Gas Transmission Network Asset Risk Metrics (NARM) Methodology

Consequence of Failure Supporting Document

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1. Introduction

This document is aimed at stakeholders who wish to obtain a more detailed understanding of how the impact of asset failure, or Consequences of Failure (CoF), are calculated in the NGT NARM Methodology. All NGT assets are modelled within a Pipeline or Site risk model. A risk model describes the relationships between the failure rate (likelihood of failure per annum) and the assessed consequences of failure (number of events and monetary value of consequence, per-annum), which are then combined to calculate the annualised monetised risk of each individual asset. The approach taken allows asset-level monetised risk analysis to be undertaken. Both condition and non-condition related failure modes and consequences are considered.

The consequences of failure, as related to service risk measures, are the same for both Sites and Pipelines. As such, the document is structured by service risk measure, rather than being split by Pipelines and Sites. Where differences in consequence calculations exist, these are noted in the relevant section.

Changes to this document, since the originally published NOMs Methodology, are limited to changes made following completion of the Validation Report, which was produced as part of the rebasing exercise to rebase our RIIO-1 network outputs target into monetised risk. These changes have already been incorporated into the Baseline Network Risk Output (BNRO) assessments carried out as part of the RIIO-2 submission and incorporated into the RIIO-2 License Special Conditions 3.1 and 9.2. The treatment of CoF in long term monetised risk benefit (LTRB) calculations is discussed in the Long-Term Risk & Network Risk Outputs Supporting Document.

All CoF calculations are categorised in the context of our Service Risk Framework (SRF). The SRF consists of 13 measures grouped into five categories as shown in Figure 1 below.

Category	Service Risk Measure
Safety	Health and Safety of the General Public and Employees
	Compliance with Health and Safety Legislation
Environment	Environmental Incidents
	Compliance with Environmental Legislation and Permits
	Volume of Emissions
	Noise Pollution
Availability and Reliability	Impact on Network Constraints
	Compensation for Failure to Supply
Financial	Shrinkage
	Impact on Operating Costs
Societal and Company	Property Damage
	Transport Disruption
	Reputation

Figure 1 Service Risk Framework Categories and Measures

The Service Risk Framework supporting document provides further detail on how service valuations were derived for the NARMs Methodology and for risk modelling and optimised investment planning. The sections below relate to probability, severity and quantity of consequences only.

Once the failure mode frequency (Probability of Failure) has been calculated for each individual asset the consequences of failure need to be determined. In calculating the consequence of asset failure, we consider several elements:

- Probability of consequence – this reflects that not all failures of a given failure mode will always lead to the consequence. For example, the probability that a corrosion defect will lead to a corrosion hole, and subsequent gas emissions and fire/explosion risk
- Severity of consequence – this reflects the potential different types and severities of the eventual consequence. For example, the mode of transport disrupted (e.g. motorway or minor road), or the severity of the health and safety event
- Quantity of consequence – this reflects the scale of the consequence. For example, the time of the disruption event or the number of people affected

The assessment is developed in this way in order to ensure that the final risk assessment can be valued in monetary terms.

2. Consequence of Failure Modelling Principles

2.1. Sites

The relationships between consequences of failure and service risk measures used in the Sites model are shown in Figure 2.

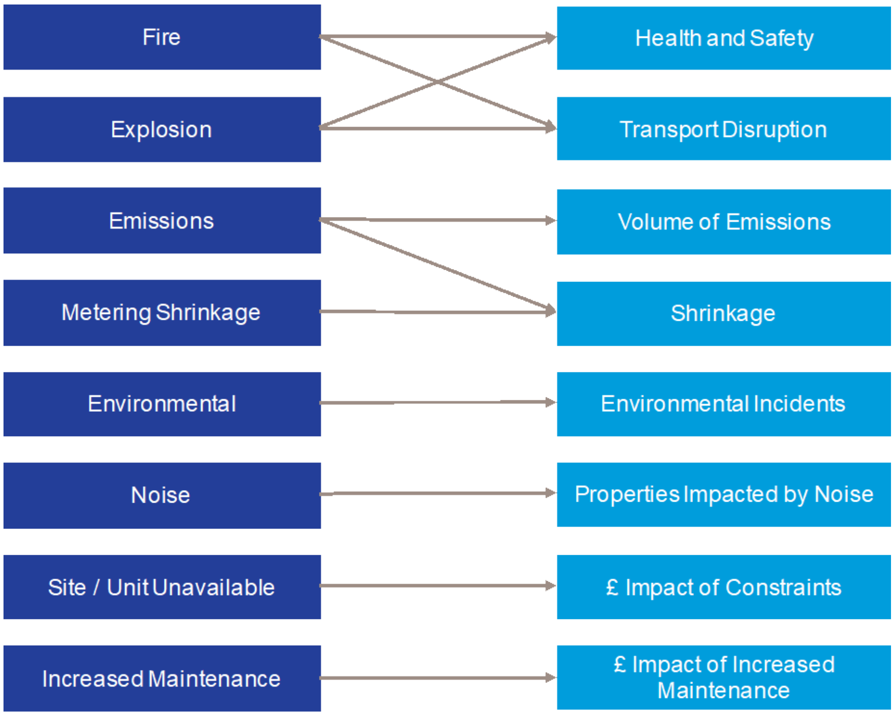

Figure 2 Mapping of Site failure consequences to the SRF

The costs to NGT of any damage to reputation resulting from asset failure are not directly quantified but are included in the SRF for completeness. An element of reputational damage, both to National Gas and the wider industry, is considered within the Gross Disproportionality Factor (see Service Risk Framework supporting document).

The events that take place following asset failure may link to a defined service measure through several consequential effects. For example, an asset failure that presents as a gas leak could potentially lead to a fire. The fire in turn could lead to an injury or disruption to transport (see Section 0).

The probability of each consequence occurring is defined for sites assets using the OREDA Offshore Reliability Data, which is an internationally recognised source of data used for reliability engineering applications (1). Appendix A includes a list of failure modes and the assumed proportions of failures which result in observable and/or measurable consequences (failure mode proportions). Appendix B shows the failure consequences assessed for each failure mode, which were obtained through the elicitation process described in the Probability of Failure supporting document (2) and validated with specialist external consultants.

[1] 5th Edition 2009 Volume 1 Topside Equipment, prepared by SINTEF, distributed by Det Norske Veritas (DNV)).
[2] Probability of Failure supporting document, Appendix D

2.2. Pipelines

The risk map for Pipelines is shown in Figure 3. There are two consequences, leak or rupture, which can arise from several failure modes. The probability of a leak or rupture consequences will be different for each failure mode. If the leak or rupture occurs then further consequences may arise, such as health and safety or environmental impacts, which can be quantified and valued in monetised risk terms:

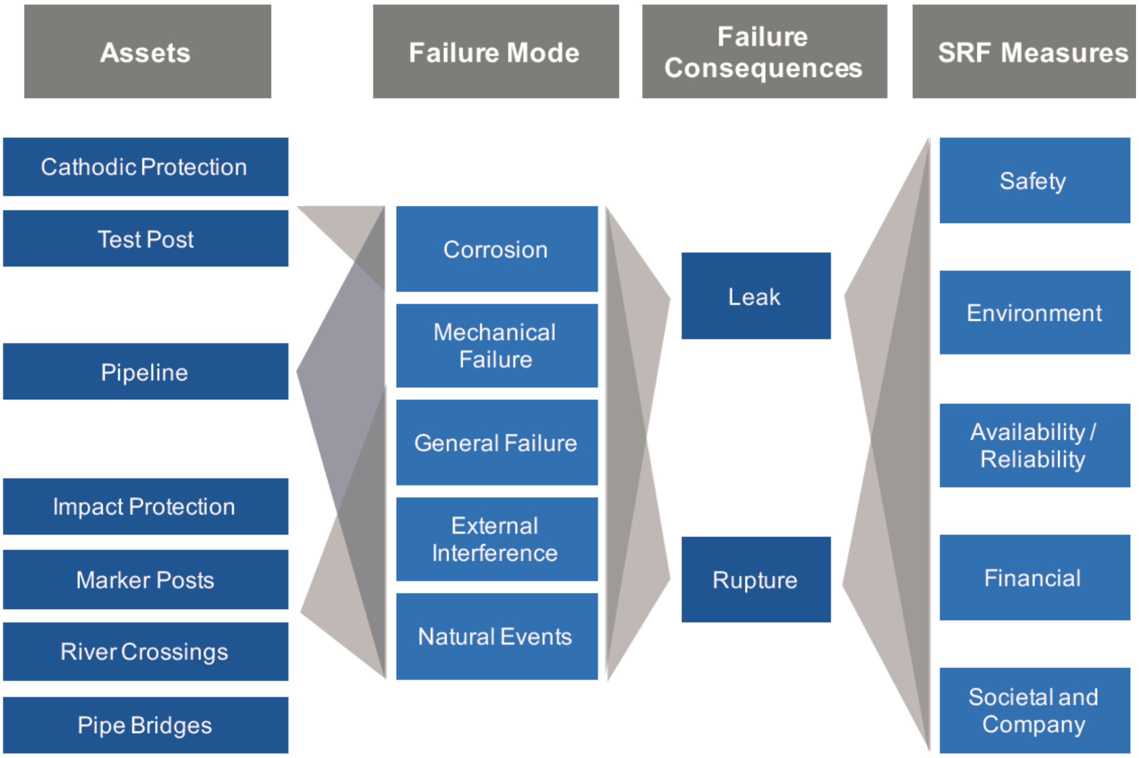

Figure 3 Risk mapping and failure consequences for Pipelines

For the example shown, a leak arising from a corrosion failure has a possibility of causing a leak or a rupture. Data from UKOPA and EGIG has been used to determine the proportion of each failure mode that leads to a leak and to a rupture. This data has been used to determine the likelihood that a leak or rupture will lead to one of the identified consequences.

UKOPA (3) data is used to benchmark and scale each of the key failure risk fault nodes and the number of leaks. EGIG (4) data is used to benchmark and scale the number of ruptures due to the very low UKOPA sample size. The UKOPA and EGIG published values are used to estimate the proportions of each defect that will result in an actual leak or rupture. The values currently used are shown in Table 1. These were updated following the expert review undertaken through the validation exercise (5).

