure reliable operation (fuses do not blow in normal operation) with 500mA quick-blow (F) fuses and 250mA time-delay (T) fuses. These fuses are provided by EA Technology in the fused terminal blocks.
3. The Blue (Neutral) Lead of the Voltage Cable is connected to the unfused terminal.

Always connect the neutral supply before any phase. Always disconnect the neutral last.

## 7.2 Installing Guard Voltage Cables

The Guard needs to be connected to the feeder circuits to provide power and to measure the feeder voltages.

1. Fit the voltage lead from the unfused terminal to the appropriate neutral phase using the Insulation Piercing Connection (IPC).
2. Fit the voltage leads from the fused terminals to the appropriate phases using IPCs. These leads will be labelled according to the phases they will monitor.
3. Once the voltage leads are connected, the power LED should switch on, and the Comms LED should start flashing soon after.



Figure 4 IPC Connection

### 7.3 Installing Current Sensors

The correct number of Guard Rogowski Current Sensors should be connected to the Guard before the unit is attached to the pole. This will allow for the weatherproof cable glands to be correctly installed and checked before the unit is installed. 4 current sensors are required per feeder for the Guard and the unit can monitor up to two feeders for a maximum of 8 connected sensors.

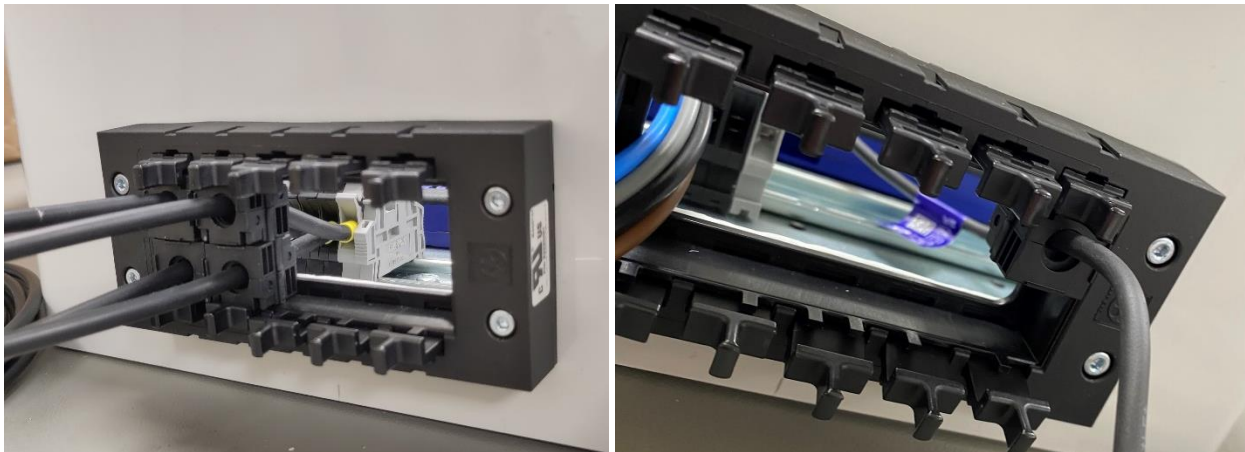


Figure 5 Cable glands allowing the pass through of the voltage leads (left) and the Rogowski sensors (right)

For the purposes of the Polesight project four Rogowski current sensors will be supplied, pre-installed, to NPg to reduce the set-up time once on site.

It is recommended that channels 2, 4, 6 and 8 are used to monitor one feeder as this allows easier installation of the cables and also provides better spacing for running the cables through the gland. The Guard devices will primarily be used to monitor single feeders and split phase feeders, which require four and three current sensors for monitoring.

Once the correct number of sensors are connected, the cover of the Guard can be reattached before the enclosure is lifted up to the attachment location. This ensures the device is IP54 rated before the enclosure is locked.

