Processing Facilities

Mistral Power Inc. Waste Heat Recovery Unit (WHRU)

This project objective was to recover waste heat from the exhaust of pipeline compressor turbine drivers and convert it into electrical power. The project is successfully generating a peak 7 MW of power.

The process utilized to capture the heat is known as the Organic Rankin Cycle (ORC). Waste heat is captured from the hot exhaust of the gas turbines in large heat exchangers called WHRU's (Waste Heat Recovery Units). The hot exhaust gas transfers its heat to a Heat Transfer Fluid (HTF) that is circulating in a closed heat medium loop. The hot HTF is then used in another cross heat exchanger (evaporator) to evaporate and superheat a working fluid which is usually an organic, high molecular weight fluid. This working fluid is expanded across an expander that is connected to a generator designed to generate power for export to the local electric utility. The expanded working fluid is then condensed in the aerial condensers and pumped back into the evaporator to begin the circuit again.

We were the prime engineering contractor from the early stages of the project including initial R&D activities to pre-FEED, then FEED to all detailed engineering and construction support management services, and troubleshooting. Truly a 'first mover' EPCM approach for this project. The project involved a number of 'firsts' in energy recovery including (but not limited to) the following:

- First two (2) stage variable guide vain radial expander utilized in operation in the supercritical region.
- First use of a readily available commercial grade organic working fluid.
- First EPCM for a WHRU project completed by a Canadian engineering firm in Canada.
- No flaring operation with use of a complex high-integrity pressure protection system (HIPPS) and SIL (Safety Integrity Level) 3.
-Fully unmanned operation with a sophisticated

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automated control system to enable both manned and fully un-manned operation.
- An evaporator operating at supercritical region.

Design of a waste heat recovery and power generation facility by an ORC process involves a number of important steps to ensure a technically sound design which is economically viable. These steps include specifying the WHRU capacities, selection of the heat transfer fluid (HTF), selection of working fluid, process design, equipment selection and heat recuperation (also known as process heat integration or optimization).

The new ORC plant has been installed adjacent to the existing booster station property. It consists of the working fluid storage, circulating and generating equipment, as well as the electrical substation and control center. WHRUs have been installed outside of each pipeline turbine building inside the fenced-in site. Heat transfer piping carries hot and cold heat transfer fluid (HTF) to and from WHRUs, and connects the new ORC plant to the existing site.

Approximately 1 MW of power is consumed by the process, leaving 4.5-6 MW to be exported to the grid. The overall thermal efficiency of the system is about 25%. The process values are directly dependant on the ambient temperature where the condensation of working fluid happens in the fin-fan aerial coolers and therefore all process values have a wide range depending on the range of ambient temperatures during summer and winter.

The major equipment for this project includes:
- Three (3) WHRU's for each of the existing gas turbines which are one (1) GE LM2500+ and two (2) GE LM1600. WHRU's are built to API 530/560 design code, with the larger one weigh approximately 300,000 lb and the

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Husky Energy McMullen TCP Air Injection Thermal Oil Recovery (Thermal Conduction) Pilot Plant

smaller ones weigh 200,000 lb each.

- The expander-generator is two high speed radial machines in series, an integral gearbox, and a 13.8 kV – 9 MVA synchronous generator, lube oil skid, lube oil cooler and all controls and instrumentation.
- Both Economizer and Evaporator/Superheater are shell & tube designs with the Evaporator/Superheater being two (2) units of stacked shells operating at supercritical region.
- The Condenser is an aerial fin-fan cooler consists of 7 bays, each bay with three (3) fans and a duty of 10 MMBtu/hr.