Table 1 Proportions of Pipeline failure modes resulting in leak or rupture consequences

[3] UKOPA Pipeline Product Loss Incidents and Faults Report (1962-2013)
[4] EGIG – Gas pipelines incidents, 9th Report of the European gas pipeline Incident Data Group (period 1970-2013)
[5] NGT NARMs Validation Report, Section 7.3.2

Failure Mode	Corrosion	External Interference	Mechanical	Natural Event	General
Leak	100%	1.42%	1.16%	0%	6.98%
Rupture	0%	2.43%	0%	4.76%	0%

3. Safety

3.1. Fire and Explosions – Probability of Consequence

The logic for fires and explosions probability of consequence is based on a several reference sources, which are listed below:

- "Review of the event tree structure and ignition probabilities used in HSE's pipeline risk assessment code" MISHAP RR1034. Prepared by the Health and Safety Laboratory for the Health and Safety Executive 2015.
- "The User Guide for the AGI safe package" V5.1, DNV GL Report No 13492, 2014
- "Detonation: Should it be Included in Hazard and Risk Assessment?" V H Y Tam, M D Johnson, DNV GL Chemical Engineering Transactions Vol 48 2016
- "Guidelines for Evaluation Process Plant Buildings for External explosions and Fires". Centre for Chemical Process Safety, AICE 1996. Appendix A, Explosion & Fire Phenomenal and Effects

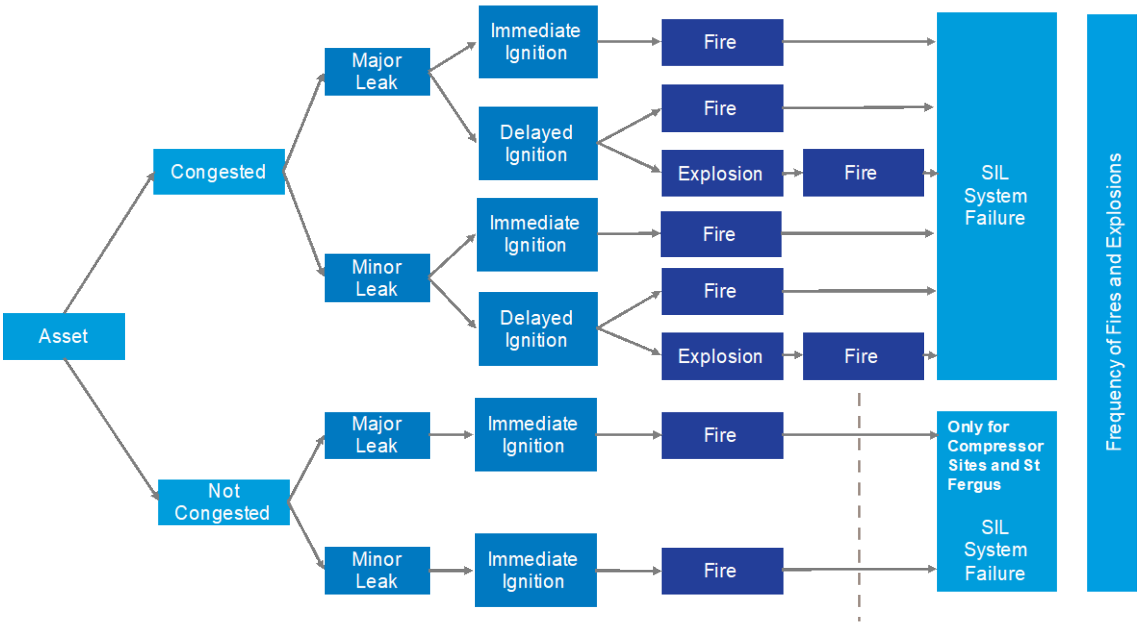

Figure 4 Logic diagram to estimate the probability of Fire and Explosion consequences

Figure 4 above shows the event tree for Fires and Explosions which has been incorporated into the Sites model.

The top half of Figure 4 shows situations where the space in which natural gas leak occurs is congested with other equipment and/or pipework. Congested areas provide the conditions in which a flammable vapour cloud could form and if ignited could lead to an explosion. Following the logic diagram, the probability of explosion applies when a major or minor leak occurs, followed by delayed ignition which has allowed a vapour cloud to form. Following an explosion, it is assumed that a fire will occur.

The relevant probabilities of immediate and delayed ignition for assets on National Gas installations are given in the AGI Safe manual and are summarised in fire safety reports for compressor stations (6). An excerpt from this report is shown in Figure 5 below.

GL Noble Denton

Report Number: 10567
Issue: 1

Table A-2: Ignition Probabilities for Small Leaks

Hole Size (mm)	Immediate Ignition Probability	Delayed Ignition Probability
100	0.29675	0.30000
50	0.12187	0.23802
20	0.03758	0.07340
10	0.01544	0.03014
5	0.01000	0.01953

Figure 5 Ignition probabilities for different leak sizes

We have assumed all significant leaks have a hole size of 5mm. Minor leaks are assumed to have a hole size of 1mm and ignition probability of zero. These values are based on SME expert opinion.

To estimate the probability of an explosion following an ignition of a significant leak a HSE document relating to offshore events was used (7), giving a value of 21% (Figure 6).

Table 9 Probability of explosion given ignition

Event	North Sea data	Worldwide data
	Number of events	
Fire (no explosion)	142	343
Explosion	38	95
	Probability	
Probability of explosion	0.21	0.22

Figure 6 Probabilities of an explosion occurring following gas ignition

[6] Report Number: 10567 Generic Fire Risk Assessment Methodology for Compressor Stations, September 2010

[7] Review of the event tree structure and ignition probabilities used in HSE's pipeline risk assessment code MISHAP RR1034. Prepared by the Health and Safety Laboratory for the Health and Safety Executive 2015, Table 9

Some installations are set up with Safety Instrumented Functions and a Safety Integrity Level (SIL) rating of two (2), which is designed to reduce the risk and impact of fire and/or explosions (8). Our approach incorporates three factors in order to assess the likely failure of the SIL system:

- Fire System – Detector
- Fire System – Control Panel
- Fire System – Fire Equipment

Using the assessed failure rates for each of these, the overall SIL system failure rate can be determined based on the assumption that if any one of these three elements fails, the overall SIL system fails.

It is appreciated that the time between a major gas release and ignition could be very short. A fire system would require an explosion suppressant, such as flooding the building with carbon dioxide or an extinguishant, to be automatically applied immediately on detecting levels of gas that could lead to ignition in order to protect against explosion. However, the SIL system will offer further protection against the fire that may follow the explosion.

3.2. Hazard Ranges – Severity & Quantity of Consequence

Following a fire or explosion, there is a possibility health and safety consequences for both employees and general public. We determine this impact in two stages by considering:

- The severity of the incident, and
- The quantity of people potentially affected (Figure 7)

The failure modes that lead to Health and Safety consequences are based on the asset type and purpose, as shown in the failure mode mapping shown in Appendix B.

[8] A methodology for the assignment of safety integrity levels (SILs) to safety-related control functions implemented by safety-related electrical, electronic and programmable electronic control systems of machines Prepared by Innovation Electronics (UK) Ltd and the Health & Safety Laboratory (HSL) for the Health and Safety Executive 2004

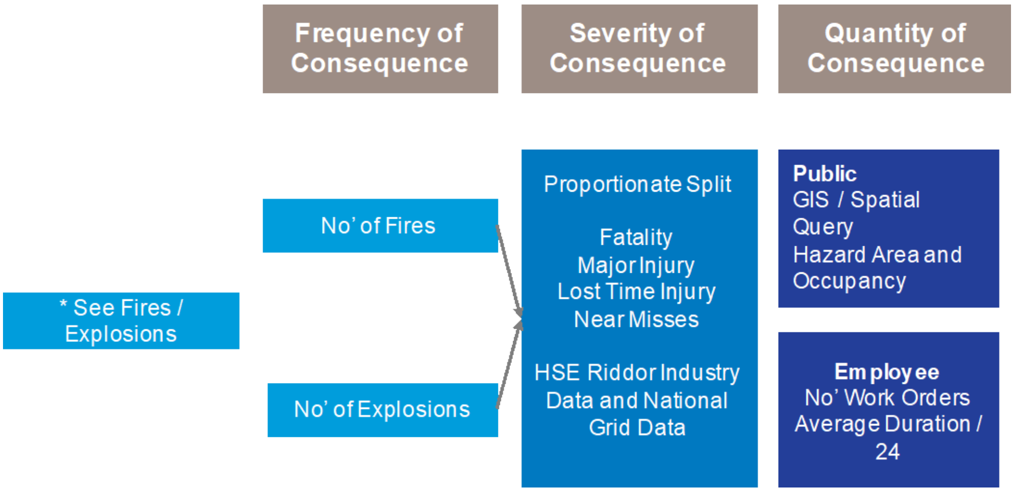

Figure 7 Health & Safety consequences of Fires and Explosions

We have not experienced any failures due to poor asset condition that have led to harm to individuals so have referred to international data (9) to estimate the proportion of failures that might lead to harm to individuals. An injury will occur should a fire or explosion occur and an individual (general public or employee) is in the vicinity of the hazard.

The modelling of hazard areas is a complex area of analysis which has been undertaken through several studies, engagement with industry experts and review of the Hazard Assessment Methodology (10). The Methodology uses the hazard distances that have been derived from studies undertaken by DNV GL (11). These distances are applied within a geographic spatial analysis to identify and count the number of properties potentially impacted by a fire on any site. An occupancy rate calculation using the Hazard Assessment Methodology is then applied so that the number of people exposed to death or injury risk can be determined.

The hazard ranges are quantified as shown in Figure 8, assuming a full-bore rupture, which is the worst-case scenario. The assumed operating pressures are consistent with those used to calculate the published Building Proximity Distance (BPD), which is further used to derive the size of the hazard ranges, and numbers of people at risk.

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[9] HSE RIDDOR (electricity, gas, steam and air conditioning supply) data for 2013/14 to 2015/16 (HSE RIDIND: RIDDOR reported injuries by detailed industry)

[10] National Grid Hazard Assessment Methodology for Above Ground Installations, July 2016

[11] Hazard Range Calculations for National Grid Compressor Stations, Report Number: 14373 August 2013; National Grid HATS Update Hazard Assessment of the National Grid Transmission System National Grid Report No.: 155218, Rev. 0 Date: September 2016

2.1 Hazard Ranges

The following hazard ranges were evaluated for each of the releases.

2.1.1 Escape Distance

"Escape distance", is the distance from the fire from which a person could be expected to escape without injury in the form of second degree burns i.e. skin blistering. The speed of escape has been assumed as 2.5 ms^{-1} for the calculations undertaken. This hazard distance also equates to the 'Inner Cordon'.

2.1.2 Building Burning Distance

Ignition of combustible material on buildings or structures can also be caused by intense thermal radiation, although this is again dependent on the time of exposure. The threshold for buildings exposed to thermal radiation is taken as the flux level at which secondary fires may be started by piloted ignition of combustible materials (minimum 12 kW/m^2).

2.1.3 Stationary Receiver Distance

A person is assumed to have escaped when a region is reached where the thermal radiation level is below 1 $kW\,m^{-2}$, and it is assumed that a person can be exposed to this level indefinitely without injury. This is termed the stationary receiver distance. This hazard distance also equates to the 'Outer Cordon' distance.

2.1.4 Dispersion Distances

For gas cloud dispersion the hazard distance is taken to be when the gas concentration has decayed to the Lower Flammable Limit (LFL). For natural the LFL is 4.9% by volume gas in air. This hazard distance for natural gas dispersion represents the maximum distance within which a sufficiently energetic ignition source could ignite a release and burn back to source leading to a flash fire or explosion. In principle, persons and property within this range could be affected in the event of ignition occurring, although in practice the occupants of most buildings would be from the effects of a transient flash fire.

Half LFL has also been considered to account for the possibility of small pockets of flammable mixture which may ignite but will not flash back to the source.

The LFL and ½ LFL dispersion distances calculated are the horizontal downwind distance (for a wind speed of 10 m/s) and the vertical distance from the release.

Figure 8 Hazard ranges following a full-bore rupture and fire/explosion (12)

For the Sites model (except block valve AGIs), the Burning Building Distance, Escape Distance and Stationary Receiver Distance have been assigned to Inner, Outer and Extreme hazard areas respectively.