To install the current sensors:

1. Work in the order of the channels (1-8) to fit the Rogowski current sensors to the relevant feeder.
  - a) Start with channel 1 and work to channel 4 for the first feeder.
  - b) If a second feeder is being monitored, then use channel 5 and work to channel 8.
2. The letter on the heat shrink indicates the polarity when fully tightened. K is for Transformer; L is for Load.
3. Note what phase each channel has been connected to in the NPg Polesight Commissioning Checklist.
4. The corresponding LED on the label will light up when the connection is made.
5. Repeat steps 1 to 5 until all Rogowski sensor cables have been installed.

## 7.4 Guard Commissioning

For the Polesight project the monitors are pre-commissioned ahead of installation to reduce time spent onsite and to remove the requirement for installers to have portable computers available for commissioning as this is not standard kit for linesmen in NPg.

The NPg Polesight Commissioning Checklist<sup>1</sup> being correctly filled out will ensure that EA Technology can be confident of what is being monitored. This includes taking photographs of the connections, including the orientation of Rogowski coils. If there is a perceived error in the data, the photos will be used to check the installation before mobilising personnel to the site.

## 7.5 Final Checks Before Leaving Site

Before leaving site ensure no trailing cables are left. Cables should be suitably bundled and secured to the pole to reduce movement and possible damage.



Figure 6 The connections can be seen tied up and secured

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<sup>1</sup> Issued alongside this document.

## 8. VisNet<sup>®</sup> Installation

The VisNet Hub for the Polesight project comes pre-installed in an external enclosure that can be directly attached to the pole.



Figure 7 NPg Polesight VisNet as installed

### 8.1 Initial Set Up

The exterior of the VisNet Hub displays the units current operating status indicating faults with communication, power supply or general operation. VisNets provided for this project will come with the correct number of current sensors connected to reduce the need for set up before installation.

If there is a need to install further VisNet Rogowski sensors the cover can be removed. Upon removal of the VisNet Hub enclosure cover the sensor connection points are available. Connections are clearly labelled with appropriate fuse and rating information prominently displayed as detailed in Figure 8.

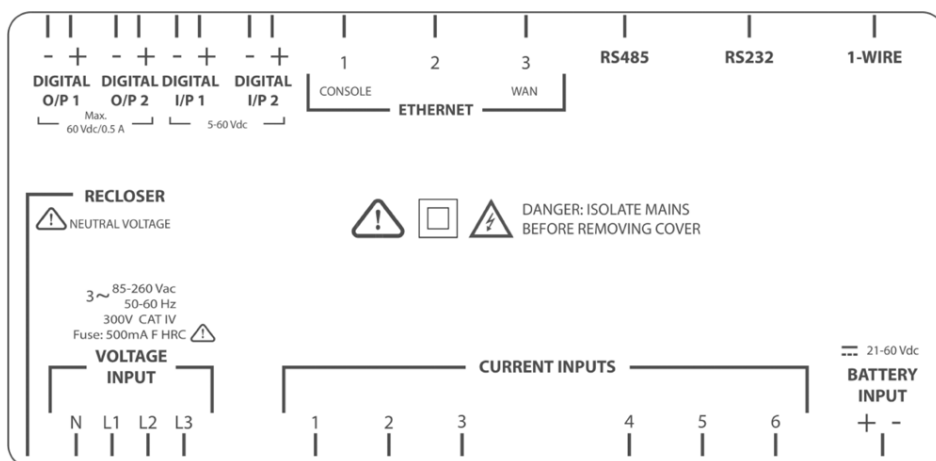


Figure 8 VisNet Hub Diagram

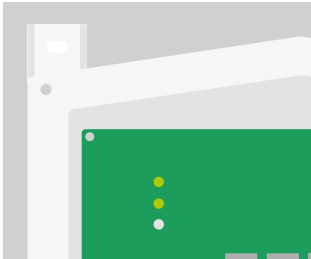
Sensor connections are facilitated through industry standard connectors with all cabling managed through a securing rack at the base of the unit. IP rating is ensured via a compression seal across the cable entry of the enclosure allowing for quick installation and the use of pre-terminated cables.



