GE
Grid Solutions

Nelson River
HVDC Equipment Upgrade for Manitoba Hydro, Canada

Replacement of aging mercury arc valves with the latest thyristor valves and four-terminal control technology.

Valve Hall of the Nelson River HVDC Converter Station

Imagination at work

890 km of HVDC transmission lines from the Hudson Bay to Winnipeg

The Radisson Converter Station built in 1968 is located 2 km south of the Kettle Generating Station

Customer Challenges

Manitoba Hydro is Canada's fourth largest power utility company serving over 1.5 million people in Manitoba. Manitoba Hydro is the main electricity source for power generation and distribution throughout the Manitoba province.

The Nelson River flows north, down from the Canadian prairies to the Hudson Bay and this is where Manitoba Hydro developed its hydro generation plant, supplying power to the entire province.

As there is a long transmission distance involved, the potential for seasonal brush fires and lightning strikes created the concern that an AC transmission system would suffer disconnection problems resulting in poor reliability. DC transmission thus became the preferred option.

Since 1972, 1,620 MW has travelled down the 890 km of HVDC transmission lines to Winnipeg. At 450 kV, created from three 150 kV bridges in series per pole, this is the highest DC voltage ever used by mercury arc valves. After 20 years of excellent service, the opportunity for lucrative power sales to the USA at higher efficiencies drove Manitoba Hydro to upgrade Pole 1 of Bipole 1 (a second Bipole having been added in the late 70's).

Nelson River Tier on its side

GE Wins Again

GE's expertise and innovation secured the initial 1967 contract to install the mercury arc valves, which were state-of-the-art at that time. GE once again demonstrated the necessary expertise on this project, as they were awarded the upgrade scopes from the mid 1980s through to the early 1990s.

For the first upgrade, GE added automatic switching to the station controls between two parallel lines on fault. This was later extended to Bipole 2 and was the first time four-terminal DC transmission was achieved on one transmission line. This feature proved its worth in 1996 when strong winds blew down both transmission lines and the repair of one line was sufficient to quickly resume full power.

Following this, in stages between 1989 and 1992, GE - through very competitive tendering - was again chosen as the preferred supplier for further system upgrades to replace the now obsolete mercury arc valves by our latest thyristor based valves.

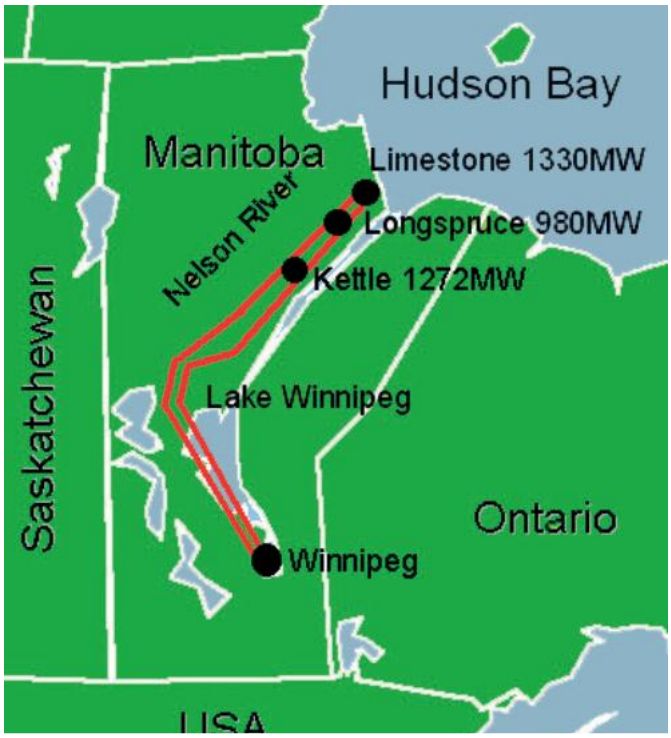
This upgrade increased the power rating of the three series valve groups, at each end of one pole, to give Pole 1 of Bipole 1 an increase in transmission rating from 450 kV to 500 kV and in power from 810 MW to 1,000 MW. There was also a corresponding upgrade of the control system.