For the Pipelines model and block valve AGIs, the Building Proximity Distances (BPD) from our asset register is used to determine the Inner, Outer and Extreme hazard areas. These were agreed to represent 1 x BPD, 4 x BPD and 8 x BPD respectively through consultation with gas pipeline safety experts. A per-property occupancy rate assumption using the Hazard Assessment Methodology is then applied so that the number of people at risk of death or injury can be assessed.

Using the Inner, Outer and Extreme spatial hazard areas, assumptions as to the proportions of deaths and/or injuries occurring following a major explosion have been defined in consultation with recognised gas pipeline safety experts (Figure 9):

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[12] Source: Report Number: 14373 August 2013 Hazard Range Calculations for National Grid Compressor Stations GL Noble Denton, p10

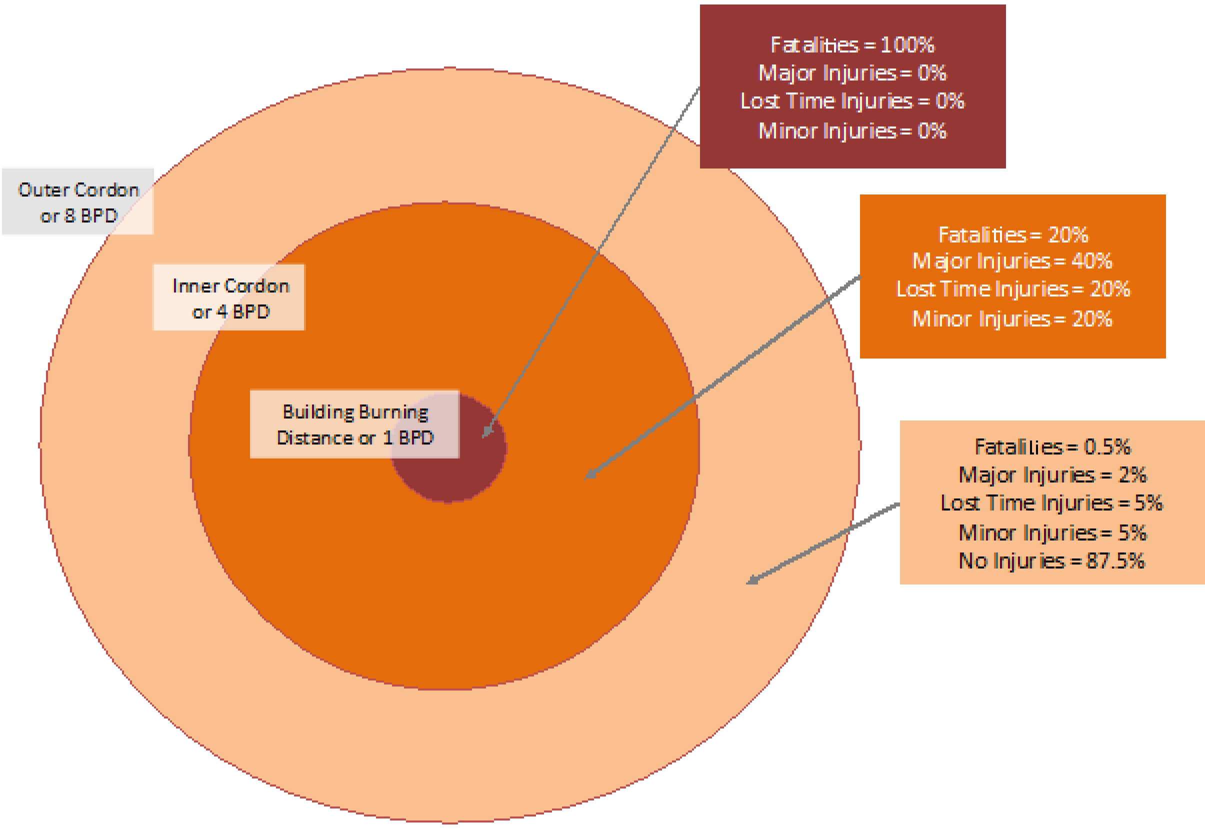

Figure 9 Assumed probabilities of death and injury at defined hazard ranges

For the impact on NGT employees, it has been assumed that employees who are working where the fire or explosion occurred will be impacted. This consideration is made following an assessment of the safety distances and the average size of NGT's sites. The chance of an employee being impacted is adjusted based on the estimated time the site is manned over a year.

We have further assumed that for fires that the impact is constrained within the NGT site and therefore consequences are limited to our employees only. We therefore assume the general public are only at risk or death or injury following explosions at AGIs and are not affected by fires (although there may be societal consequences).

For Pipelines, a similar approach has been used but the hazard areas have been calculated dynamically, as buffers around the pipe section, using spatial data analysis (Figure 10). Impact of NGT employees is not considered (we assume that our employees' activities are constrained to AGIs). This is a reasonable assumption as block valve AGIs are modelled as sites, not pipelines. We assume that the Safety consequences of fire and explosion are equivalent at the hazard ranges defined in Figure 9.

The Validation Report expert review (13) highlighted that there was a potential for over-statement of population risk from fires and explosions. The previous approach was believed to overstate Safety risk as: PIE recommended that correction factors to be applied based on degree of likely protection at these locations which were applied in our models. The

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[13] NGT Validation Report, Section 7.2.10

application of these factors reduces the numbers of fatalities by a factor of 90% in rural areas and 97% in suburban areas.

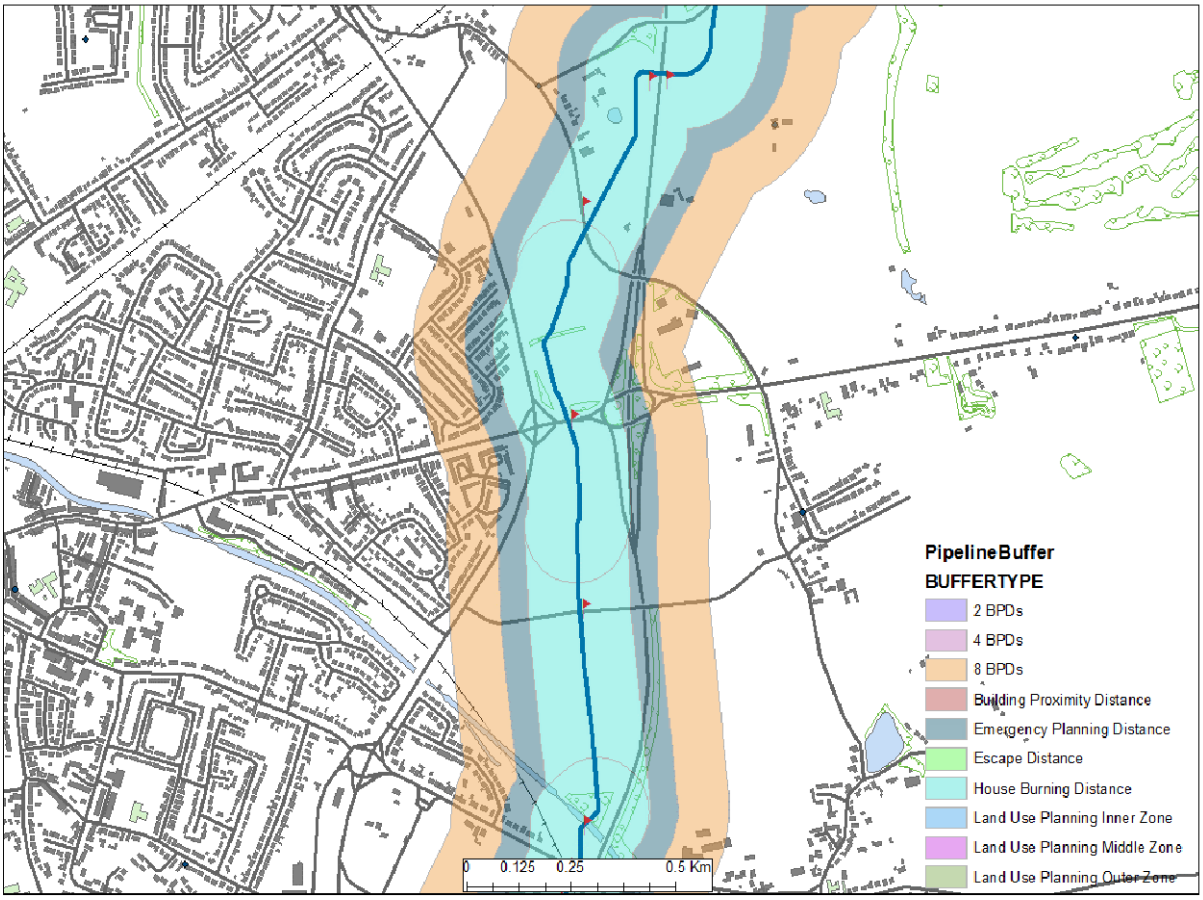

Figure 10 Pipeline buffer zones, showing changes in death and injury likelihood based on localised pipe characteristics and environment

4. Environmental

4.1. Incident Categories – Probability & Severity of Consequence

The failure modes that lead to environmental incidents are based on the asset type and purpose as shown in the mapping provided in Appendix B.

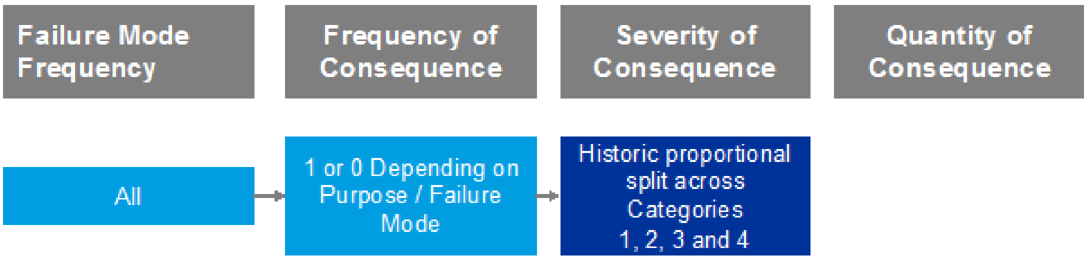

Figure 11 Environmental incident consequences

The spread of environmental incident severities is based on proportions representative of the spread of actual environmental incidents for the different incident severities covering the past 5 years (National Gas internal data).

This is summarised in Table 2 below:

Table 2 Assumed proportions of each severity of environmental incident

Incident	Proportions
Category 1 Incident	4%
Category 2 Incident	69%
Category 3 Incident (near miss)	27%

There are four severities for compliance with Environmental Legislation and Permits in the Service Risk Framework[14]:

- Increased permit costs
- Increased reporting against legislation
- Improvement notice / prohibition notice
- Prosecution

A value and expected probability for each of these is defined based on the severity and quantity of the environmental incidents. The valuation of Environmental monetised risk is discussed in the SRF supporting document.

Environmental incidents have been assessed to have a comparatively minor impact on overall monetised risk but are included such that localised issues can be identified and addressed within the Methodology.

4.2. Gas Emissions – Quantity of Consequence

As per Figure 12, the failure modes identified to impact on emissions relate to:

- Emergency Shut Down (ESD) venting which have been identified to occur with unit or system trips
- Major and minor leaks
- Routine maintenance activity

The failure modes that lead to Emissions consequences are based on the asset type and purpose as shown in the mapping provided in Appendix B.

