

## HyNet Hydrogen Production Plant 1 – Technical Note

### EPR Response - 2g - Operating techniques and BAT for the flare

#### Summary

Section 6.2.1 of Permit Application Supporting Document states that the flare will operate only during process upset (including start-up and shutdown) and emergency operations, well below 3% of the time. Explain the basis for this estimate.

#### Response

##### **1. Introduction**

The HPP will be designed for an operational life of 25 years. This means 25 years X 365 days X 24 hours = 219,000 operational hours.

The flare will be used during:

1. Start-up
2. Shutdown
3. Planned maintenance
4. Process upset (unplanned event)
5. Blowdown

Sections below address the flare usage duration for each activity.

##### **2. Flare Usage Duration for Start-up, Shutdown, Planned Maintenance and Process Upset (Unplanned Event)**

After commissioning, first plant start-up will require some flaring. Same is true for final decommissioning of the plant at end-of-life. Hence for flare usage:

- No. of plant start-ups = 1 (first after commissioning)
- No. of plant shutdowns = 1 (for final plant de-commissioning)

The HPP will be designed to achieve a 4-year turnaround schedule (i.e., planned shutdowns only occur on each unit every four years). Hence total no. of planned plant shutdowns = 25 years / 4 years = 6. This means:

- No. of planned plant start-ups = 6 (for each turnaround)
- No. of planned plant shutdowns = 6 (for each turnaround)

The plant shall be designed to have an availability of at least 95% averaged over its lifetime. Availability is to take account of both planned and unplanned maintenance. The plant shall be designed so that no planned outage is greater than 20 days from hydrogen off to hydrogen on (full load to full load).

Assuming 2 process upsets (unplanned events) that will require flaring:

- No. of unplanned start-ups = 2 (for each event)
- No. of unplanned shutdowns = 2 (for each event)

Tabulated below are the durations of flare usage for each activity:

Table 2-1: Flare Usage Duration for Start-up, Shutdown, Planned Maintenance and Process Upset (Unplanned Event)

Sl. No.	Activity	Flare Usage Duration (hours) Note-1
1	First Plant Start-up	1 X 5 days X 24 hours = 120
2	Plant Start-up after Planned Maintenance	6 X 3 days X 24 hours = 432
3	Start-up after Unplanned Process Upset	2 X 2 days X 24 hours = 96
4	Plant Shutdown for Planned Maintenance	6 X 3 days X 24 hours = 432
5	Shutdown due to Unplanned Process Upset	2 X 2 days X 24 hours = 96
6	Shutdown for Final Plant De-commissioning	1 X 5 days X 24 hours = 120
<b>7</b>	<b>Total Flare Usage Duration</b>	<b>1,296 hours (Note-2)</b>

Note-1: These are ballpark estimates of days the activities are carried-out for in general.

Note-2: This is not the non-stop flaring duration. It is sum of flaring durations over the entire life of plant.

### 3. Flare Usage Duration for Blowdown

#### 3.1. Individual Blowdowns

Blowdown valves are provided within the hydrogen export metering system, natural gas import system, and CO<sub>2</sub> capture unit, in order to depressurise the system during an emergency scenario. Each blowdown valve shall discharge to the flare system.

A blowdown arrangement consists of a valve with downstream restriction orifice. Each orifice has been sized to depressurise the system to 6.9 barg in 15 minutes due to an external fire scenario as per API521.

Tabulated below are the durations of flare usage during blowdowns of individual area:

Table 3-1-1: Flare Usage Duration for Individual Blowdowns

Sl. No.	Area	Flare Usage Duration (minutes)		
		Fire Case (De-pressurized to 6.9 barg)	Adiabatic Case (De-pressurized to 0 barg)	Cold Case (De-pressurized to 0 barg)
1	Hydrogen export system	15	36.5	37
2	Natural Gas Metering	15	29.5	31.25
3	Natural Gas Suction KO Pots	15	26.75	27.25
4	Natural Gas Compressor	15	28.5	29.25
5	Natural Gas Supply	15	34.75	35.75
6	Natural Gas Let-down	15	31.0	32.75
7	CO <sub>2</sub> Capture Unit	15	HOLD	HOLD
<b>8</b>	<b>Total Flare Usage Duration</b>	<b>485 minutes/60 = 8 hours (Note-1)</b>		

Note-1: This is not the non-stop flaring duration. It is sum of flaring durations over the entire life of plant.

#### 3.2. Full Blowdown – simultaneous blowdown of all Phase 1 and 2 blowdown valves due to an emergency scenario.

This scenario assumes that there is a fire in the LCH Plant (either Phase 1 or 2) or in the natural gas import area with coincident adiabatic blowdown of all other areas. It is assumed that the rest of the plant is operating at normal conditions when an emergency shutdown is initiated. The full blowdown scenario also assumes additional blowdown valves that will be added as part of Phase 2 of the project.

Tabulated below are the durations of flare usage during full blowdown:

Table 3-2-1: Flare Usage Duration for Full Plant Blowdown

Sl. No	Area	Flare Usage Duration (minutes)	
		Fire Case (De-pressurized to 6.9 barg)	Adiabatic Case (De-pressurized to 0 barg)
1	LCH Plant (Phase 1 or 2)	15	NA
2	Hydrogen export system	NA	36.5
3	Natural Gas Metering	NA	29.5
4	Natural Gas Suction KO Pots	NA	26.75
5	Natural Gas Compressor	NA	28.5
6	Natural Gas Supply	NA	34.75
7	Natural Gas Let-down	NA	31.0
8	CO <sub>2</sub> Capture Unit	NA	HOLD
<b>9</b>	<b>Total Flare Usage Duration</b>	<b>202 minutes/60 = 3 hours</b>	

#### 4. Conclusion

The total time during which flare would be used is approximately 1,307 hours (not continuous, it is spread over the entire life of the plant). For total operational life of 219,000 hours (25 years), this equates to approx. 0.6% flare usage.

Hence, with flare operational only during process upset (including start-up and shutdown) and emergency operations, it's usage duration will be below 3% of the time.

#### References:

1. Basis of Design (5194812-000-30EA-2-0001, Rev. 06)
2. Flare Simulation Report (5194812-400-49ER-4-0001, Rev. 03)