## 8.2 Installing Voltage Cables

The VisNet Hub is to be connected to the LV Phases using the Voltage Cable supplied. When neutral plus any one phase is connected power will be applied to the unit. The neutral phase should **always be connected first**.

1. Fit the voltage lead from the unfused terminal to the **neutral phase**.
2. Fit the voltage leads from the fused terminals to the appropriate phase cables, the voltage cables will be numbered ensure correct installation.



Two minutes after the power being applied to the Unit, the 3 x LEDs should be:

Power- Green

Status - Green

Comms - Off

## 8.3 Installing Current Sensors

The correct number of VisNet Rogowski Current Sensors should be connected to the VisNet before the unit is attached to the pole. This will allow for the weatherproof cable glands to be correctly installed and checked before the unit is installed. 1 current sensor set is required per feeder for the VisNet monitor and the unit can monitor up to 6 feeders for a maximum of 6 connected sensor sets.

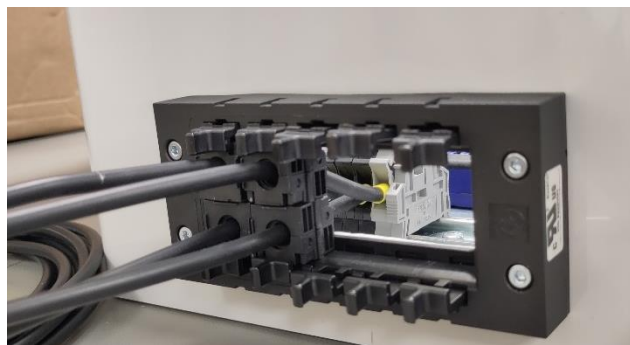


Figure 9 Cable Gland before the current sensors have been installed

Once the correct number of sensors have been connected, the cover of the VisNet can be reattached before the enclosure is lifted up to the attachment location.

Recommended installation sequence:

1. Connect the Rogowski current sensor cable to a VisNet Hub current input channel.
2. Any current input channel may be used but it is recommended to start with the left most connection, marked 1.
3. The LED on the PCB will light up when the connection is made.
4. Keep a note of what current channel the Rogowski has been plugged in as it will be needed for the commissioning.
5. Fit the individual Rogowski coils to the relevant L1, L2, L3 or Neutral Cables.
  - a. The letter on the heat shrink indicates the polarity when fully tightened: K is for Transformer, L is for Load.
6. Cable Tie the Rogowski Current Sensor Cable securely to pole.
7. Repeat 1 to 6 until all Rogowski Sensor Cables have been installed.

Once all current sensors have been installed the following steps can be taken while operative is on the ground.

8. Use EA9744-TR05 Polesight Installation Checklist to record Way number and VisNet Current Input number.



Figure 10 Rogowski Current Sensors for VisNet

## 8.4 VisNet Hub Commissioning

For the purposes of this project the VisNets installed will be commissioned by EA Technology using the information noted in the Installation Checklist provided for this project.

The NPg Polesight Commissioning Checklist being correctly filled out will ensure that EA Technology can be confident of what is being monitored. This includes taking photographs of the connections, including the orientation of Rogowski coils. If there is a perceived error in the data, the photos will be used to check the installation before mobilising personnel to the site.



Figure 11 Correctly secured trailing cables bundled neatly across poles

## 8.5 Final Checks Before Leaving Site

Before leaving site ensure no trailing cables are left. Cables should be suitably bundled and attached to the pole to reduce movement and possible damage.

The VisNet monitor indicators within the external enclosure should be checked before securing the cabinet door.