[14] Service Risk Framework Supporting Document, Section 5.5.2

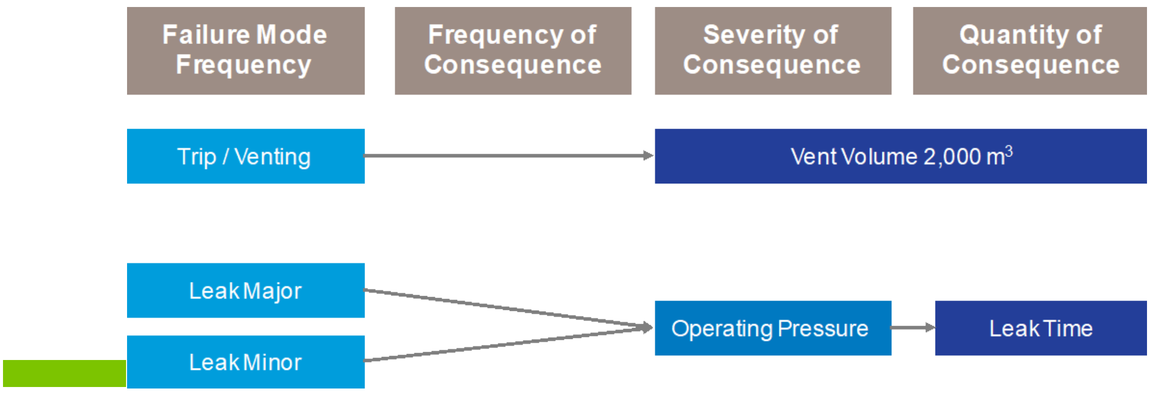

Figure 12 Gas emissions consequences

To estimate the emissions arising from compressor venting, an average vent quantity of 1813 m^3 per vent is assumed based on analysis of emissions data reported in the RRP. Venting events arise from failure modes of specific assets.

For non-compressor sites, vent events due to emergency shut down or other venting down of site equipment/systems are assumed to always take place given that the failure mode has occurred. Examples of failure modes leading to a vent are listed below:

- Mechanical electrical elements failing
- Failure of lube oil system leading to unit trip
- Temperature control loss trip – only associated with After Coolers
- Fire alarm evacuation may cause unit trip
- Pre heat trip low outlet temperature
- Filter blockage unit trip – only for air intakes

Where leaks occur and should a fire or explosion then arise, then the emissions impact is assumed to be zero (although burned gas will release carbon dioxide this is assumed to have minimal impact on environmental risk). As modelled numbers of fires and explosions are very low then this simplification has minimal impact on overall monetised risk. The probability of a leak that does not lead to a fire or explosion is then used to determine the vent volume of unburned gas and therefore overall emissions volumes.

To determine the quantity of the emissions, the leak volume equation from the Pipeline Rules of Thumb Handbook (15) has been used.

For Sites assets, a hole diameter of 5mm has been assumed for significant leaks and that minor leaks lead to negligible levels of emissions (1mm hole diameter assumed). The equations used (in imperial units) are shown in Figure 13.

[15] E W McAllister 5th Edition ISBN 0-7506-7471-7, 5th Ed, 2002

Estimate the amount of gas blown off through a line puncture

To calculate the volume of gas lost from a puncture or blowoff, use the equation:

$$Q = D^2 P_1$$

where: Q = Volume of gas in Mcf/hr at a pressure of 14.9psi, 60°F, and with a specific gravity of 0.60
D = Diameter of the nipple or orifice in inches
P = Absolute pressure in lb/in.^{2} at some nearby point upstream from the opening

Example. How much gas will be lost during a five minute blowoff through a 2-in. nipple if the upstream pressure is 1,000 psi absolute?

$$Q = D^2 P_1$$

$$Q = (2)^2 \times 1{,}000$$

$$Q = 4{,}000 \text{ Mcf/hr}$$

$$Q_{5\,\text{min}} = 4{,}000 \times \frac{5}{60} = 333 \text{ Mcf}$$

Figure 13 Gas loss volume calculations

Allowing for conversion to imperial units, the following equation has been used:

Volume of emissions in m^3 = 0.00157088 x D^2 x P x LEAK_TIME

Where:

D is the hole diameter in millimetres

P is the absolute pressure in bar

LEAK_TIME is in hours

For Pipelines assets the Maximum Operating Pressure (MOP) of the specific section is used. For Sites assets, we assume an average pressure of 50 bar and the leak run times as follows:

- 10 minutes for Bacton and St Fergus Terminals (24 hour manned)
- 12 hours for compressor sites
- 24 hours for all other sites

For pipelines, a 40mm hole is assumed with the leak running for an average of 12 hours. The gas volume associated with the depressurisation of the pipeline to undertake a repair assumed based on the average distance between block valves and an average pipeline diameter. For a rupture the loss of gas is assumed to occur at a high rate corresponding to open pipe flow for 3 hours (until isolated) and then depressurised for repair (as per leak).

To reflect the overall emissions from the network, including the environmental impact of our own repair and maintenance activity, the concept of maintenance emissions was introduced. This approach distributes all non-failure related emissions across assets which have a “loss of gas” failure consequence. The maintenance emissions are calculated from the difference between overall emissions and emissions from gas leaks and ESD vents and equates to a value of 110 m3 per asset per year (16).

The conversion of these assessed emissions and shrinkage volumes to a monetary value is discussed in the SRF supporting document.

[16] NGT Validation Report, Section 7.4

5. Financial

All financial consequences of failure are measured directly from the modelled failure rates, as described in the SRF supporting document. For example, a repairable failure (or a reactive repair) will result directly in a repair cost. Shrinkage volumes arise directly from Environmental consequences, as described in the previous section.

6. Availability and Reliability

To value the contributions of Above Ground Installations (AGIs, which includes Compressors) and Pipeline sections towards NTS resilience and the avoidance of supply loss, we recognise that the consequence of asset failure (and hence consequence value) will depend on the prevailing demand and supply conditions.

Following the Validation Report expert review some extensive changes were made to how we estimate Availability/Reliability risk, allowing the sensitivity of risk to changes in supply and demand scenarios to be tested (17). The changes made are summarised as follows:

- A 1 in 20 supply and demand scenario was chosen after sensitivity testing against other high terminal flow scenarios. This uses gas flows extracted from hydraulic modelling, rather than the historic telemetry data used previously
- A revised approach to value the loss of a gas terminal was implemented, using the expected entry flows under the applied 1 in 20 demand scenario
- Previously it was assumed that the loss of an exit point could be "flow swapped" in agreement with a Gas Distribution Network (GDN). This assumption has been removed as the opportunity to use another offtake is unlikely under 1 in 20 demand conditions

Other changes in how the loss of supply to customer is valued are discussed in the SRF supporting document. The overall approach to assessing the Availability and Reliability CoF is shown in Figure 14.

[17] NGT Validation Report, Section 9.1

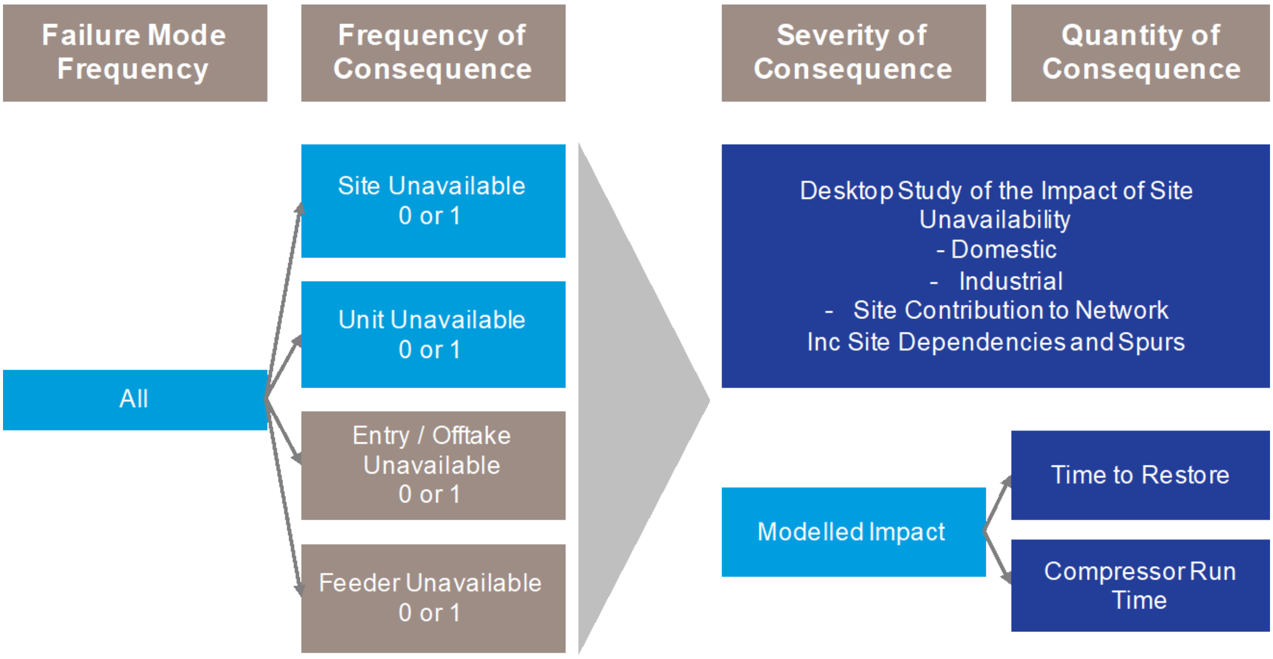

Figure 14 Availability and reliability consequences following asset outage

To understand the impact of the loss of a single site or pipeline on the whole network, a logical, connectivity model has been built including every AGI and pipeline. This considers for any individual failure the loss of directly connected exit or entry points in addition to the loss of any dependent connected assets. Where an exit point site is part of the interconnected network then the loss of supply is only due to a failure at the exit point itself.

Where a site is situated on a spur, the loss of supply consequence applies to all upstream sites up to the point at which the site is supplied by two separate pipelines, discounting cases where the 2 pipelines pass through a common site further upstream (Figure 15). For pipelines assets, we treat individual sections as per individual AGIs and an equivalent connectivity-based approach is adopted.

This NTS connectivity model was updated to take account of the changes in gas flows through a pipeline and site under different supply and demand conditions. This uses data from our NTS hydraulic modelling system (SimOne) assuming a base demand year of 2021 and a Steady Progression Future Energy Scenario (FES) demand projection.

For RIIO-3 planning the scenario of Falling Short and a demand year of 2031 has been used as Steady Progression no longer exists in the FES.

Two major consequences of failure were identified by the expert review that have not been addressed at this stage

- That the Safety risk associated with the wide-scale loss of supply to customers is not included
- That the social costs (potential increase in customer gas prices) caused by breakdown of the UK gas trading market (and we are unable to transport gas from major Entry points) are not modelled

The Safety risk has been included for RIIO-3 planning following an OFGEM led NARMs Audit, to increase alignment to other sectors, the safety impact following an outage is detailed in section 6.1. The impact on the gas trading market was not considered and should be explored through a future improvement to the Methodology.

