

HyNet Hydrogen Production Plant 1 – Technical Note

EPR Response – 9a – BAT for energy efficiency

Summary

Problem Statement

Overall energy efficiency conversion. Recalculate and express the overall energy efficiency conversion figure, presented in table 3-4 of the Permit Application Supporting Document as 74.1%, on a consistent thermal input basis for the power input figure.

- Energy Content of H2 product (LHV) is a thermal power figure
- Energy Content of Feed Gas (LHV) is a thermal power figure
- Power import is an electrical power figure

The power import figure should be expressed as the equivalent *Energy content of H2 product (LHV)* that would be necessary to generate the electrical power input required by the hydrogen production plant. To calculate this figure, you may either:

Response

Calculation Inputs:

The power import for the main rotary equipment during the operating of Plant 1 are as below, with consideration given to over the fence utilities and operational integration with plant equipment:

- H2 Compressor – 2.95 MW
- CO2 Compressor – 5.65 MW
- Natural Gas Compressor – 0.044 MW
- O2 Vaporizer – 0.039 MW
- Natural Gas heater – 0.465 MW
- Fire Water pump & Jockey pump – 0.046 MW
- ASU – 9.854 MW

Therefore, the total power import currently stands at 22.8 MW per hr, which includes all other auxiliaries for plant operation.

Based on an electrical efficiency of 96% this increases the power input to 23.7 MW. This is based on a weighted average absorbed load for the anticipated operational plant setup.

Calculations:

Using a Best Available Technology CHP efficiency of 58.5 % for power as a reference.

Taking the hydrogen production of 9,000 kg/hr.

The Energy Content of H₂ = 300 (LHV)

The Energy Content of Feed Gas = 375 (LHV)

Then using the following equation for overall energy efficiency conversion

$$\frac{\text{Energy content of H2 product (LHV)}}{\text{Energy content of Feed Gas (LHV) + power import}}$$

The overall energy efficiency is calculated as:

$$\text{Efficiency} = 300 / (375 + (23.7 / 0.585)) = 0.7219 = 72.19\%$$

Further Developments:

The Permit Application data within table 3-4 updated shall be updated in due course as required.

Further updates are envisaged to Appendix#2 and Electrical load list update, with respect to;

- Finalisation of individual loads from vendor data
- Operation synchronisation
- Heat integration
- Possible removal of equipment such as the Natural Gas inlet compressors

All of which shall drive the import power requirements down and hence increase the overall energy efficiency of the plant.

Used References:

[1] Appendix#2 prepared for power import calculation in line with Document No. 5194812-000-47EL-4-0001_Rev 04 Electrical Load List (Phase 1).