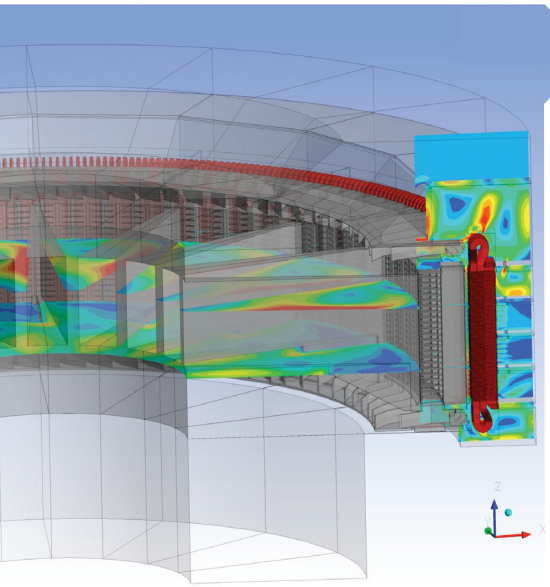
Hydro Québec



Numerical simulation of tangential speeds of cooling air flow in a generator at Beauharnois generating station

AUPALE

Generator Uprating

Hydro-Québec operates nearly 350 generating units. Most of them are used at their full capacity, which leaves operators little margin for manoeuver. Since 2002, the Institut de recherche d'Hydro-Québec (IREQ) has been working on numerical modeling of generators in an effort to evaluate the possibility of increasing the maximum capacity of certain targeted generators without compromising their service life.

Fleet flexibility

The knowledge acquired since the beginning of the AUPALE project has increased our understanding of the physical phenomena governing generator behavior under all operating conditions. We now know that it is possible to obtain more operating flexibility without jeopardizing generator reliability. By increasing the maximum capacity of certain generators, Hydro-Québec maximizes the capacity of its generating fleet. This flexibility is a strategic asset for meeting peak demand and ensuring unit availability for responding to market conditions. In addition, an understanding of these machines may make it possible to propose, in the near future, solutions to problems such as generator overheating.

A two-part project

The first part of the AUPALE project focused mainly on stator performance. The second part involves modeling the rotor and combining the two components (stator and rotor) into a single modeling tool. This part should conclude in 2014.

Conclusive results

Thermal measurements on the rotor of a unit at Beauharnois made it possible to determine the maximum allowable capacity for six of the generators at this facility. Using this data, the research team evaluated the potential for uprating the generators. Result: up to 20% increase in capacity, without creating any mechanical or thermal problems.

A multiphysical model

The physical phenomena affecting generator behavior are very complex. Understanding them requires considerable capacities for calculation and data exchange. In addition, the simulation codes are not always able to handle all the generator details. AUPALE brings together a large team of engineers and technicians from various fields. Together, they are working to develop a multiphysical generator model that will include all aspects of the machine's behavior: thermal and mechanical phenomena, electromagnetism and cooling fluid flows.

Combining phenomena

To date, the team's work has yielded electromagnetic, thermal, mechanical and fluid flow simulation models. The project is progressing, and there are always more parameters and information to transfer from one model to another. The programming of all these interactions still has to be fine-tuned. In addition to these models, the simulation results are calibrated by detailed measurements on the generators during in situ tests. Probes have been installed on rotors and stators to measure parameters such as temperature, air gap variations, vibration and noise. This project has already furthered our overall understanding of generator behavior. The main challenge is yet to come: linking the various phenomena to create a truly multiphysical generator model.

Why build a multiphysical model?

- To determine uprating possibilities for certain generators
- For better overall understanding of generator behavior
- To validate new generator designs offered by manufacturers

For more information

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