Methods of leak detection

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Leak Response

• All UK Power Networks fluid filled cables are monitored by pressure alarm systems.

• An alarm from one of these systems may indicate a fluid loss from the cable and the potential presence of a leak.

• These alarms are monitored by our control centre, and our teams are on call 24 hour a day.

• Throughout UK Power Networks we have specialised field teams who maintain and repair our fluid filled network.

• The local team will be mobilised to investigate cause of the alarm and potential leak.

• The action taken by our field teams will be dependant of several factors:

  Environmental sensitivity of route
  Volume of fluid lost, ability to locate and urgency
Leak Response

• Once the severity of the leak has been ascertained the following actions may be taken:
  
  – The circuit replenished with fluid
    • To keep the cable integrity, to keep customers on supply
  – Circuit pressure reduced
    • To reduce leak rate
  – Route patrol
    • The leak could be a 3rd party damage, or visible above ground or from ancillary equipment
  – Cable de-energised
    • If the leak rate is unsustainable, dependant on environmental impact and risk to customers
  – Leak location undertaken
    • Leak Locations undertaken in a timely manner, this can depend on several factors, primarily excavation restrictions and the availability of the circuit.
  – Repairs made
    • The condition of the cable will also be assed at this stage and feedback to our asset management systems
Methods of detection

• Traditionally, there have been two primary leak detection techniques for fluid filled cables:
  – Cable Freezes
  – Capenhurst hydraulic method

• Technology has now moved forward, and we now have a new method becoming available:
  – Perfluorocarbon Tracer Leak Location (PFT)
Cable freezes

- Cable freezes have been the mainstay for leak detection for many years.

- This method freezes the fluid in the cable, and by monitoring the pressure drop at each end of the circuit an indication can be given of the leaky section.

- There are limitations to this method
  - The cable needs to be de-energised
  - Unable to detect smaller leaks
  - Multiple excavations required
  - Disruption to the public and highways
  - Cost
  - Time
Capenhurst Hydraulic Method

- This leak location technology measures the flow of fluid through the cable, and by knowing the length and hydraulic resistance of the cable an estimation of the leak position can be found.

- The limitations with this method are:
  - The cable needs to be de-energised
  - Unable to find smaller leaks
  - Accuracy of the results
  - Cannot find multiple leaks
PFT Leak Location

- UK Power Networks is now using a new detection system developed by Wasson ECE.

The detection technique is based upon introducing a small amount Perfluorocarbon Tracer (PFT) into the degassed cable fluid of the leaking cable, this tracer is then detectable by a mobile unit.

The ultimate goal is to be able to detect fluid filled cable leaks faster, more cost effectively with reduced impact to the environment.
Perfluorocarbon Tracers

- Perfluorocarbons (PFTs) are a man made, non toxic, non flammable, non corrosive, chemically stable material which have a very low background levels.

- Uses to date for PFTs range from cable leak location, petroleum reservoir mapping, atmospheric testing and medical uses such as in artificial blood and eye surgery.

- UK Power Networks has undertaken extensive compatibility testing to ensure that there is no degradation or premature ageing of our assets.

- Further testing has also been carried out to ensure that there are no environmental, health or safety issues from using this material.
The Wasson Tracer Concentrator was developed by Wasson ece in conjunction with Con Edison NY and this is the 1st unit commissioned in Europe.
• With the Wasson Tracer concentrator it is possible to perform an initial “Drive by” location. This method will give a general indication of the leak’s location, and with further bore hole sampling a near exact location of the leak position can be given.
Benefits of this Method of Leak Location

- This new method of cable leak location has the following benefits over existing technologies:
  - Location of smaller volume leaks, typically around 50 litres/month.
  - Once fully tagged, a leak on a circuit can potentially be found in less than 24 hours.
  - Leaks can be located without making excavations.
  - Leaks can be found without having to de-energise the cable, which reduces risk of customer’s supplies being interrupted.
  - The cost of leak location is greatly reduced.
Case study:

West Weybridge - Walton No 2
Circuit details

- **West Weybridge - Walton No2**
  - 33KV Three Core, Copper Conductor, 0.2sq inch, Fluid Filled Cable.
  - Installed circa 1958.
  - Hydraulic section length 2.1Km.
  - Losing 80 Litres per day.
  - History of leaks between joint positions.
Method

• Calculate the free fluid volume of the circuit.

• Replenish the cable fluid with PFT Tagged cable fluid.

• Hydraulic section fully tagged within 11 days.

• Initial Leak location undertaken after 5 days.

• Full survey undertaken after 11 days if not found beforehand
Overview
Results

• Three leak positions were found.
• Volume of leak discernable between locations.
• Leak Locations accurate to less than 1 metre.
• This cable has now been overlaid due to its poor condition.
Results
Results
• Thank You

Any Questions