

## ENERGY AND UTILITIES

# Hydro-Québec

Canadian energy provider uses Simcenter testing solutions to optimize power output

### Product

Simcenter

### Business challenges

Better plan and predict turbine maintenance intervals

Increase hydroelectric turbine and generator power output

Augment customers' satisfaction with energy delivery services

### Keys to success

Use Simcenter Testlab and Simcenter SCADAS to maximize testing efficiency onsite

Rely on versatile equipment

Implement an innovative multidisciplinary technology approach

### Results

For specific large generators, increased power output by up to 20 percent

Spaced out maintenance intervals to a minimum of five years

Achieved 91 percent customer satisfaction in 2016

### Siemens Digital Industries Software solution helps Hydro-Québec monitor vibration levels and better predict optimal maintenance intervals

#### Addressing challenges of the 21st century

Generating and distributing energy in a more sustainable way is a major challenge in the 21st century. Hydro-Québec is a world-renowned power utility and a leading technological innovator. It aims to play a pivotal role in the transition to renewables and the decarbonization of electrical generation.

Hydro-Québec generates, transmits and distributes electricity. It is the largest power utility in Canada, and a major player in the global hydropower industry. It also operates a vast high-voltage transmission system. Its sole shareholder is the Québec provincial government.

Its mission is to provide customers with a high-quality power supply while contributing significantly to Québec's collective wealth. As a recognized leader in hydropower and large transmission systems, Hydro-Québec exports clean, renewable power and commercializes its expertise and innovations in world markets.



Photo courtesy of Hydro-Québec.

### **Enable sustainable power generation**

Hydro-Québec operates some 60 hydroelectric generating stations and is one of the largest hydroelectricity producers in the world. Nearly all of the electricity is generated using water. To support its objectives to deliver clean energy to customers across Québec and export markets, Hydro-Québec also relies on its research institute, the Quebec Electricity Research Institute (IREQ). IREQ is the largest electric utility research center in North America. Hydro-Québec invests a yearly average of \$100 million Canadian dollars (CAD) in its innovation projects.

The IREQ team is made up of approximately 500 people; a broad range of scientists, technicians, engineers and specialists. Their efforts make it possible to extend the service life of facilities, boost performance, optimize the maintenance of equipment, support energy efficiency programs and improve customer service.

François Lafleur is a researcher who specializes in mechanics and vibration at the IREQ. The research projects Lafleur is involved in span multiple technology fields, from optimizing the maintenance intervals of large turbines and maximizing

the power output of existing facilities, to finding ways to preserve the aquatic fauna in the vicinity of hydraulic-electric installations.

### **Testing for better planning**

One of the objectives of the IREQ team is to optimize the maintenance of the large turbines used in hydroelectric power generation. Those turbines operate permanently, keeping the shutdown episodes that occur for research, maintenance or repair purposes to a minimum, ensuring continued energy delivery and full customer satisfaction. The goal is to space out planned inspections by a minimum of five years.

Using Simcenter testing solutions from the Simcenter™ portfolio, Lafleur measures and analyzes the vibration levels of the turbines. A typical test campaign takes up to 10 days to complete. Since some measurements cannot be performed when turbines are in use, the timing of tests depends on the grid needs. No tests are performed during the winter season when energy needs peak. In the spring or summer season, multidisciplinary IREQ researchers visit power-generation sites to perform extensive tests on idle turbines.



Simcenter SCADAS Mobile and Simcenter SCADAS XS provide maximum flexibility. They can easily be brought to the most remote test sites to perform measurements in operating conditions.”

