Q. The response to NP-NLH-018 in Hydro's Holyrood Blackstart Application (the Blackstart Application) states that all 8 of the 2 MW temporary black start diesels must be running to support the startup of a boiler feed pump. In its December 2011 report filed as attachment 1 to NP-NLH-022 in the Blackstart Application, AMEC stated 5 X 2 MW diesels was a viable option. Please explain this apparent discrepancy, and describe whether, in retrospect, all the AMEC recommended options were inadequate.

A. The referenced AMEC report (the Report) identified two potential alternative blackstart sources:

- Two x 5 MW gas turbine generators rated at 13.8 kV connected to the delta primary of the existing T9 transformer; and
- Five x 2 MW diesel generators rated at 13.8 kV connected to the delta primary of the existing T9 transformer.

In the Report, it was identified that Option 1 (two x 5 MW gas turbines) would see excessive voltage drop during starting of the 3000 hp motor. This is presented in Section 3 of the Report:

> Option 1 - Voltage Drop on the 4160 V Bus
> The voltage drop on the 4160 V bus during starting the largest MV motor - 3000 horsepower (hp) boiler feed pump (BFP) motor under the condition of both 5 MW units running (in islanded mode) is about 10% below the recommended minimum of 80% by NEMA MGI. At the same time, starting of a 3000 hp BFP with isolation transformer was found to be unacceptable following preliminary simulation calculations from ETAP. Therefore a detailed procedure must be prepared for the black-start of MV motors.

Concerns were also expressed regarding Option 2 (five x 2 MW diesels), as per Section 3 of the Report:

> Option 2
> The five 2 MW transportable diesel engine generator units option is potentially consistent with the requirements for black start power, but:
> i) The units may have significant difficulty responding to a block load start of 3 MW power block (one boiler feed pump motor), and
> ii) Islanded synchronous operation during start-up of five units may be difficult to maintain and affect overall system capacity available and overall system start-up reliability. It will also likely require a more complex control system.

As stated above, AMEC did not conclusively present either solution as an effective solution for the blackstart of units at Holyrood.

Hydro's specification of a requirement for eight units is based on motor starting analysis. This analysis was performed on the basis that during a blackstart procedures, voltages shall not drop below 81% of nominal voltage. This is based on 4160 V protection relay settings at the Holyrood plant to protect motors from damage during excessive low voltage conditions.

The results of the analysis indicated that a minimum of eight x 1825 kW diesels would be required for blackstart operation of a 3000 hp motor.

It should also be noted that Hydro's analysis was based on the use of 480 V diesel generators and step-up transformers to 4160 V with base loading of 1825 kW. The AMEC analysis involved the use of 2000 kW generators at an operating voltage of 13.8 kV. These discrepancies further explain the difference in results.