

Rapid Repair for a Solo Hydrogenerator

With over 50 years on its back, the hydrogenerator at Inverawe power station recently needed a thorough repair of the stator. The time for the repair was very limited because there was no other generating capacity on-site. The site's owners, Scottish and Southern Energy (SSE), awarded the project to Sulzer, which has a distinguished history in high-voltage-generator repair.



1 The stator was repaired in situ at the Inverawe power station.

Scotland has many hydroelectric power stations that were built in the 1950s and 1960s. These power stations continue to provide reliable service to this day, mainly to meet peaks in demand. After working so many years without a break, the Inverawe power station — located in Argyll and Bute, Scotland — needed comprehensive maintenance for its hydrogenerator.

Reliability is of prime importance

Routine maintenance of hydroelectric generators is essential in order to sustain reliability of supply. These repair projects are always planned to minimize disruption. Most of the power stations have multiple generators, which produce a reduced output during the repair of single generators.

However, some power stations have only one generator, which means that the time for maintenance must

be kept to an absolute minimum. Inverawe power station runs only a single generator. This is why Scottish and Southern Energy (SSE), the owner of the power station, had planned a specific maintenance project for the generator. It awarded the project to Sulzer. From its refurbishment and repair of the Lochay and Fasnakyle generators in Scotland in 2015, Sulzer is well known to SSE to be a reliable partner.

In between aqueducts and tunnels

The Inverawe power station is part of the Sloy Awe hydroelectric scheme, which is a series of stations connected by a number of aqueducts and tunnels. The site itself contains a single 25 MW generator driven by a Kaplan turbine. A 5-kilometer-long tunnel feeds it from the 18-meter-high barrage built across Loch Awe. Originally built in 1963, the Inverawe generator has been in service for over 50 years with only minor maintenance

Inspections and project planning is essential

Marc Stuart, Assistant General Manager at Sulzer's Falkirk Service Center, explains: "Time-critical projects such as this require a considerable amount of planning and resources to achieve the desired result. In addition, close coordination and clear communication are essential once the project has started to ensure any potential issues are dealt with as they arise."

Stuart concludes: "This generator has performed well over the past 50 years but there are signs that more extensive work will be required in the future. Normally this would be a straightforward task, but with no additional generation capacity on-site, the total time available for any repairs is and will be very limited."

conducted during that time. Throughout its lifetime, the Inverawe generator has been monitored for vibration and overheating, which may indicate potential failures, and it has undergone regular inspections.

During the annual routine inspection, SSE requested that Sulzer carry out a restricted visual review of the stator and rotor condition. The service center manager detected alarming defects: several wedges migrating across numerous areas of the stator core. To prevent any movement of the windings, these stator wedges, which hold the stator windings securely in position, needed to be replaced. SSE decided to briefly take the generator offline to complete the maintenance and repair as quickly as possible.

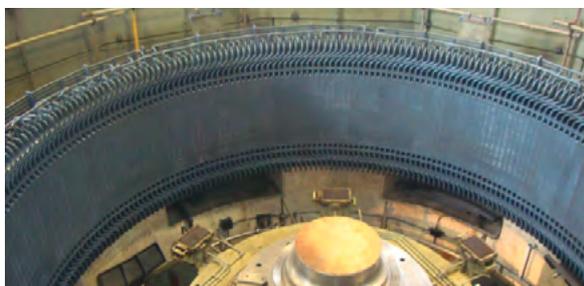
Detailed rotor and stator inspection

The generator was taken offline and the rotor removed by SSE engineers before the Sulzer personnel arrived on-site. This allowed a detailed inspection of the rotor while the stator was being repaired. It also allowed Sulzer to set up a repair plan. The initial inspection showed that several of the wedges had started to migrate out of position (Fig. 2). The repair process started with the removal of all of the original wedging and packing. Once the windings had been cleaned, the rebuild got underway. The Sulzer engineers installed a full set of new G11 wedges — made from glass laminate — which had been manufactured in-house. Additionally, the wedges got a new packing (Fig. 3).

After the rebuild had been completed, the stator was tested for insulation resistance as well as winding continuity under static conditions. All of the test results were recorded to ensure the highest quality standards. With a full set of satisfactory results, the stator was re-varnished — ready for the SSE engineers to rebuild the generator on-site. Though the stator repair progressed smoothly, the findings from the rotor inspection indicated that additional work would be required soon. However, since the generator had been operating without



2 Stator with migrating wedges before the repair.



3 Stator after installation of new G11 wedges.

any cause for concern, it was decided to return the unit to service as soon as this project was completed. A more detailed evaluation of the rotor report would be conducted in due course.

Experienced project coordination

The whole project was coordinated and run by the local service center in Falkirk, Scotland. The Sulzer engineers in Falkirk have vast experience in maintaining hydroelectric generators. It also has an expert field service team that is accustomed to working in the more remote areas of the country. Additional technical support was provided by the Birmingham Service Center, which provides the design and manufacturing expertise for the engineers on-site.

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