

R&D projects in Power System Dynamics at Hydro-Québec

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Abstract

Hydro-Québec is operating a large and complex power system which has the following main characteristics :

- A total production of 37000 MW with a winter peak load of 34000 MW.
- Long distances between generation and load. Most of the generating facilities are large hydroelectric power stations located more than 1,000 km from the main load centres.
- Transmission system comprising eleven series compensated 735 kV lines, thirty seven 735 kV substations, a ± 450 kV multi-terminal DC line and dynamic shunt compensation implemented with eleven static and nine synchronous compensators.
- Isolated system (no synchronous link with its neighbours).

As a general reliability objective and according to NPCC specific requirements, the transmission system must provide adequate flexibility, strength and operating margin to supply firm loads, despite constant variations in operating conditions, occurrence of equipment faults or normal equipment unavailabilities. Its design criteria are therefore based on two key rules:

- the system must support a set of conceptual contingencies without service interruption or without using any System Protection Schemes (SPS). Conceptual contingencies, also called normal contingencies, are those with greatest probability of occurrence. System stability must be maintained during and after the most severe of these contingencies. Besides normal protection functions, power system stability mainly relies on regulation devices.
- the system must comprise means of avoiding system-wide power failure under extreme contingencies. The objective, in this case, is to preserve system's integrity by using automatic measures (SPS) that are simple, reliable and safe for the system and provide the most extensive possible coverage against all possible extreme contingencies. SPS are the means chosen to limit the consequence of these contingencies and are thus mainly used to improve power system security.

Based on these general principles, the research on power system dynamics at Hydro-Québec are focused on two main activities :

- For stability improvement : new regulation functions and devices
- For security improvement : new system protection concepts and relays

Hydro-Quebec is presently conducting twenty innovation projects for improving its transmission system. Out of these, one specific project, so called ACOR, is the main subject of this paper.

ACOR is dedicated to power system dynamics issues. Research on innovative concepts and development of new products are conducted with two major industrial partners. Regulation devices are jointly developed with ABB while new protection relays are involving Alstom T&D.