

## Pipeline to Ultra-Clean Generation Phase I - Energy Recovery Generation (ERG)

**Description:** An environmentally conscience solution at pressure reducing stations to provide new revenues that offset system operating costs by conserving energy.

**Status:** A One-MW turbo expander cogeneration system has been installed and interconnected with the electrical grid at an Enbridge pressure reduction station.

### BENEFITS

This is an opportunity to participate in a technology demonstration offering natural gas utilities the potential for new revenues through the generation of low impact electricity by optimizing existing utility assets. Utilities will be able to claim corporate goodwill and generate new revenues through technology deployment that reduces air pollution, greenhouse gases, and conserves fossil fuels. Companies that elect to participate in the project sponsorship will have access to performance and economic information attained by the system. Participating utilities will be able to leverage the performance reports to assess how this application could be considered for their respective franchise areas while limiting their own technology implementation risks. The information gained may also serve as a tool that assists with regulatory discussions and a means of justifying

potential requests for revenue premiums or environmental credit

### BACKGROUND

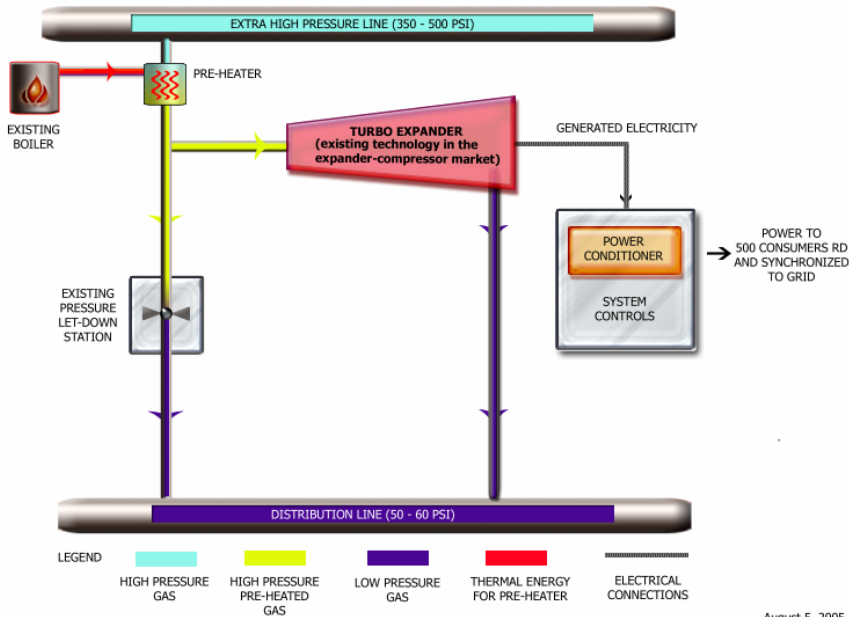
In the past, gas utilities have explored the concept of converting energy from high pressure gas flow to electricity. Historically, the use of technologies such as turbo expanders and reciprocating engines has been limited by site issues. NYSEARCH resolved to examine the risks and opportunities of this concept by collecting information about ongoing and potential activities in this area. A document was written which listed the perspectives captured on the pressure letdown concept. The goal of this exercise was to inform management about the risks and opportunities of this approach. During this process, Enbridge disclosed their activity with this technology and its plans to demonstrate it. Enbridge, along with manufacturers and

other partners has developed a project proposal which focused on Phase I of a two-phase effort. The Phase I effort will demonstrate the turbo expander approach for generating electricity via pressure reduction. As an optionally funded Phase II, a combined heat and power fuel cell in parallel to the turbo expander will be studied and demonstrated as well.

### TECHNICAL APPROACH

The flow in a natural gas pipeline contains significant energy. This is similar to a moving river that can develop hydro electrical power via a water flow turbine. In a similar manner, a unique turbine can be placed in a gas stream to extract energy from the flow while providing reduced pipeline pressure for a distribution system. A turbo-expander generator can be used for this purpose as shown in Figure 1. The amount of power that is produced is a function of the

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flow rate and the pressure reduction ratio.

In accordance with the laws of thermodynamics, a refrigeration effect occurs when gas is expanded. This effect occurs in the static pressure reduction systems currently employed by utilities and will occur to a greater extent when a turbo expander generator is implemented. In order to offset this cooling effect, it is standard practice to pre-heat the gas before it is expanded to maintain discharge pressures at temperatures higher than 32 °F. Failure to do so may create pipeline integrity issues and system control problems due to moisture. The pre-heat can be supplied by an auxiliary boiler or from combined heat and power technologies such as reciprocating engines or high temperature fuel cells.

Phase I work scope includes purchase and incorporation of the turbo expander and other new components of the redundant system, startup and implementation of the system, control optimization, and documentation of performance.

### PROJECT STATUS

Phase I of the project is in progress. The new system has been constructed and commissioned. Control optimization and performance monitoring is underway. Enbridge has also started construction of the second phase, which involves the integration of a 1.2 MW Direct FuelCell® with the turbo expander. This hybrid fuel cell design is starting to attract commercial interest from gas utilities in CT, and other markets.

### HIGHLIGHTS

- Reduce GHG emissions from pipeline operations
- Gain environmental credits
- Eliminate costs of operating pressure reduction stations
- Generate new revenue for gas LDCs

### FOR ADDITIONAL INFORMATION

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