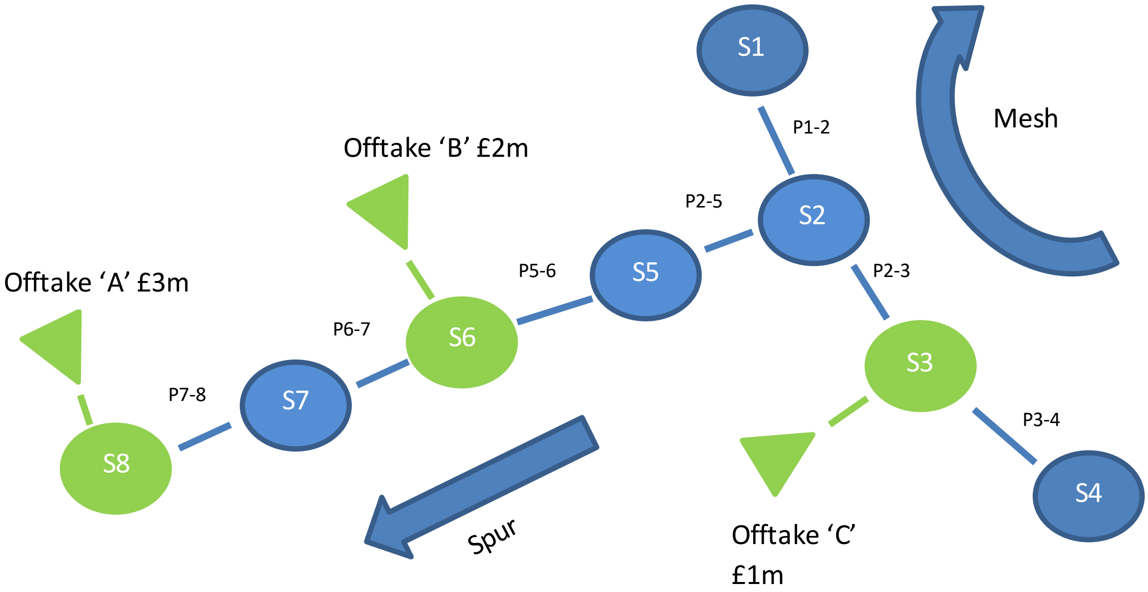

Figure 15 Connectivity approach to assess availability/reliability consequences

This connectivity model is then translated into a dependencies and consequence matrix for each AGI and pipeline section as shown in Figure 16 below. For example, a failure of AGI S7, would also impact on pipeline P7-8, AGI S8 and Offtake 'A', with a consequence value of £3m. If S1 and S4 were the selected site to be valued, then all sites would be dependent on them as they are not part of the wider mesh.

Node	S2	P2-5	S5	P5-6	S6	P6-7	S7	P7-8	S8	S3	S1	P1-2	P3-4	S4
Dependencies	P2-5	S5	P5-6	S6	Offtake 'B'	S7	P7-8	S8	Offtake 'A'	Offtake 'C'				
	S5	P5-6	S6	Offtake 'B'	P6-7	P7-8	S8	Offtake 'A'						
	P5-6	S6	Offtake 'B'	P6-7	S7	S8	Offtake 'A'							
	S6	Offtake 'B'	P6-7	S7	P7-8	Offtake 'A'								
	Offtake 'B'	P6-7	S7	P7-8	S8									
	P6-7	S7	P7-8	S8	Offtake 'A'									
	S7	P7-8	S8	Offtake 'A'										
	P7-8	S8	Offtake 'A'											
	S8	Offtake 'A'												
	Offtake 'A'													
Total loss Cost	£5m	£5m	£5m	£5m	£5m	£3m	£3m	£3m	£3m	£1m	£0	£0	£0	£0

Figure 16 Sites/pipelines dependency matrix

The failure modes and proportions of failures that lead to Availability/Reliability consequences are based on the asset type and purpose as shown in the mapping provided in Appendix B. The raw model outputs were calibrated to an expected frequency of site outage (given that many outages can be prevented by operational or commercial interventions) (18).

6.1. Fatalities following an Outage

Following an Ofgem NARMs led audit to increase alignment across networks and resilience work with the Department for Energy Security and Net Zero the addition of cold weather fatalities has been added to the NARMs Methodology.

The addition will help focus monetised risk around Sites and Pipelines that are single source supply to large customer offtakes. This addition will see prioritised investments around customer offtakes in order to maintain and reduce the risk values and calculations can be seen in the Service Risk Framework Supporting Document

7. Societal & Customer

7.1. Transport Disruption

In order to calculate the disruption caused to traffic from a leak, fire or explosion incident the cordon distances within the National Gas Incident Procedures have been used. These cordon distances have been applied to each site and pipeline and the affected transport routes identified (e.g. major road or railway). The duration of the incident is considered when undertaking the valuation. This process is shown in Figure 17.

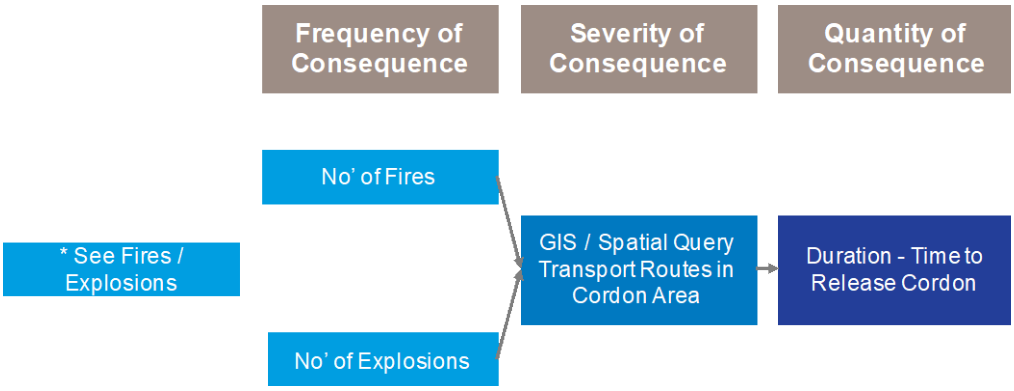

Figure 17 Transport disruption consequences of fires and explosions

Transport disruption has a relatively minor impact on monetised risk but is included such that localised issues can be modelled within the Methodology.

7.2. Noise Pollution

Noise nuisance consequences have been assessed to have a relatively minor impact on monetised risk but are included such that localised issues can modelled within the Methodology.

[18] NGT Validation Report, Section 5.2.4

As per Figure 18, the failure modes that lead to noise pollution are based on the asset type and purpose, as shown in the mapping provided in Appendix B.

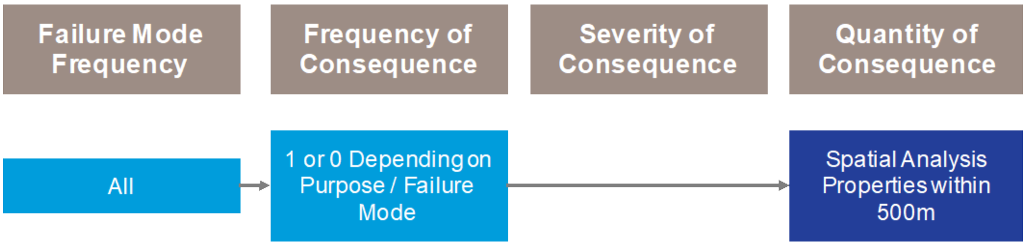

Figure 18 Noise pollution consequences

The numbers of properties affected by noise have been calculated from a spatial analysis of properties within 500 metres of the site boundary, which has been assessed as the maximum distance for a quantifiable noise nuisance caused by our assets.

8. Consequence of Failure Validation

Version 2.0 of the NOMs Methodology described how the initial validation of the CoF for sites and pipelines assets was carried out. This has been superseded by the NARM Methodology Validation Report, which is part of the NGT NARM Methodology document suite.

9. Document Control

Version	Date of Issue	Notes
1.0	3rd April 2018	Draft NOMs Methodology version ready for public consultation
2.0	22nd May 2018	Final NOMs Methodology version sent for Ofgem acceptance
3.0	17th May 2021	Draft NARMs Methodology version ready for public consultation updated following RIIO-2 business plan submission
4.0	14th August 2021	Final NARMs Methodology version sent for Ofgem acceptance
4.1	5th December 2022	Draft NARMs Methodology submitted for Ofgem approval
5.0	31st March 2024	Draft NARMs Methodology version ready for public consultation updated following RIIO-3 business plan submission

10. Appendix A

Site Failure Modes (Consequences) and Failure Mode Proportions

SUBPROCESS	FAILURE_MODE_DESCRIPTION	FAIL_MODE_PROPORTION
132KV COMPOUND SYSTEM	Loss of electric drive unit - trip	0.20
ABOVE GROUND PIPEWORK SYSTEM	Corrosion no leak - pressure reduction	0.59
ABOVE GROUND PIPEWORK SYSTEM	Gas leak loss of Part of site minor leak	0.02
ABOVE GROUND PIPEWORK SYSTEM	Gas leak loss of Part of site significant leak	0.00
ACCESS & SITE SERVICES SYSTEM	Fail to access site for maint/ emergency	0.50
AFTER COOLER SYSTEM	Corrosion minor leak	0.02
AFTER COOLER SYSTEM	Corrosion no leak	0.59
AFTER COOLER SYSTEM	Electric fault loss of aftercooler high outlet temp - trip	0.05
AFTER COOLER SYSTEM	Gas leak significant	0.00
AGI STATION PIPEWORK	Corrosion no leak	0.59
AGI STATION PIPEWORK	Gas leak minor	0.02
AGI STATION PIPEWORK	Gas leak significant	0.00
AIR INTAKE SYSTEM	Loss of station gas drive - trip	0.08
AIR INTAKE SYSTEM	Loss of unit gas drive - trip	0.08
ALL IN ONE GAS MEASUREMENT SYSTEM	Loss of gas quality information	0.87
ALL IN ONE GAS MEASUREMENT SYSTEM	Minor gas leak from instruments	0.02
ALL IN ONE GAS MEASUREMENT SYSTEM	Significant gas leak from instruments	0.00
ANCILLARY EQUIPMENT SYSTEM	Corrosion no leak	0.39
ANCILLARY EQUIPMENT SYSTEM	Gas leak minor	0.04
ANCILLARY EQUIPMENT SYSTEM	Gas leak significant	0.05
ANCILLARY EQUIPMENT SYSTEM	Unable to isolate for maint/emergency	0.02
ANCILLARY VALVES SYSTEM	Corrosion no leak	0.39
ANCILLARY VALVES SYSTEM	Gas leak minor	0.04
ANCILLARY VALVES SYSTEM	Gas leak significant	0.05
ANCILLARY VALVES SYSTEM	Unable to isolate for maint/emergency	0.02
BATTERY CHARGER & BATTERIES SYSTEM	Power failure leading to loss of control	0.55
BATTERY CHARGER & BATTERIES SYSTEM	Power failure leading to loss of station	0.55
BATTERY CHARGER & BATTERIES SYSTEM	Power failure leading to loss of unit	0.55
BELOW GROUND PIPEWORK SYSTEMS	Corrosion no leak - pressure reduction	0.59

