HyNet North West

VERTEXHYDROGEN

HyNet Hydrogen Production Plant 1 – Technical Note

EPR Response - 9eii - BAT for energy efficiency

Summary

Problem Statement

A quantitative estimate of waste heat, and its thermal level, that could be potentially recovered from the CO_2 compressor to potential users either within the hydrogen plant flow sheet or external users.

Quantify the potential benefit on the overall energy conversion figure presented in Table 3-4 of the Application Supporting Document, from the potential heat recovery from the CO_2 compressor.

Response

The CO2 Compressor (C103 A/B) is multi-stage unit with interstage cooling. Heat of compression is removed in interstage coolers using cooling water as cooling medium.

A Hysis simulation was used to evaluate the interstage cooling. CO2 is cooled in the interstage coolers from 117°C-106°C at the compression stage outlet to 45°C utilising approximately 7092kW of cooling duty.

While heat integration with the compressor interstage coolers will introduce significantly more operational complexity to the CO2 compression system, further study is planned for purposes of optimising cooling and considering recovery of waste heat, including heat of compression. Streams that could be considered for heat integration are itemised below, subject to the study outcome.

1. Boiler Feed Water: Boiler Feed water is at 129.6°C (Stream 705) and will not be a source of cooling for the hydrogen product stream.
2. Demineralised Water heating: The water stream is heated from 4°C to 120°C by cooling a syngas stream from 135°C to 124°C. This system (demin water heating) is already heat integrated and is not available as a source of cooling.
3. Oxygen from ASU: this stream is heated from 30°C (stream 114) to 210°C (stream 211) in heater E-103 requiring 1,200kW of duty. However, from Enquiry 9e, Table 2-4: HPP Utilities states: “It is noted in passing that for safety reasons there will be no integration between the ASU and the wider HPP.” Oxygen from the ASU is not available as a source of cooling.
4. Combustion air – this stream is heated from 10°C to an unspecified temperature at the outlet of the Fired Heater (F-101) and the Steam Boiler (B-101). Potentially this is a good match on temperature basis. This stream is integrated into the Fired Heater and Boiler packages and further study is required.
5. NG Feed (stream 103) is heated from 40.7°C to 230°C (stream 104) in a section of the Feed Fired Heater F101. Potentially CO2 compression heat could be used for pre-heat of this stream – not to 230°C but partially. This stream is integrated into the Fired Heater package and further study is required.
6. The NG Feed is heated in electrical heater 10-AAF-H-001A from 5°C to 40°C. The duty of the electrical heater is 789.9kW from data sheet 5194812-000-45ED-4-0037. Heat integration with this stream could save electrical import of 789.9kW however it is operated intermittently.
7. NG Feed is also heated in electrical heater 10-AAF-H-002A. The heat duty from data sheet document 5194812-000-45ED-4-0039 reports a duty of 327kW heating natural gas from 4.5°C to 20.5°C however it is operated intermittently.

Heat integration results in an improvement on the energy conversion figure in Table 3-4 of the Environmental Permit Application Supporting Document, if it results in a reduction in electrical power import. It is to be confirmed with further study if heat integration can reduce power import.

Heat integration does not result in less Natural gas feed import as natural gas is not used for process heat. Process heat is supplied by either heat integration (for example using hot syngas to heat Demin Water) or combustion of PSA tail gas.

If power import is reduced then a 1,000kW of power import reduction leads to ca 0.3% efficiency improvement.

In conclusion, there are possibilities for use of the CO_2 Interstage coolers for heating or partial heating of colder process streams. This will be looked into at the next phase of engineering in which cooling system optimisation will be evaluated.