François Lafleur  
Researcher  
Hydro-Québec

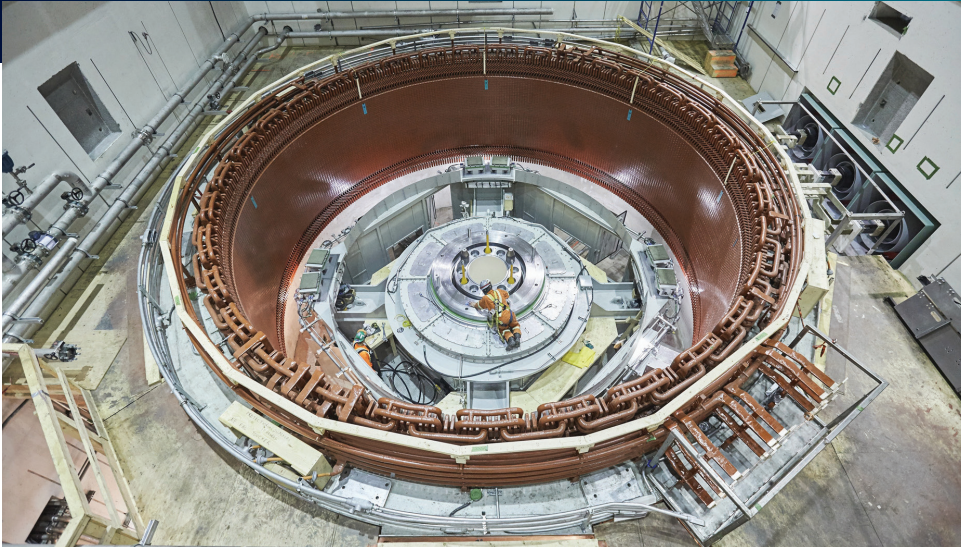


Photo courtesy of Hydro-Québec.

“One advantage of Simcenter testing solutions is the seamless integration of the hardware and software.”

François Lafleur  
Researcher  
Hydro-Québec

The objective of the tests is to evaluate turbine conditions in order to predict maintenance needs. Ultimately, the tests aim to improve the planning of maintenance intervals and minimize turbine downtime. To get full insights into turbine conditions, the team takes up to three days to instrument the power generation equipment with a panel of temperature, electromagnetic, acoustic and vibration sensors.

During a planned shutdown phase, Lafleur carries out tests to measure the cavitation erosion on turbine blades. He uses techniques such as impact testing, or more rarely shaker excitation, to measure the transmissibility functions between the blades and the lower guide. The results let him understand whether the erosion stayed within reasonable limits.

#### **Understanding the structural dynamics in operational conditions**

To get full insight into the turbine’s operating conditions, some tests are performed during operation. Lafleur carries out measurements to confirm that vibration levels do not exceed the regulatory norms and standards, or uses modal analysis to find out at which frequency the maximum level of vibration occurs in the turbine. Since excitation forces cannot be

measured when the turbine is in operation, Lafleur relies on operational modal analysis (OMA) and operational deflection shape (ODS) techniques to understand the structural dynamics of the turbine. The ODS also helps him separate stator from rotor frequencies, while the OMA filters out electromagnetic harmonics from the structural modes.

Equipped with Simcenter SCADAS™ Mobile software or Simcenter SCADAS XS hardware, Lafleur performs measurements and a first assessment onsite before he brings the data back to the laboratory for further analysis. To Lafleur, the advantages of hardware like Simcenter SCADAS XS are obvious.

“Simcenter SCADAS Mobile and Simcenter SCADAS XS provide maximum flexibility,” says Lafleur. “They can easily be brought to the most remote test sites to perform measurements in operating conditions. There I can carry out my measurements autonomously, even without a connection to my laboratory’s server. With Simcenter SCADAS Mobile and Simcenter SCADAS XS, I am confident I will obtain high-quality, well-conditioned data that I will be able to further analyze in the lab. The good quality of results is critical in my job as I have only limited access to the item under test.

**“When onsite, I focus on measurements using Simcenter SCADAS Mobile as a throughput recorder. I am always certain of the precision and quality of the measured data that I will analyze later back in the laboratory.”**

François Lafleur  
Researcher  
Hydro-Québec

“One advantage of Simcenter testing solutions is the seamless integration of the hardware and software. With the Simcenter Testlab software, I can prepare my test in the lab, for example, creating a basic geometry of the turbines with the diameters and the shapes, or prepare calculations on the complete synchronous and asynchronous frequency range. When onsite, I focus on measurements using Simcenter SCADAS Mobile as a throughput recorder. I am always certain of the precision and quality of the measured data that I will analyze later back in the laboratory.”

The modularity of the solution also meets Lafleur’s needs when it comes to laboratory analysis: “I can use the information coming from the same accelerometer to calculate multiple values, for example, speed and displacement. Since we adopted the Simcenter value-based licensing scheme, I can use tokens to perform the analysis I need, from an operational modal analysis to a sound intensity calculation. I also appreciate the project workflows in the software and the easy data documentation.”