BELOW GROUND PIPEWORK SYSTEMS	Gas leak minor	0.02
BELOW GROUND PIPEWORK SYSTEMS	Gas leak significant	0.00
BOUNDARY PRESSURE CNTRL & PROT SYS	Reduction in pipeline capacity if unavailable	0.38
BUILDING & ENCLOUSURES SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	0.64
BUILDINGS SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	0.87
BURIED INOPERABLE VALVES SYSTEM	Corrosion no leak	0.59
BURIED INOPERABLE VALVES SYSTEM	Gas leak minor	0.02
BURIED INOPERABLE VALVES SYSTEM	Gas leak significant	0.00
BYPASS PROCESS PIPEWORK SYSTEM	Corrosion no leak	0.59
BYPASS PROCESS PIPEWORK SYSTEM	Gas leak minor	0.02
BYPASS PROCESS PIPEWORK SYSTEM	Gas leak significant	0.00
BYPASS PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - loss of monitoring and control	0.29
CAB VENTILATION SYSTEM	Loss of unit - Instrumentation or Electrical fault	0.11
CATHODIC PROTECTION SYSTEM (SI)	Increased corrosion on pipe	0.69
CMS - ANTI-SURGE CONTROL SYSTEM	Failure to control surge damage unit	0.17
CMS - ANTI-SURGE CONTROL SYSTEM	Loss of unit - trip	0.17
CMS - HMI/SCADA SYSTEM	Loss of remote monitoring / control	0.50
CMS - PLC/DCS SYSTEM	Loss of local control	0.50
CMS - STATION PROCESS CONTROL SYSTEM	Loss of local control	0.50
COMPRESSOR SEAL SYSTEM (DRY)	Filter blockage - unit trip	0.01
COMPRESSOR SEAL SYSTEM (DRY)	Filter blockage detection failure	0.01
COMPRESSOR SEAL SYSTEM (DRY)	Loss of gas unit	0.69
COMPRESSOR SEAL SYSTEM (WET)	Filter blockage - unit trip	0.01
COMPRESSOR SEAL SYSTEM (WET)	Filter blockage detection failure	0.01
COMPRESSOR SEAL SYSTEM (WET)	Loss of gas unit	0.23
COMPRESSOR SEAL SYSTEM (WET)	Oil spill from wet seal	0.61
CONDENSATE TANK SYSTEM	Vessel corrosion	0.70
CONDENSATE TANK SYSTEM	Vessel failure significant gas release	0.50
Control Loop	Loss of site - trip	0.50

Control Loop	Loss of unit - trip	0.40
CONTROL MONITORING & PROTECTION SYSTEM	Station failure to operate	0.50
CONTROL MONITORING & PROTECTION SYSTEM	Unit failure to operate	0.38
CRITICAL VALVES SYSTEM	Gas leak minor	0.03
CRITICAL VALVES SYSTEM	Gas leak significant	0.11
CRITICAL VALVES SYSTEM	Unable to isolate for maint/emergency	0.11
DETECTOR	Fire alarm evacuation may cause unit trip	0.64
DISCHARGE PROCESS PIPEWORK SYSTEM	Corrosion no leak	0.59
DISCHARGE PROCESS PIPEWORK SYSTEM	Corrosion on pipework - no leak	0.59
DISCHARGE PROCESS PIPEWORK SYSTEM	Filter blockage - unit trip	0.01
DISCHARGE PROCESS PIPEWORK SYSTEM	Filter blockage detection failure	0.01
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak minor	0.02
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak minor from Pipework	0.02
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak significant	0.00
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak significant from Pipework	0.00
DISCHARGE PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	0.28
DISCHARGE PROCESS PIPEWORK SYSTEM	Temperature control loss - trip	0.04
DISTRIBUTION BOARD & POWER CIRCUITS SYS	Loss of control / monitoring	0.15
DISTRIBUTION BOARD & POWER CIRCUITS SYS	Loss of unit - trip	0.22
DISTRIBUTION BOARD + POWER CIRCUITS SYS	Loss of control / monitoring	0.15
DISTRIBUTION BOARD + POWER CIRCUITS SYS	Loss of unit - trip	0.22
DISTRIBUTION BOARDS SYSTEM	Loss of control / monitoring	0.15
DISTRIBUTION TRANSFORMER SYSTEM	Loss of control / monitoring	0.15
DISTRIBUTION TRANSFORMER SYSTEM	Loss of unit	0.22
DOMESTIC PRESSURE REDUCTION STREAM	Corrosion no leak	0.59
DOMESTIC PRESSURE REDUCTION STREAM	Gas leak minor	0.02

DOMESTIC PRESSURE REDUCTION STREAM	Gas leak significant	0.00
DOMESTIC PRESSURE REDUCTION STREAM	Loss of stream regulator slam shut - trip	0.53
DOMESTIC SERVICES SYSTEM	Utility leakage	0.02
DRAINAGE & SEWAGE SYSTEM	Environment spill off site	0.02
DRAINAGE SYSTEMS	Environment spill off site	0.02
DRIVE COOLING SYSTEM	Filter blockage - unit trip	0.01
DRIVE COOLING SYSTEM	Filter blockage detection failure	0.01
DRIVE COOLING SYSTEM	Loss of electric drive unit - trip	0.03
EARTHING & LIGHTNING PROTECTION SYSTEM	Loss of lightning protection	0.05
EARTHING + LIGHTNING PROTECTION SYSTEM	Loss of lightning protection	0.05
EARTHING CABLES SYSTEM	Electric trip - loss of monitoring/ control	0.15
EARTHING SYSTEMS, CABLES & ELECTRODES	Electric trip - loss of monitoring/ control	0.15
EARTHING, CABLES & ELECTRODES SYSTEM	Electric trip - loss of monitoring/ control	0.15
ELECTRIC COMPRESSOR PACKAGE SYSTEM	Loss of electric drive unit - trip	0.17
ELECTRIC DRIVE OIL SYSTEM	Filter blockage - unit trip	0.01
ELECTRIC DRIVE OIL SYSTEM	Filter blockage detection failure	0.01
ELECTRIC DRIVE OIL SYSTEM	Loss of electric drive unit - trip	0.17
ELECTRIC SURFACE HEATING	Loss of preheat - pipework ices up	0.44
ELECTRICAL GENERAL	Loss of control / monitoring	0.15
ELECTRICAL SYSTEM	Loss of control / monitoring	0.15
EMERGENCY LIGHTING	Loss of illumination in emergency	0.15
EMERGENCY LIGHTING CIRCUITS SYSTEM	Loss of illumination in emergency	0.15
ENGINE & ENGINE ENCLOSURE SYSTEM	Loss of unit - trip	0.16
ENGINE GOVERNOR SYSTEM	Loss of unit - trip	0.26
ENHANCED GAS SYSTEM	Gas leak minor	0.02
ENHANCED GAS SYSTEM	Loss of gas quality information	0.87
EXHAUST SYSTEM	Loss of environmental protection / monitoring	0.23
EXHAUST SYSTEM	Loss of unit - trip	0.23
EXIT GAS QUALITY SYSTEM	Loss of gas quality information	0.87
FILTER	Corrosion no leak	0.59
FILTER	Filter blockage - maintenance	0.01
FILTER	Filter blockage detection failure	0.01
FILTER	Gas leak minor	0.02

FILTER	Gas leak significant	0.00
FILTRATION STREAM	Corrosion no leak	0.59
FILTRATION STREAM	Filter blockage - maintenance	0.01
FILTRATION STREAM	Filter blockage detection failure	0.01
FILTRATION STREAM	Gas leak minor	0.02
FILTRATION STREAM	Gas leak significant	0.00
FIRE & GAS SYSTEM	Loss of unit - trip	0.06
FIRE SYSTEM	Loss of fire protection if incident occurs	0.06
FIRE SYSTEM	Loss of site - trip	0.06
FIRE SYSTEM	Loss of unit - trip	0.06
FIRE WATER SYSTEM	Loss of fire protection if incident occurs	0.23
FIXED TOOLS SYSTEM	Unable to maintain equipment	0.07
FLOW WEIGHTED AVERAGE GAS SYSTEM	Loss of gas quality information	0.87
FUEL GAS SYSTEM	Filter blockage - unit trip	0.01
FUEL GAS SYSTEM	Filter blockage detection failure	0.01
FUEL GAS SYSTEM	Gas leak minor	0.01
FUEL GAS SYSTEM	Gas leak significant	0.05
FUEL GAS SYSTEM	Loss of unit	0.17
FWACV GAS QUALITY SYSTEM	Loss of gas quality information	0.87
FWACV METERING SYSTEM	Loss of gas quality information	0.87
GAS COMPRESSOR SYSTEM	Filter blockage - unit trip	0.01
GAS COMPRESSOR SYSTEM	Filter blockage detection failure	0.01
GAS COMPRESSOR SYSTEM	Loss of unit - trip	0.28
GAS GENERATOR STARTER PACKAGE SYSTEM	Loss of unit - trip	0.49
GAS GENERATOR SYSTEM	Loss of unit - trip	0.87
GAS METERING SYSTEM GENERAL ASSETS	Corrosion no leak	0.59
GAS METERING SYSTEM GENERAL ASSETS	Gas leak minor	0.02
GAS METERING SYSTEM GENERAL ASSETS	Gas leak significant	0.00
GAS METERING SYSTEM GENERAL ASSETS	Metering fault inaccurate reading	0.87
GAS QUALITY MEASUREMENT SYSTEM	Gas leak minor	0.02
GAS QUALITY MEASUREMENT SYSTEM	Loss of gas quality information	0.87
GAS QUALITY SYSTEM GENERAL ASSETS	Gas leak minor	0.02

GAS QUALITY SYSTEM GENERAL ASSETS	Loss of gas quality information	0.87
GAS SYSTEM	Gas leak minor	0.02
GAS SYSTEM	Loss of gas quality information	0.87
GAS VENTING SYSTEM	Loss of vent capability	0.07
GENERAL PIPEWORK SYS	Corrosion no leak	0.59
GENERAL PIPEWORK SYS	Gas leak minor	0.02
GENERAL PIPEWORK SYS	Gas leak significant	0.00
GENERAL PIPEWORK SYS	Mechanical electrical elements failing - loss of monitoring and control	0.29
GG LUBE & HYDRAULIC OIL SYSTEM	Failure of lube oil system leading to unit trip	0.46
GG LUBE & HYDRAULIC OIL SYSTEM	Filter blockage - unit trip	0.01
GG LUBE & HYDRAULIC OIL SYSTEM	Filter blockage detection failure	0.01
GG LUBE & HYDRAULIC OIL SYSTEM	Oil leak	0.19
GG LUBE & HYDRAULIC OIL SYSTEM	Oil leak leading to cab fire	0.09
GSMR GAS QUALITY SYSTEM	Loss of gas quality information	0.87
HARMONIC FILTER CONTAINER	Loss of unit - Instrumentation or Electrical fault	0.38
HEATING & VENTILATION SYSTEM	Unable to maintain suitable temperature in control room	
HEATING PRESSURE REDUCTION STREAM	Corrosion no leak	0.39
HEATING PRESSURE REDUCTION STREAM	Gas leak minor	0.04
HEATING PRESSURE REDUCTION STREAM	Gas leak significant	0.05
HEATING PRESSURE REDUCTION STREAM	Loss of control stream - trip	0.03
HEATING PRESSURE REDUCTION STREAM	Low outlet temp	0.44
HEATING STREAM	Corrosion no leak	0.22
HEATING STREAM	Gas leak minor	0.10
HEATING STREAM	Gas leak significant	0.01
HEATING STREAM	Low outlet temp	0.44
HIGH VOLTAGE SWITCHBOARD SYSTEM	Loss of electric supply to site	0.40
INRUSH LIMITING RESISTOR SYSTEM	Loss of electric drive unit - trip	0.15
INSTRUMENT POWER SUPPLIES SYSTEM	Gas leak minor	0.02
INSTRUMENT POWER SUPPLIES SYSTEM	Loss of control / monitoring	0.87
INSTRUMENT POWER SUPPLIES SYSTEM	Loss of instrumentation - station	0.87

