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Waste Heat Recovery for Offshore Application

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1 Motivation

With increasing incentives for reducing CO₂ emissions, energy optimization on offshore platforms becomes a focus area. Gas turbines efficiency in offshore application typically ranges from 20-30%. To enhance their performance a bottoming cycle is introduced. A preferable technology is the organic Rankine cycle (ORC) because of its low gas turbine outlet temperature, space and weight restrictions. The case of study is the Draugen platform in the Norwegian Sea.

2 Methods

DNA (Dynamic Network Analysis) is the simulation tool used for the system analysis. The fluid library has been extended by linking DNA with the commercial software REFPROP 9; more than a hundred real media including hydrocarbon fluids are now available.

3 Plant Analysis

The plant is constituted by the Siemens SGT-500 twin spool gas turbine, the intermediate loop and the ORC. The low and high pressure axial compressors are mechanically coupled by two distinct shafts with the low and high pressure turbines while the power turbine drives the generator. The fuel is assumed to be natural gas.


DOWTHERM Q is utilized as heat carrier: it presents low viscosity, better thermal stability and heat transfer coefficient with respect to hot oils through its operating range. The off-gases temperature requires fluids with a high critical temperature. Toluene, cyclohexane, cyclopentane and benzene are therefore selected as ORC working media.

5 Acknowledgements & References

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Figure 1: Tube-type gas turbine Siemens SGT-500

Figure 2: Draugen oil platform, North Sea, Kristiansund, Norway

Figure 3: Tube-type gas turbine Siemens SGT-500

Figure 4: Temperature vs. heat exchanged inside the waste heat recovery unit (Maximum pressure of working fluids)

Figure 5: Temperature vs. heat exchanged inside the waste heat recovery unit (Maximum pressure of working fluids)

Table 1: Design point specifications for the Draugen platform [1]

Table 2: Thermodynamic states at critical point and hazard rating for the four ORC working fluids [3]

Table 3: Working fluids for the ORC bottoming cycle [1]. The off-gases temperature requires fluids with a high critical temperature. Toluene, cyclohexane, cyclopentane and benzene are therefore selected as ORC working media.