HyNet North West

VERTEXHYDROGEN

HyNet Hydrogen Production Plant 1 – Technical Note

EPR Response 21 - Risk assessment for emissions from the flare

Summary

Provide a quantitative risk assessment for the emissions of sulphur compounds from the combustion of off-gases from the flare based on our web guidance https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit and Environmental permitting: air dispersion modelling reports - GOV.UK (www.gov.uk), or provide additional justification and evidence in support of your proposal not to carry out a quantitative risk assessment.

Notes: The application states that 'Periodic short-term flaring of gas with an elevated sulphur content is conceivable' (ref. 2.3.37 of the Application Supporting Document), whilst the area is withing an AQMA for SO2. Based on the application, we don't have enough information to concur with the conclusion of the qualitative assessment presented in section 7.3.3 of the Permit Application Supporting Document that the impacts from emissions from the flare are negligible.

Response:

Additional justification and evidence in support of not carrying out quantitative risk assessment, for the emissions of sulphur compounds from the combustion of off-gases from the flare, is aligned with response to 2a:

Details:

Refinery Off Gas

Refinery Off Gas (ROG) is supplied from the Stanlow Manufacturing Complex to the Hydrogen Production Plant for the production of hydrogen, which is then fed back to enable the decarbonisation of the existing refinery operations.

Upstream of the ROG off-take to the hydrogen plant is a dedicated H_2S removal unit, which targets H_2S composition < 10ppmv.

There is an analyser package [10-AAI-U-003] located upstream of the ROG compressor package [10-AAI-U-002] near to the supply of ROG on the Stanlow Complex, which provides data on ROG quality and composition. If the ROG is found to be off specification, then isolation valve 10-700-AAI-XZV-0003 is closed at the outlet of the ROG compressor package and the ROG stream is recycled around the ROG compressor package itself, or if the pressure on the outlet of the ROG compressor package increases, it is sent back to the Stanlow Complex via 10-700-AAI-PCV-0001. In either case, the ROG is prevented from entering the Hydrogen Production Plant (HPP1) and prevents high levels of sulphur entering the plant and hence the flare system.

To minimise flaring at HPP and utilise the calorific content, the preference would be to return any off-specification gas that passes the analyser during its cycle time, discussed below, to Stanlow for use in plant fired heaters (as it is today).

Analyser Description

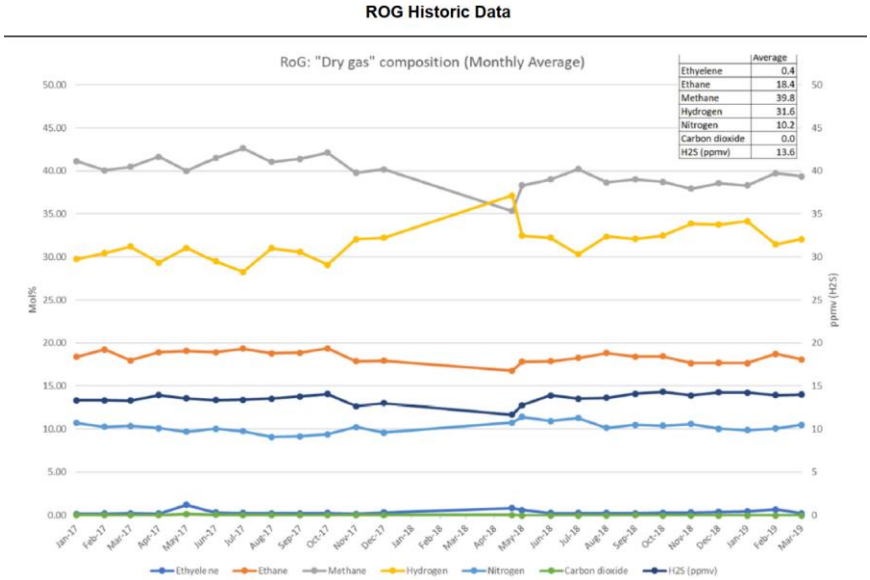
An analyser package [10-AAI-U-003] is currently contained within the design and contains a Gas Chromatography (GC) analyser. There shall also be a dedicated Sulphur Species (SS) analyser installed during the next engineering design phase. Both of these analysers shall have a 2 out of 3 voting system. The GC operates on a 5-minute cycle time and the (SS) operates with a 1 second cycle time.

Therefore, the duration of an off-specification ROG stream with higher sulphur content entering the pipelines feeding the ROG compressor would be 2 seconds, based on the 2 out of 3 voting system for the SS analyser. A margin of 5 seconds would be assumed.

Sulphur Content Specification Point

As shown by the recent chart below of the compositional analysis for the ROG stream, the sulphur content is reasonably stable between 12 ppmv and 15ppmv. Therefore, the value at which the ROG stream flow is set at to prevent higher

levels of sulphur in entering the Hydrogen Production Plant (HPP1) shall be at 20ppmv (final value set at commissioning and after operational performance is completed), this set value shall close isolation valve 10-700-AAI-XZV-0003.



Sulphur Content Protection

Consideration is given to various scenarios:

- Normal operations: where the sulphur content shall range between 12 ppmv and 15ppmv.
- Higher sulphur load operations: that are higher than the 13.6ppmv but lower than the set point of 20ppmv.
- Possible spike levels of sulphur operation: higher than the setpoint of 20ppmv which closes isolation valve 10-700-AAI-XZV-0003.

The potential sulphur slip within these scenarios has been catered for by the inclusion of a Hydrosulphurisation vessel [V-101] using propriety catalyst “Puraspec 2571” and a Desulphurisation vessel [V-102A/B] using propriety catalyst “Katalco 32-4”.

Both of these vessels are located downstream of the ROG compressor package, immediately before entering the Hydrogen Production Plant’s (HPP1) reforming units. These vessels remove the sulphur components by converting any sulphur species to hydrogen sulphide (Hydrodesulphurisation) and then capturing them (Desulphurisation) within a guard bed.

Sulphur Potential Slip

Based on envisaged normal and higher sulphur load operations, it is expected that this sulphur capturing system would last for approximately 4 years, with very low levels (<0.1ppm) of sulphur species envisaged to enter the reforming reactors. As sulphur is a poison to the downstream reforming catalyst, sulphur slippage and required timing of catalyst replacement will be closely monitored.

Based on possible spike levels of sulphur operations, the duration of 5 seconds for the SS analyser, would lead to approximately 15kg of off specification ROG entering the pipelines network upstream of the ROG compressor. This quantity is considered insignificant, and the 5 second time margin allows sufficient time to close isolation valve 10-700-AAI-XZV-0003 and divert the off-specification ROG back to the Stanlow Manufacturing Complex.

Even if any sulphur did find its way downstream of the sulphur capturing system, it would be removed within the reforming reactors / catalyst as a poison and be prevented to from entering any of the further downstream processes.

Any high sulphur ROG not being fed to HPP1 will still be burnt elsewhere on the refinery, via the fuel gas main using existing controls.