The new 100 mm thyristor valves were of such a high specification that they delivered over 30% higher reliability than that specified by Manitoba Hydro. As Manitoba Hydro was completely conversant with the master control, it was only necessary to upgrade the elements of the control system that were required to interface with the new, advanced thyristor valves, and to ensure all the original switching capabilities were retained.

GE Solution

The original installation included:

- Converter transformers 341 MVA, 138 kV
- Converter transformers 323 MVA, 230 kV
- Six synchronous compensators +160/-80 MVA at 17 kV
- AC filters 230 MVA, tuned 2x5th, 2x7th, 11th, 13th and high-pass
- AC filters 350 MVA, tuned 2x5th, 2x7th, 2x11th, 2x13th and 2 high-pass
- DC filters (both terminals) tuned 6th and 12th
- Smoothing reactors: 2 per pole per terminal, each 0.5 H
- Land electrodes each 305 m diameter ring of steel in coke, 0.16 to 0.60 ohms



Key Benefits

Manitoba Reaps the Rewards

Maintenance costs were greatly reduced due to the increased reliability of the new thyristor valves.

In turn, labor costs were all but eliminated and revenue increased due to the higher power rating and reduced outage times.

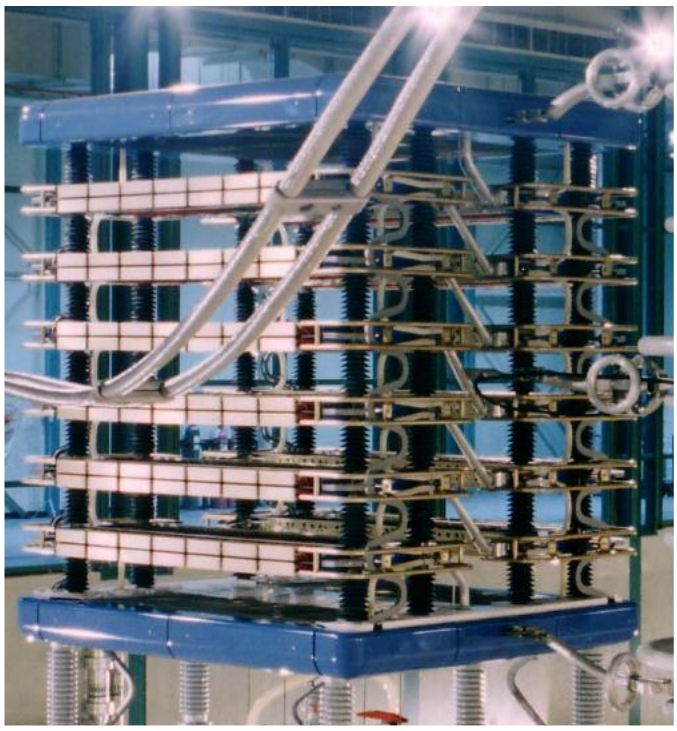
Over the first seven-year period since the refurbishment of the pole, the total time of unavailability, number of outages and mean time to failure fell to such an extent that it equated to an impressive overall increase in performance of 92%.

GE's Advantages

- Long-term client/supplier partnership
- Industry leading expertise and technologies
- Innovative, specifically-tailored solutions
- New equipment compatibility with existing installations
- Maximum return-on-investment

"The importance of the HVDC transmission link to its consumers means that Manitoba Hydro requires a high degree of reliability. Integration of the new equipment into a 20-year old system proved very challenging and these aspects were successfully taken into account in the design by GE. The project was completed in three stages between June 1991 and November 1993 and has, to date, given trouble-free service. Manitoba Hydro has achieved excellent cooperation and performance from GE, a relationship that has been in existence for over 25 years."

R. O. Lambert, Executive Vice President, Engineering and Environment, Manitoba Hydro



H400 valves

For more information please contact
GE Power
Grid Solutions

Worldwide Contact Center

Web: www.GEGridSolutions.com/contact
Phone: +44 (0) 1785 250 070

GEGridSolutions.com

Imagination at work