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EPL Composite Solutions

Arago TECHNOLOGY

A TRIAL INSTALLATION OF HIGH VOLTAGE COMPOSITE CROSS-ARMS

C. Zachariades[1], S. M. Rowland[1], I. Cotton[1], P. R. Green[1], C. A. Veerappan[1] and D. Chambers[2]
[1]The University of Manchester, [2]EPL Composite Solutions

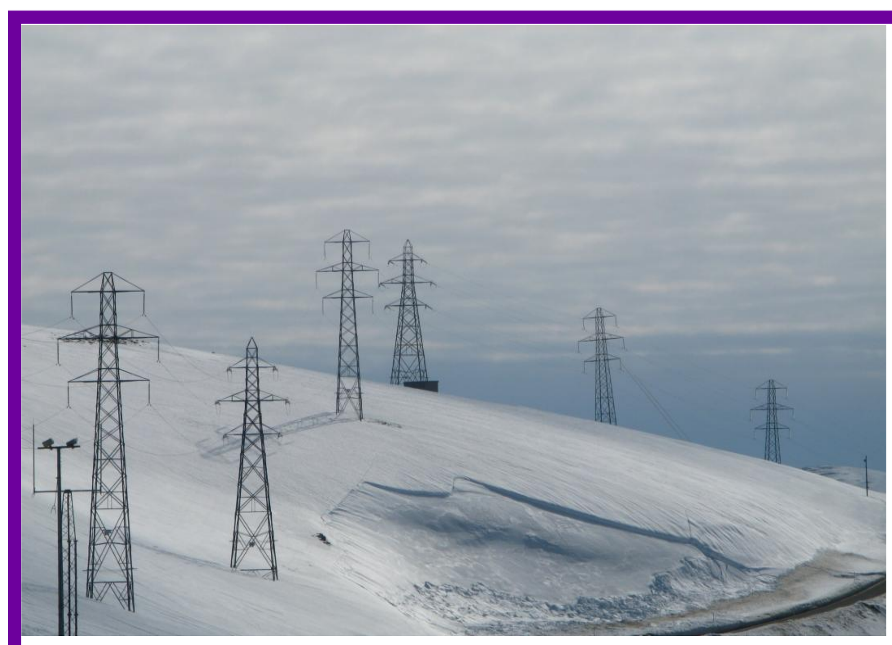


Figure 1 - Decommissioned line on high altitude trial site

1. INTRODUCTION

Continuously increasing demand for electrical energy combined with rising environmental concerns and land prices which create difficulties in obtaining permissions for new overhead lines, have forced the industry to seek solutions for improving the power transfer capabilities of existing infrastructure. One of the most attractive solutions to this problem is the replacement of the steel lattice tower cross-arms with ones made out of insulating materials. In addition to the increased power rating, other benefits of the technology include:

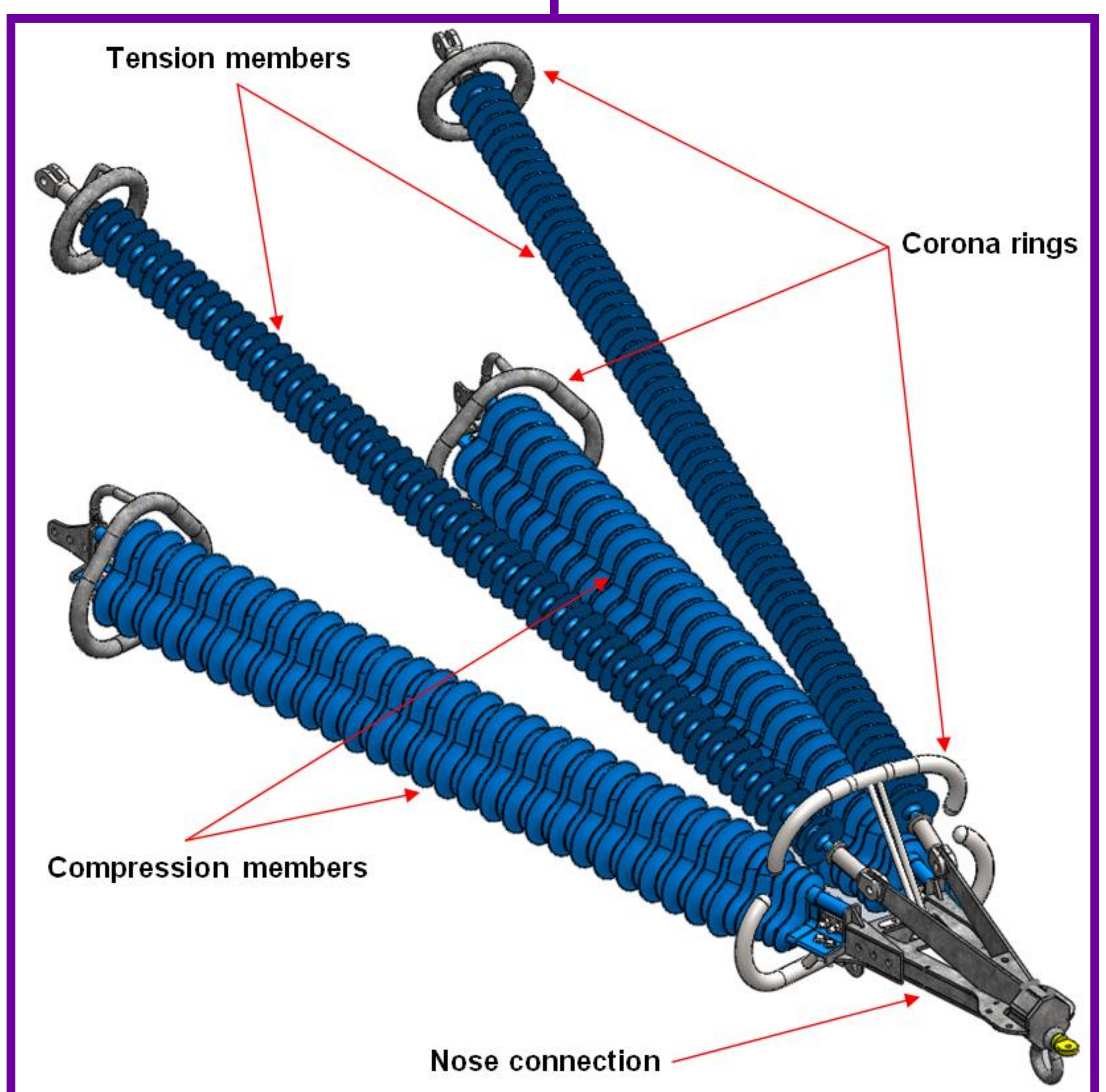
- a narrower right-of-way requirement
- the reduction of electromagnetic radiation at ground level
- reduction of the visual impact of overhead lines due to the compaction of tower dimensions

2. THE COMPOSITE CROSS-ARM

The cross-arm consists of :

- four insulating members
- end fittings
- field grading devices
- a nose connection for the attachment of the conductor

The horizontal members are the main structural elements of the cross-arm and are designed to be under compression when installed. The unique shape of their core enables them to exhibit improved resistance to bending and buckling. They can also be Manufactured cheaper and be made lighter than cylindrically- shaped alternatives.



3. INSTALLATION

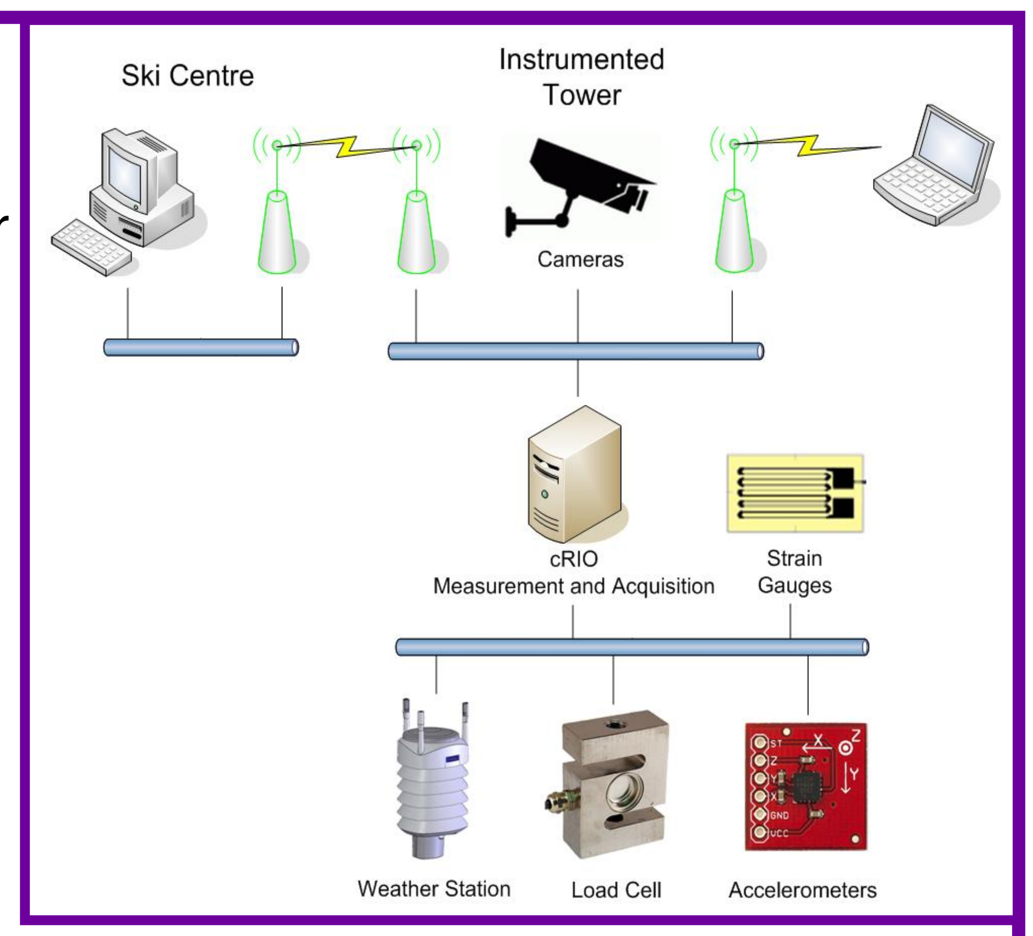
Four composite cross-arms were installed in November 2010 on a decommissioned 132 kV line in the Scottish Highlands (*Figure 1*). This location was specifically chosen due to the adverse weather it experiences especially during the winter months. They were retrofitted in the place of steel cross-arms to demonstrate the relative ease with which this can be achieved (*Figure 2*). The installation procedure is as follows:

Figure 2 - Completed retrofit installation of composite cross-arm

- The individual members are transported to the base of the tower
- The composite cross-arm is assembled on the ground
- The old steel cross-arm is removed
- Using a specially designed lifting frame the composite cross-arm is raised and bolted in place
- The installation is completed with the re-attachment of the conductor

4. INSTRUMENTATION

A system was developed to monitor the forces and weather conditions that the cross-arms are subjected to during their first trial.



4.1 Strain gauges

Strain gauges embedded half way along the core of the horizontal members monitor how the forces seen by each member change with the varying wind loading.

4.2 Load Cell

A five tonne load cell installed between the nose attachment point and the conductor clamp monitors the weight changes on the cross-arm due to snow and ice accretion on the conductor and the cross-arm itself.

4.3 Accelerometers

Two accelerometers log any vibrations experienced through the nose connection and measure any relative movement of the conductor in respect to the cross arm.

4.4 Weather station

The weather station records temperature, humidity, pressure, dew point, wind speed and direction. The data is to be used to match the mechanical loads to specific weather phenomena.

4.5 Cameras

Cameras record one minute of video every hour during daytime. They can provide useful information on how ice accretes on the surface of the cross-arm and how effective the current profile is (*Figures 3 and 4*).

5. RESULTS AND CONCLUSION

Mechanically the cross-arms perform as expected. Ice accretion is of a similar magnitude on both the horizontal and the more conventionally shaped diagonal members and glass cap-and-pin tension insulators nearby. These observations lead to the tentative conclusion that the geometry of the horizontal members is unlikely to affect the performance of the cross-arm in such conditions.

Through the trial, handling, transportation and installation procedures for composite cross-arms have been established. The data collected will be used to further optimize the cross-arm design both mechanically and electrically.

Figure 3 - Composite cross-arm top view recorded on 01 December 2010

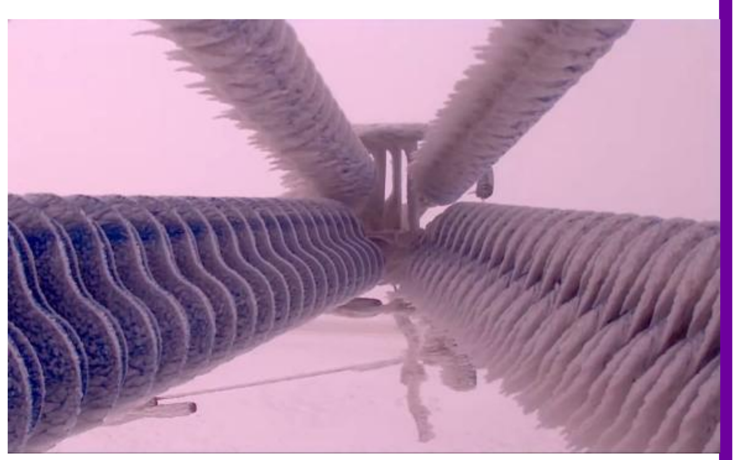


Figure 4 - Composite cross-arm nose view recorded on 21 February 2011

ELECTRICAL ENERGY AND POWER SYSTEMS GROUP

School of Electrical and Electronic Engineering

The University of Manchester

For details contact: ***Christos Zachariades*** Tel.: ***0161-306-4679***

E-Mail: ***christos.zachariades@postgrad.manchester.ac.uk***

Supervisor: ***Prof. Simon Rowland*** Tel.: ***0161-306-4720***

E-Mail: ***S.Rowland@manchester.ac.uk***