Organic Rankine Cycle: an effective solution for heat recovery in the Oil & Gas industry

In the Oil&Gas supply chain, several processes produce a considerable amount of heat, currently wasted in the atmosphere: Associated Petroleum Gas (also known as flare gas) characterizes the upstream, whereas high-temperature refining processes are typical of the downstream. In the middle, the transport of both oil and natural gas requires a not negligible amount of energy. In this context, pipelines are the preferred choice where gas compressor stations (or oil pumping stations) usually operate open-cycle gas turbines to pump the products along the pipeline. Gas turbines are a simple and reliable technology, but they are not very efficient and they waste a considerable amount of energy in the atmosphere through the exhaust.

Specifically, when analyzing the natural gas transport, it is possible to define the typical configuration of a gas compressor station, where several gas turbines with limited capacity (< 50 MW each) work in parallel to drive natural gas compressors. Such small-to-medium size gas turbines do not allow the implementation of traditional combined Rankine Cycle. Indeed their exhaust gas temperatures and flow may not be sufficiently high, especially under partial load conditions, to generate steam at the conditions needed to achieve a high overall electrical efficiency, while maintaining good flexibility. An alternative, viable and effective solution is the implementation of a combined cycle based on the Organic Rankine Cycle (ORC).

ORC technology, thanks to the use of specific organic working fluids, permits an efficient exploitation of high-to-low temperatures exhaust gas streams, as it could be the case for smaller gas turbines, especially when working on poor quality fuels. In addition, the specific features of the organic fluids used lead to relevant technical advantages, such as high turbine efficiency (up to 90%), low mechanical stress of the turbine (low rotational speed and low tip speed), no blades erosion, no oxidation, high efficiency at partial loads and with low temperature sources. These characteristics result in an overall heat recovery system that is completely automatic, with simple start-stop procedures and quiet running, and that has high availability and flexibility while maintaining long lifetime (> 20 years) and minimum O&M requirements and costs. Considering also that the ORC unit can be air condensed (therefore ensuring an operation with no water consumption), the ORC technology is perfectly suited for application in areas where water supply can be problematic or even impossible.

Among its 300 ORC plants operating worldwide and other 50 units under construction, Turboden has field-proven experience in combined cycle projects with different plants exploited as bottoming cycle of both open cycle gas turbines and reciprocating engines. The latest contracts awarded in this field are located in Uzbekistan, where two Turboden power plants are under construction, recovering heat from three GE LM1600 gas turbines and one GE LM2500 gas turbine respectively.