HyNet North West

VERTEXHYDROGEN

HyNet Hydrogen Production Plant 1 – Technical Note

EPR Response - 9e - BAT for energy efficiency

Summary

Problem Statement

Provide further assessment of the opportunities for recovering waste heat from compressors (CO2 compressor, ASU compressor and hydrogen compressor), informed by:

Response

Opportunities for recovering waste heat have been discussed in 9eii and 9eiii and summarised for this response.

Heat recovery from the ASU unit is excluded due to safety concerns and complexity or reliability limitations at this stage, which can be further verified during detailed engineering along with individual vendor package details and integration and value engineering workshop.

For the CO_2 Compressor and H_2 Compressor systems:

A cooling optimisation study is planned and the outcome of that will support evaluation of heat integration and waste heat recovery from the CO_2 and Hydrogen compressor systems. For the CO_2 compressor system, interstage cooling is required, as is cooling on the outlet of the last stage – both are included for purposes of this response. For the Hydrogen compressor, there is no interstage cooling, it is a single stage compressor but cooling is required on compression outlet, and this is included in the response discussion.

Streams that could be considered for heat integration are included below for consideration 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: Referring to data sheet 5194812-100-45ED-3-0011 for the demineralised water heater, the water stream is heated from 4°C to 120ºC by cooling a syngas stream from ca 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 1200kW 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 for heat integration. 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 230oC 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.
8.

Heat integration results in an improvement on the energy conversion figure in Table 3-4 of the Environmental Permit Application Supporting Document only if it results in a reduction in electrical 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 in the Boiler and Fired Heater packages.

If power import is reduced then a 1000kW of power import reduction leads to ca 0.3% efficiency improvement.

In conclusion, there are possibilities for using heat of compression in the CO2 and Hydrogen compression concepts for heating colder process streams. This will be looked into at the next phase of engineering in which cooling system optimisation will be evaluated.