INSTRUMENT POWER SUPPLIES SYSTEM	Loss of unit - Instrumentation or Electrical fault	0.87
INSTRUMENTATION SYSTEM (AGI)	Gas leak minor	0.02
INSTRUMENTATION SYSTEM (AGI)	Loss of control / monitoring	0.87
INTEGRATED SITE SECURITY	Security system failure	0.64
IRIS TELEMETRY SYSTEM	Loss of remote monitoring / control	0.66
LAND & BUILDINGS	Structural damage leak affecting electrical control equipment loss of control / monitoring	0.64
LAND AND BUILDINGS SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	0.64
LGT SYSTEM	Corrosion no leak	0.59
LGT SYSTEM	Gas leak minor	0.02
LGT SYSTEM	Gas leak significant	0.00
LGT SYSTEM	Loss of odourisation	0.13
LIFTING EQUIPMENT SYSTEM	Unable to maintain equipment	0.07
LIGHTING CIRCUITS SYSTEM	Loss of illumination	0.15
LIGHTING COLUMN CIRCUITS SYSTEM	Loss of illumination	0.15
LIU METERING SYSTEM	Corrosion no leak	0.59
LIU METERING SYSTEM	Gas leak minor	0.02
LIU METERING SYSTEM	Gas leak significant	0.00
LIU METERING SYSTEM	Metering fault inaccurate reading	0.87
LOW VOLTAGE SWITCHBOARD SYSTEM	Electric trip - loss of monitoring/ control	0.15
LV SWITCHBOARD & CONTROL GEAR SYSTEM	Electric trip - loss of monitoring/ control	0.38
MACHINERY OPTIMISATION SYSTEM	General instrumentation fault	0.02
MACHINERY OVER-SPEED PROTECTION SYSTEM	Loss of unit - trip	0.03
MAGNETIC PARTICLE DETECTION SYSTEM	Loss of unit - Instrumentation or Electrical fault	0.17
MCC SWITCHBOARD SYSTEM	Electric trip - loss of monitoring/ control	0.38
MCC SWITCHBOARD SYSTEM	Loss of electric supply to site	0.38
METERING GENERAL	Corrosion no leak	0.59
METERING GENERAL	Gas leak minor	0.02
METERING GENERAL	Gas leak significant	0.00
METERING GENERAL	Metering fault inaccurate reading	0.87
METERING STREAM	Corrosion no leak	0.59
METERING STREAM	Gas leak minor	0.02
METERING STREAM	Gas leak significant	0.00
METERING STREAM	Metering fault inaccurate reading	0.87

METERING SYSTEM	Corrosion no leak	0.59
METERING SYSTEM	Gas leak minor	0.02
METERING SYSTEM	Gas leak significant	0.00
METERING SYSTEM	Metering fault inaccurate reading	0.87
MISCELLANEOUS ELECTRICAL EQUIPMENT	Failure to control or monitor plant on site	0.15
MODULAR BOILER SYSTEM	Low outlet temp	0.44
MOTOR	Motor inoperable	0.03
NITROGEN GENERATOR SYSTEM	Failure of compressor gas seal	0.64
NITROGEN SNUFFING SYSTEM	Unable to snuff out flame from vent stack	0.05
NON CRITICAL VALVES SYSTEM	Corrosion no leak	0.39
NON CRITICAL VALVES SYSTEM	Gas leak minor	0.04
NON CRITICAL VALVES SYSTEM	Gas leak significant	0.05
NON CRITICAL VALVES SYSTEM	Unable to isolate for maint/emergency	0.03
NON SIL RATED INSTRUMETED LOOP	Loss of remote monitoring / control	0.50
OIL STORAGE SYSTEM	Corrosion no oil leak	0.59
OIL STORAGE SYSTEM	Leak oil spill	0.02
OIL SYSTEM	Corrosion no oil leak	0.59
OIL SYSTEM	Failure of lube oil system leading to unit trip	0.46
OIL SYSTEM	Leak oil spill	0.02
PANEL	Loss of control / monitoring	0.40
PIGTRAP SYSTEM	Corrosion no leak	0.59
PIGTRAP SYSTEM	Door seal failure	0.04
PIGTRAP SYSTEM	Gas leak minor	0.02
PIPE CP SYSTEM (ICS)	Increased corrosion on pipe	0.69
POWER CIRCUITS SYSTEM	Loss of control / monitoring	0.15
POWER FACTOR CORRECTION SYSTEM	Loss of control / monitoring	0.15
POWER GAS EQUIPMENT SYSTEM	Corrosion no leak	0.59
POWER GAS EQUIPMENT SYSTEM	Gas leak minor	0.02
POWER GAS EQUIPMENT SYSTEM	Gas leak significant	0.00
POWER GAS EQUIPMENT SYSTEM	Loss of power - gas supply instrument trip	0.53
POWER SUPPLY UNIT (DUAL CAB)	Electric trip - loss of monitoring/ control	0.38
POWER TRANSFORMERS	Electric trip - loss of monitoring/ control	0.38
POWER TURBINE SYSTEM	Filter blockage - unit trip	0.01
POWER TURBINE SYSTEM	Filter blockage detection failure	0.01
POWER TURBINE SYSTEM	Loss of unit - trip	0.32

PRA STREAMS & SUPPLY SYSTEM	Corrosion no leak	0.59
PRA STREAMS & SUPPLY SYSTEM	Filter blockage - maintenance	0.01
PRA STREAMS & SUPPLY SYSTEM	Filter blockage - unit trip	0.01
PRA STREAMS & SUPPLY SYSTEM	Filter blockage detection failure	0.01
PRA STREAMS & SUPPLY SYSTEM	Gas leak minor	0.02
PRA STREAMS & SUPPLY SYSTEM	Gas leak significant	0.00
PRA STREAMS & SUPPLY SYSTEM	Loss of stream regulator slam shut - trip	0.53
PRE-HEATING SYSTEM	Corrosion no leak	0.59
PRE-HEATING SYSTEM	Gas leak minor	0.02
PRE-HEATING SYSTEM	Gas leak significant	0.00
PRE-HEATING SYSTEM	Pre heat trip low outlet temp	0.44
PRESSURE REDUCTION STREAM	Corrosion no leak	0.39
PRESSURE REDUCTION STREAM	Gas leak minor	0.04
PRESSURE REDUCTION STREAM	Gas leak significant	0.05
PRESSURE REDUCTION STREAM	Loss of stream regulator slam shut - trip	0.53
PRESSURE REDUCTION SYSTEM	Corrosion no leak	0.39
PRESSURE REDUCTION SYSTEM	Filter blockage - unit trip	0.01
PRESSURE REDUCTION SYSTEM	Filter blockage detection failure	0.01
PRESSURE REDUCTION SYSTEM	Gas leak minor	0.04
PRESSURE REDUCTION SYSTEM	Gas leak significant	0.05
PRESSURE REDUCTION SYSTEM	Loss of stream regulator slam shut - trip	0.53
PRESSURE TRANSMITTER (Non Flow)	Loss of gas quality information	0.87
PROCESS COMPRESSED AIR SYSTEM	Workshop tools and equipment	0.00
PROCESS OPERATIONS SYSTEM	Corrosion no leak	0.59
PROCESS OPERATIONS SYSTEM	Gas leak minor	0.02
PROCESS OPERATIONS SYSTEM	Gas leak significant	0.00
PROCESS OPERATIONS SYSTEM	Pre heat trip low outlet temp	0.44
PROCESS PRE-HEATING SYSTEM	Corrosion no leak	0.59
PROCESS PRE-HEATING SYSTEM	Gas leak minor	0.02
PROCESS PRE-HEATING SYSTEM	Gas leak significant	0.00
PROCESS PRE-HEATING SYSTEM	Pre heat trip low outlet temp	0.44
PROTECTION RELAYS	Loss of control / monitoring	0.15
PT/COMP OIL SYSTEM	Failure of lube oil system leading to unit trip	0.46
PT/COMP OIL SYSTEM	Filter blockage - unit trip	0.01
PT/COMP OIL SYSTEM	Filter blockage detection failure	0.01
PT/COMP OIL SYSTEM	Oil leak	0.19
PT/COMP OIL SYSTEM	Oil leak leading to cab fire	0.09

RECYCLE PROCESS PIPEWORK SYSTEM	Corrosion no leak	0.59
RECYCLE PROCESS PIPEWORK SYSTEM	Gas leak minor	0.02
RECYCLE PROCESS PIPEWORK SYSTEM	Gas leak significant	0.00
RECYCLE PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	0.28
REMOTE CP TR UNITS	Increased corrosion on pipe	0.69
REMOTELY OPERABLE VALVES SYSTEM	Corrosion no leak	0.39
REMOTELY OPERABLE VALVES SYSTEM	Gas leak minor	0.04
REMOTELY OPERABLE VALVES SYSTEM	Gas leak significant	0.05
REMOTELY OPERABLE VALVES SYSTEM	Unable to isolate for maint/emergency	0.11
RESIDUAL CURRENT DEVICES	Electric trip - loss of monitoring/ control	0.38
RESIDUAL CURRENT DEVICES SYSTEM	Electric trip - loss of monitoring/ control	0.38
SAFETY RELATED PLC/DCS SYSTEM	Loss of unit - Instrumentation or Electrical fault	0.50
SCRUBBER	Blockage - maintenance	0.01
SCRUBBER	Blockage detection	0.01
SCRUBBER	Corrosion no leak	0.59
SCRUBBER	Gas leak minor	0.02
SCRUBBER	Gas leak significant	0.00
SCRUBBER A SYSTEM	Blockage - maintenance	0.01
SCRUBBER A SYSTEM	Blockage detection	0.01
SCRUBBER A SYSTEM	Corrosion no leak	0.59
SCRUBBER A SYSTEM	Filter blockage - maintenance	0.01
SCRUBBER A SYSTEM	Filter blockage detection failure	0.01
SCRUBBER A SYSTEM	Gas leak minor	0.02
SCRUBBER A SYSTEM	Gas leak significant	0.00
SCRUBBER B SYSTEM	Blockage - maintenance	0.01
SCRUBBER B SYSTEM	Blockage detection	0.01
SCRUBBER B SYSTEM	Corrosion no leak	0.59
SCRUBBER B SYSTEM	Filter blockage - maintenance	0.01
SCRUBBER B SYSTEM	Filter blockage detection failure	0.01
SCRUBBER B SYSTEM	Gas leak minor	0.02
SCRUBBER B SYSTEM	Gas leak significant	0.00
SCRUBBER C SYSTEM	Blockage - maintenance	0.01
SCRUBBER C SYSTEM	Blockage detection	0.01

