Northeast GAS ASSOCIATION
NYSEARCH

Technology Brief

Pipeline to Ultra-Clean Generation Energy Recovery Generation (ERG)

Description: **Development and evaluation of power generation through gate station's existing pressure reduction process making efficient use of energy capacity within the pipeline.**

Status: **Project complete. Enbridge is currently operating a 2.2MW hybrid power plant using a cogeneration system of turbo expander and fuel cell built at an existing city gate station.**

BENEFITS

Technical advancements in many areas of alternative electrical generation are being pursued in today's energy markets. Lowering carbon emissions and increasing efficiencies in producing electricity have been emphasized in the energy sector. There are limits and restrictions to practical generation for an LDC. This project has shown that using the energy inherent to the gas pipeline can be used to produce electricity in a highly efficient way while greatly reducing emissions. An LDC producing electricity from the existing energy within a city gate or large district regulator station can generate additional revenue through the sale of the electricity to the local electric utility or the power can be consumed internally to offset the cost of outside expenses.

This project provides insight to how Enbridge designed, built and now operates and maintains the world's first 2.2MW hybrid power plant of its kind, schematically shown in Figure 1.

BACKGROUND

Enbridge designed and constructed an electric generating facility to adapt to energy conditions existing at a typical gas city gate or large district regulator station. The concept was to capture and convert energy being lost through the existing pressure let-down process and thermodynamically balance the gas pre-heating requirements. Additional technical considerations included interconnection with the local electrical grid. NYSEARCH members supported this project to gain insights to design, material selection, construction and other considerations for potential sites for a similar plant at their city gate or large district regulator stations. This energy capture offers ultra-clean electrical generation from energy already in the gas pipeline. The projections indicated a lower level of carbon emissions to produce the same amount of electricity from standard available power generation practices.

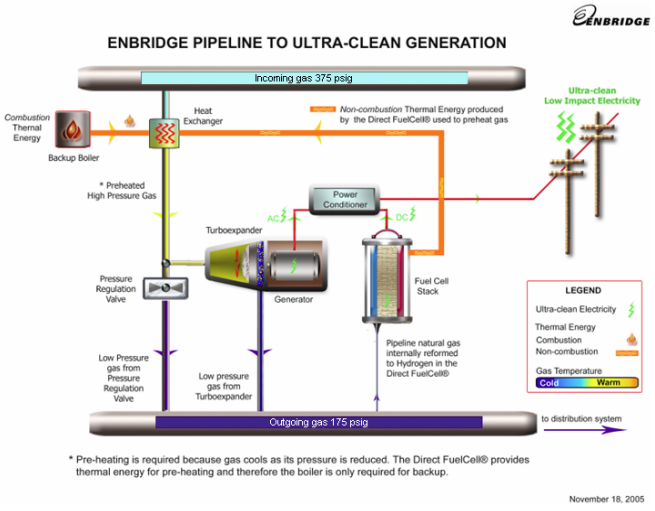

Figure 1: Schematic of Modified Gate Station with Cogeneration Hybrid Facility

TECHNICAL APPROACH

There is significant energy contained in the high pressure and flow characteristics within transmission pipelines. At a gate station, during

the transition point between the transmission energy state to the distribution energy state there are opportunities to capture and reform transitioning energy rather than allowing it to be lost. At each gate and distribution system, pressure is reduced and flow is distributed to feed a piping network. Energy is converted in the pressure let-down activity in accordance with fundamental thermodynamic effects. The energy is lost through a pressure reducing regulator as the temperature drops. Replacing this regulator with a turbo-expander captures this lost energy, producing work (or spinning power). This work energy and flow rate dictates the amount of electricity that may be produced from the turbo-expander.

Figure 2: 2.2MW Ultra-Clean Hybrid Power Generation Facility Located at an Existing Urban Gate Station.

The temperature drop is compensated with gas pre-heaters, typically glycol baths. Glycol baths burn gas to heat the pipeline gas at very low efficiency, 40%. Replacing the glycol bath with a fuel cell provides required temperature compensation for the pipeline gas and produces electricity directly.

The finished hybrid station, shown in Figure 2, combines a thermodynamically balanced turbo-expander with fuel cells to produce 2.2MW of electricity at a very high efficiency rate of 60%.

PROGRAM STATUS

The hybrid facility is complete and operating. Enbridge is successfully operating and maintaining the 2.2MW generating plant while continuing normal operations of the existing gate station.

The NYSEARCH project has captured the lessons learned from Enbridge as they brought this plant from the initial conceptual designs through to operating and maintaining gas flows and electrical production. Enbridge has shared experiences of improvements and avoidance scenarios learned while producing this first facility. They developed economic models that include consideration of plant capital costs, operation and maintenance balanced with point-of-sale and return on investment. The final report and continued Enbridge dialogue provides the NYSEARCH funders a foundation to pursue ultraclean power generation locations.

Highlights

- Power generation through high efficiency cogeneration
- Environmental impact in lower carbon emissions for electricity
- Revenue stream or offset of internal power consumption
- Ready for market

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