



Electricity Generator Set Hydrogen Coolant

Background

Within the power generation industry, it is common practice to use hydrogen as a direct coolant for the generator stator windings. Hydrogen is used because it has an extremely high heat transfer capacity - it is much more efficient at transferring heat than any other medium.

The re-circulating hydrogen removes heat from the generator, transferring it, via a heat exchanger, into a secondary cooling circuit which uses de-mineralised water. Often this de-mineralised water is then cooled either by sea water or river water, dependent upon the location of the power station.

As it is not possible to hermetically seal the generator set casings it is possible for moisture to ingress from the surrounding air, similarly, as the heat exchanger gradually becomes more porous with age, it too will allow moisture to get into the hydrogen. So it is important that the circulation loop for hydrogen gas on such an installation should include a desiccant dryer, to continuously remove absorbed moisture. The greatest fear, should moisture be allowed to build up in the hydrogen, is that condensation will occur on exposed live metal parts - leading to the risk of flashover. On generator sets which typically produce 22 kV at 19,000 A, this could be disastrous. It is therefore recognised practice within the industry that the dew point of the hydrogen gas leaving the generator set should be maintained at a safe margin below the minimum casing temperature, typically an upper limit of 0 °C dew point at system pressure is observed. Should the hydrogen dew point rise above this upper limit, it is important for immediate action to be taken - either to de-commission the generator to effect a repair or more likely to take immediate remedial action by pumping fresh, dry hydrogen into the system.

Measurement Technique

Continuous on-line measurements from the outlet for the generator frame and the outlet from the H₂ adsorption dryer can be made using the Transmet IS Transmitter with its ceramic moisture sensor installed in a sampling arrangement. An in-line instrumentation filter with coalescing element should be incorporated to remove any lubricating oil mist or particulates present in the sample flow. Measurements should be made at full system pressure to accurately in the sample flow. Measurements should be made at full system pressure to



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accurately represent the risk of condensation occurring under generator set conditions.

The Transmet IS Transmitter is CENELEC certified for the dew point measurement of flammable gases in hazardous areas. As hydrogen constitutes an explosion risk, a digital indicator should be installed remote from the generator set at a designated safe location, with galvanic isolators installed in the sensor cable assembly. The monitor provides full function display and analogue output facilities with two customer configurable alarms which can be set to provide 'warning' and 'immediate shut down' status conditions. Transmet IS can provide either of two analogue signals, 4-20 mA or 0-20 mA which can be sent to the control room - SCADA, BMS, PCs.

Michell's intrinsically safe portable dew-point hygrometer, Cermax IS, can be used as a spot check tool. Fast response and ease of use (with data logging facility) enables the user to make a quick gas analysis.

Reference Users

Kendle Kriel & Dauhva Power Stations, National Grid, National Power, Powergen, Scottish Hydro Electric