**Table 3** VisNet Indicators

Indicator	Version
Power	<ul style="list-style-type: none"><li>● Off: unit not powered.</li><li>● Green: unit powered.</li><li>● Amber: L1/L2/L3 voltage error – any phase outside statutory limits.</li></ul>
Status	<ul style="list-style-type: none"><li>● Green: all systems working.</li><li>● Amber flash: sensor error detected.</li></ul>
Comms	<ul style="list-style-type: none"><li>● Off: communications not started yet.</li><li>● Green on: communication link OK.</li><li>● Green flash: communication in progress.</li><li>● Red: communications error connecting to LV Cloud.</li></ul>

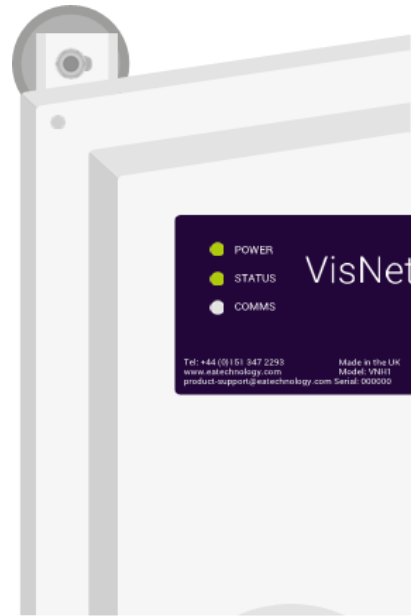


Figure 12 VisNet Indicator Lights



## 9. Types of Installations

The majority of the installations on the Polesight projects are expected to be on single feeder substations. Provided the poles are free of vegetation, in good condition and have suitable space for the monitor to be attached while avoiding interactions with the fuses, the install will be as previously described. Some other cases have been identified and are described below.

### 9.1 Two or More Feeders

The next most common substations will be those that feed more than one circuit. For example, [Error! Reference source not found, Figure 13](#), shows a two-feeder substation where each set of fuses is attached to a separate pole. This will provide some level of difficulty in both placing the monitoring hub and attaching the current sensors to the second monitored feeder.

All standard steps for installing the monitoring hubs should be followed and correctly choosing the length of the second set of Rogowski leads will ensure that both feeders can be monitored. EA Technology provides Rogowskis in varying lengths (Guard: 1.5m and VisNet: 3m, 6m and 9.5m) so in cases where the distance between the two poles extends beyond 1.5m a VisNet Hub would need to be used.

This is an important consideration when choosing the equipment to be installed on a site before the installation activities begin.



Figure 13 Two feeders with fuses on separate poles

However, where Figure 13 shows a relatively ideal set up for two feeders to be monitored, not all pole mounted substations are the same. [Error! Reference source not found, Figure 14](#) has both sets of the feeder fuses situated on the same pole. In this case, positioning of the monitoring unit to allow safe installation and adequate connection to all feeder phases will be more difficult.

In this case, it is suggested that the monitoring unit is attached to the pole not carrying the fuses and the connections are all made like the second feeder connection on a standard two feeder set up, like Figure 13. This allows the monitoring unit to be installed with a no chance of physically interfering with the fuses.



Figure 14 Two sets of fuses on the same pole

## 9.2 Split-Phase Installations

In some of the chosen monitoring locations, the substations feed a split phase circuit, one where only two phases and a neutral are connected to the customer load. For example, [Error! Reference source not found, Figure 15](#), has two fuses on the pole. These phases and the neutral can be connected as is standard in the installation procedure but when the unit is commissioned it should be noted that a third phase is not being monitored.



Figure 15 Split-phase installation

For the purposes of the Polesight Project, Northern Powergrid require that the voltage and current connections are situated downstream from the transformer and the fuses. In cases where there are multiple feeders but only one set of fuses the connections will have to be made where feasible, noting all feeder names when commissioning the device.

## Appendix I Equipment Supplied on Polesight Project

The following equipment will be supplied by EA Technology for installation by Northern Powergrid's linesmen.

**Table 4** Guard Installation Pack

Description	Quantity
Guard (in enclosure)	1
Rogowski Current Sensors for Guard	4

**Table 5** VisNet Installation Pack

Description	Quantity
VisNet (in enclosure)	1
Rogowski Current Sensors for VisNet	1 or 2