### **Multidisciplinary intelligence**

With Simcenter Testlab™ software, Lafleur has access to a wealth of analysis tools to gain deeper insights into the data sets. He shares his findings with colleagues from the multidisciplinary team. For example, vibration measurements are correlated and compared with temperature and electromagnetic measurements. The IREQ investigations allow Hydro-Québec to implement innovative methods to reduce maintenance time and intervals so they only need to perform necessary maintenance using nonintrusive methods.

IREQ’s multidisciplinary team works on projects that require them to find intelligence in the data from various origins, and consolidate it to gain a deep understanding of a system’s multi-physics behavior. The team carries out investigations to find out if the power output of a turbine could be increased from 70 to 120 percent without jeopardizing safety or reliability of the equipment, and with a minimal impact on the turbine’s lifetime. Limitations to uprate are mostly linked to mechanical and thermomechanical stress on the generators. The multidisciplinary team combines its knowledge of the system to create intelligent models of the turbine generator system. Test data is widely used to validate assumptions on the complex models.

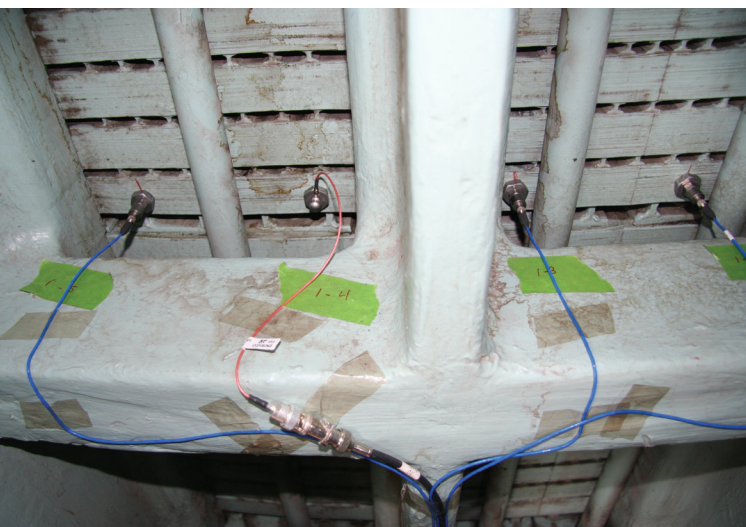


Photo courtesy of Hydro-Québec.



Photo courtesy of Hydro-Québec.

### Solutions/Services

Simcenter Testlab  
siemens.com/simcentertestlab  
Simcenter SCADAS  
siemens.com/simcenterscadas

### Customer's primary business

Hydro-Québec generates, transmits and distributes electricity. The largest power utility in Canada and a major player in the global hydro-power industry, Hydro-Québec also operates a vast high-voltage transmission system. Its sole shareholder is the Québec government.  
www.hydroquebec.com

### Customer location

Montréal, Québec  
Canada

Although this innovative approach is still being consolidated, it already yields astonishing results: a power increase in some generators of 15 to 20 percent.

### Focusing on customer service

Hydro-Québec activities are not solely focused on power generation. The company also offers energy transmission and distribution to homes. Hydro-Québec's mission is to deliver a safe, reliable power supply and offer outstanding customer service. IREQ's researchers also support this objective with their projects.

Electromagnetic repulsion effects coming from electric wires can be the source of annoying noise and vibrations. Hydro-Québec seeks to reduce these effects inside homes and around distribution grids in the vicinity of settlements in order to improve the comfort of electricity users. Whenever a disturbance is reported, members of the IREQ team will come to the site to measure and characterize noise

levels, using, for example, the compact and portable Simcenter SCADAS XS. They will analyze the situation and apply appropriate countermeasures, such as modifying the wire configuration or installing a noise-damping device in order to reduce noise levels and increase consumers' satisfaction with the energy delivery services.

### Versatile tools for a multitasking team

Being involved in such diverse projects, it is no wonder that Lafleur appreciates the versatility of the Simcenter testing solutions. He also appreciates the efficiency of the technical support offered by the Siemens team. By extracting the information nested in the high-quality data acquired with Simcenter SCADAS and fully exploiting the multiple analysis possibilities offered by Simcenter Testlab, Lafleur is able to gain invaluable insights into data sets, and work jointly with experts in other engineering disciplines to propose novel solutions to tackle current challenges.



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François Lafleur  
Researcher  
Hydro-Québec

### Siemens Digital Industries Software

Americas 1 800 498 5351  
Europe 00 800 70002222  
Asia-Pacific 001 800 03061910  
For additional numbers, click [here](#).

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