



Bonding measurement performed onto Substation Earth Bar

**THE PROJECT**

Earthing systems form a crucial part of a power network and need to be regularly inspected/tested, as per the BS 7430 requirements, to ensure safety to personnel under fault conditions. As part of the routine maintenance/inspection schedules at the Port of Felixstowe, point-to-point earth bonding checks are required to ensure the various electrical equipment are adequately bonded to the global earthing system.

**TESL INVOLVEMENT**

- Visit site to perform point-to-point earthing bonding measurements between each of the Customer Substations and Crane Rails to the overall Global Earthing system.
- A desktop study to assess the Earth Potential Rise (EPR) at each of the Customer Substations during earth fault scenarios. The respective EPRs were then referenced against the safe touch and step touch voltage limits, as defined by BS EN 50522, to confirm site safety under fault conditions.

**PROJECT DATES**

Project Start Date: Jan 2018  
 Submission Date: Mar 2018

**CLIENT**

Ethical Power Ltd

**PROJECT OUTCOMES**

**The various electrical loads throughout the Port of Felixstowe, including cranes, flood lights, refrigeration containers and office blocks, are supplied by over 60 land based 11/0.415kV substations. These substations are all interconnected via respective cable sheaths and earth electrode connections, to create an overall global earthing system.**

Due to scheduled maintenance and inspection requirements, the bonds of these substations, to the global earthing system need to be verified. This is to ensure stray voltages do not arise during everyday operation, prevent hazardous touch and step voltages to personnel during fault conditions and to ensure appropriate protection elements operate to clear faults.

Point-to-point bonding checks were performed between each of the substations. These were checked against reference values, calculated based on the cable sheath cross sectional area, material type and cable length. High readings were identified to the client so that the respective bonding connections could be checked during the next scheduled maintenance.

In addition to the bonding checks, TESL proposed routine examination and maintenance schedules comprising of annual visual inspections and 5 yearly testing in line with the BS 7430 requirements. This ongoing plan ensures that the earthing system is maintained and kept to a high standard.

**PERFORMANCE**

Due to the high traffic volume within the port areas, TESL had to work directly with the Port of Felixstowe employees, to determine the safest routes to run the bonding leads.

These routes crossed roadways, footpaths and crane rails where regular radio communication was used between the test personnel and port managers/drivers to ensure safety to personnel and minimise disruptions.

The areas of testing were also scheduled to coincide with planned quiet periods in those areas.

Some of the point-to-point bonding check runs between the substations were over 700m in length. TESL developed a quick and efficient method of using 200m reels which could be plugged together to achieve the required measurement length. This meant that additional reels could be added to each other, to reach the desired bonding measurement point, instead of using one long reel which would need to be carried around and unreel for each measurement.

Post testing, TESL developed a desktop model of the land based substations and their respective interconnecting 11kV cables in ATP-EMTP software. Phase-to-earth faults were simulated at each of the land based substations to simulate their respective earth return fault currents and resultant EPRs. These EPRs were then referenced against safe touch and step touch voltage limits as defined by BS EN 50522 to confirm safety across the site, under fault conditions.

**SPECIFIC REQUIREMENTS**

The testing was performed on live equipment as the port functions 24hrs a day. Appropriate procedures, PPE and direct supervision was used to ensure personnel safety when working around the equipment and to prevent any required outages.

Point-to-point bonding checks are an effective way to ensure that the structures are adequately bonded to the earthing system. By utilising all four poles of the DET2/2 earth tester, the resistance of the leads can be neglected giving greater accuracy to the bonding measurement.

As requested by the client, a map based on the measurement GPS locations was included as part of the report which clearly referenced the respective readings. This is extremely useful for future inspections, as the tests could be repeated and compared to the bench marked values.