SCRUBBER C SYSTEM	Corrosion no leak	0.59
SCRUBBER C SYSTEM	Filter blockage - maintenance	0.01
SCRUBBER C SYSTEM	Filter blockage detection failure	0.01
SCRUBBER C SYSTEM	Gas leak minor	0.02
SCRUBBER C SYSTEM	Gas leak significant	0.00
SCRUBBER D SYSTEM	Blockage - maintenance	0.01
SCRUBBER D SYSTEM	Blockage detection	0.01
SCRUBBER D SYSTEM	Corrosion no leak	0.59
SCRUBBER D SYSTEM	Gas leak minor	0.02
SCRUBBER D SYSTEM	Gas leak significant	0.00
SITE CP SYSTEM (SACRIFICIAL ANODE)	Increased corrosion on pipe	0.69
SITE CP SYSTEM (ICM)	Increased corrosion on pipe	0.69
SITE CP SYSTEM (ICS)	Increased corrosion on pipe	0.69
SITE CP SYSTEM (MIXED)	Increased corrosion rate	0.69
SITE SECURITY SYSTEM	Security system failure	0.50
SPECIAL GAS QUALITY SYSTEM	Loss of gas quality information	0.87
STANDBY GENERATOR SYSTEM	Loss of standby power control monitoring issues if required	0.10
STRUCTURES SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	0.64
SUCTION PROCESS PIPEWORK SYSTEM	Corrosion no leak	0.59
SUCTION PROCESS PIPEWORK SYSTEM	Filter blockage - maintenance	0.01
SUCTION PROCESS PIPEWORK SYSTEM	Filter blockage - unit trip	0.01
SUCTION PROCESS PIPEWORK SYSTEM	Filter blockage detection failure	0.01
SUCTION PROCESS PIPEWORK SYSTEM	Gas leak minor	0.02
SUCTION PROCESS PIPEWORK SYSTEM	Gas leak significant	0.00
SUCTION PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	0.28
SUPPLY REGULATOR SYSTEM	Corrosion minor leak	0.04
SUPPLY REGULATOR SYSTEM	Corrosion no leak	0.39
SUPPLY REGULATOR SYSTEM	Corrosion significant leak	0.05
SUPPLY REGULATOR SYSTEM	Loss of gas supply to preheater or actuators	0.53
TELEMETRY SYSTEM	Loss of control / monitoring	0.87
TERMINAL INCOMER SYSTEM	Loss of pressure temperature information	0.87

TERMINAL PROCESS PIPEWORK SYSTEM	Corrosion no leak	0.59
TERMINAL PROCESS PIPEWORK SYSTEM	Filter blockage - maintenance	0.01
TERMINAL PROCESS PIPEWORK SYSTEM	Filter blockage detection failure	0.01
TERMINAL PROCESS PIPEWORK SYSTEM	Gas leak minor	0.02
TERMINAL PROCESS PIPEWORK SYSTEM	Gas leak significant	0.00
TERMINAL PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - loss of monitoring and control	0.29
TERMINAL PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	0.28
UNINTERRUPTIBLE POWER SUPPLY SYSTEM	Power failure leading to loss of control	0.44
VALVE	Gas leak minor	0.03
VALVE	Gas leak significant	0.11
VALVE	Unable to isolate for maint/emergency	0.11
VALVES & EQUIP - CRITICAL NON ROV	Corrosion no leak	0.39
VALVES & EQUIP - CRITICAL NON ROV	Gas leak minor	0.04
VALVES & EQUIP - CRITICAL NON ROV	Gas leak significant	0.05
VALVES & EQUIP - CRITICAL NON ROV	Unable to isolate for maint/emergency	0.02
VALVES & EQUIP - CRITICAL ROV	Corrosion no leak	0.39
VALVES & EQUIP - CRITICAL ROV	Gas leak minor	0.04
VALVES & EQUIP - CRITICAL ROV	Gas leak significant	0.05
VALVES & EQUIP - CRITICAL ROV	Unable to isolate for remote maint/emergency	0.02
VALVES & EQUIP - NON-CRITICAL	Corrosion no leak	0.39
VALVES & EQUIP - NON-CRITICAL	Gas leak minor	0.04
VALVES & EQUIP - NON-CRITICAL	Gas leak significant	0.05
VALVES & EQUIP - NON-CRITICAL	Unable to isolate for maint/emergency	0.02
VIBRATION MONITORING SYSTEM	Loss of unit - Instrumentation or Electrical fault	0.02
VOLUMETRIC REGULATOR STREAM	Corrosion minor leak	0.04
VOLUMETRIC REGULATOR STREAM	Corrosion no leak	0.39
VOLUMETRIC REGULATOR STREAM	Corrosion significant leak	0.05
VOLUMETRIC REGULATOR STREAM	Filter blockage - maintenance	0.01
VOLUMETRIC REGULATOR STREAM	Filter blockage detection failure	0.01
VOLUMETRIC REGULATOR STREAM	Loss of stream regulator slam shut - trip	0.53

WATER BATH HEATER (AGI)	Corrosion no leak	0.22
WATER BATH HEATER (AGI)	Gas leak minor	0.10
WATER BATH HEATER (AGI)	Gas leak significant	0.01
WATER BATH HEATER (AGI)	Low outlet temp	0.44
WATER WASH SYSTEM	Unable to wash engine	0.54

11. Appendix B

11.1. Sites Failure Consequence Events

Where "Y" indicates that the asset (subprocess) could cause a specific failure mode and "N" or blank indicates that the asset (subprocess) cannot cause a specific failure mode.

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUTDOWN
AFTER COOLER SYSTEM	Corrosion minor leak	N	Y	Y	Y	N	Y	N	N		Y	N	Y	Y	N	N
AFTER COOLER SYSTEM	Gas leak significant	N	Y	Y	Y	N	Y	N	N		Y	N	Y	Y	N	N
AGI STATION PIPEWORK	Corrosion no leak	N	N		Y	N			N			N	Y		N	N
AGI STATION PIPEWORK	Gas leak minor	N	N	Y	Y	N	Y		N		Y	N	Y		N	N
AGI STATION PIPEWORK	Gas leak significant	N	N	Y	Y	N	Y		N		Y	N	Y	Y	N	N
AIR INTAKE SYSTEM	Loss of unit gas drive - trip	N	N	N		N	Y	N	N	Y	N	N	Y	Y	N	N
AIR INTAKE SYSTEM	Loss of station gas drive - trip	N	N	N	N	N	Y	N	N		Y	N	Y	Y	N	N
ALL IN ONE GAS MEASUREMENT SYSTEM	Loss of gas quality information	N	N	N	Y	N	N	N	N	N	N	Y	Y	N	N	N
ALL IN ONE GAS MEASUREMENT SYSTEM	Minor gas leak from instruments	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
ALL IN ONE GAS MEASUREMENT SYSTEM	Significant gas leak from instruments	N	N	Y	Y	N	Y	Y	N	N	N	N	Y	Y	N	N
ANCILLARY EQUIPMENT SYSTEM	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
ANCILLARY VALVES SYSTEM	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
ANCILLARY EQUIPMENT SYSTEM	Corrosion no leak	N	N		Y	N			N			N	Y		N	N
ANCILLARY VALVES SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
ANCILLARY EQUIPMENT SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
ANCILLARY VALVES SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
ANCILLARY EQUIPMENT SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	Y

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
ANCILLARY VALVES SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	Y
BATTERY CHARGER & BATTERIES SYSTEM	Power failure leading to loss of control	Y	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
BELOW GROUND PIPEWORK SYSTEMS	Corrosion no leak - pressure reduction	N	N	N	Y	N	N	N	N	N		N	Y		N	N
BELOW GROUND PIPEWORK SYSTEMS	Gas leak minor	N	N	Y	Y	N	Y	N	N	N		N	Y		N	N
BELOW GROUND PIPEWORK SYSTEMS	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	Y	N	Y	Y	N	N
BOUNDARY PRESSURE CNTRL & PROT SYS	Reduction in pipeline capacity if unavailable	N	N	N	Y	N	N	N	N	N	N	N	N	N	Y	N
BUILDINGS SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	N	N	N	Y	Y	N	N	N	N	Y	N	N	Y	N	N
BURIED INOPERABLE VALVES SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	N	N	Y	Y
BURIED INOPERABLE VALVES SYSTEM	Gas leak significant	N		Y	Y	N	Y	N	N	N	N	N	N	N	Y	Y
BURIED INOPERABLE VALVES SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N		N	Y		N	N
BYPASS PROCESS PIPEWORK SYSTEM	Gas leak minor	N	Y	Y	Y	N	Y	N	N	Y			Y		N	N
BYPASS PROCESS PIPEWORK SYSTEM	Gas leak significant	N	Y	Y	Y	N	Y	N	N	Y			Y	Y	N	N
BYPASS PROCESS PIPEWORK SYSTEM	Corrosion no leak	N	Y		Y	N		N	N	Y			Y		N	N
CAB VENTILATION SYSTEM	Loss of unit - Instrumentation or Electrical fault	N	N	N	Y	N	Y	N	N	Y	N	N	Y	N	N	N
CATHODIC PROTECTION SYSTEM (SI)	Increased corrosion on pipe	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
CMS - ANTI-SURGE CONTROL SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y		N	N
CMS - ANTI-SURGE CONTROL SYSTEM	Failure to control surge damage unit	N	N	N	Y	N	N	N	N	Y	N	N		Y	N	N
CMS - HMI/SCADA SYSTEM	Loss of remote monitoring / control	N	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
132KV COMPOUND SYSTEM	Loss of electric drive unit - trip	N	N	N	Y	N	N	N	N	Y	N	N	Y	Y	N	N
ABOVE GROUND PIPEWORK SYSTEM	Gas leak loss of Part of site minor leak	N	N	Y	Y	N	Y	Y	N			N	Y	Y	N	N
ABOVE GROUND PIPEWORK SYSTEM	Gas leak loss of Part of site significant leak	N	N	Y	Y	N	Y	Y	N			N	Y	Y	N	N
ABOVE GROUND PIPEWORK SYSTEM	Corrosion no leak - pressure reduction	N	N	N	Y	N	N	N	N		N	N	Y	Y	N	N
ACCESS & SITE SERVICES SYSTEM	Fail to access site for maint/ emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
AFTER COOLER SYSTEM	Electric fault loss of aftercooler high outlet temp - trip	N			Y	N		N	N		Y	N	Y		N	N
AFTER COOLER SYSTEM	Corrosion no leak	N			Y	N		N	N		Y	N	Y		N	N
GAS QUALITY MEASUREMENT SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	Y	Y	N	N	N
GAS QUALITY SYSTEM GENERAL ASSETS	Loss of gas quality information	N	N	N	N	N	N	?	N	N	N	Y	Y	N	N	N
GAS QUALITY SYSTEM GENERAL ASSETS	Gas leak minor	N	N	Y	Y	N	Y	?	N	N	N	Y	Y	N	N	N
GAS SYSTEM	Loss of gas quality information	N	N	N	N	N	N	?	N	N	N	Y	Y	N	N	N
DRAINAGE SYSTEMS	Environment spill off site	Y	N	N	N	Y	N		N	N	N	N	Y	N	N	N
DRIVE COOLING SYSTEM	Loss of electric drive unit - trip	N	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N
EARTHING & LIGHTNING PROTECTION SYSTEM	Loss of lightning protection	Y	N		Y	N	N	N	N	N	N	N	Y	Y	N	N
EARTHING + LIGHTNING PROTECTION SYSTEM	Loss of lightning protection	Y	N		Y	N	N	N	N	N	N	N	Y	Y	N	N
EARTHING CABLES SYSTEM	Electric trip - loss of monitoring/ control		N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
EARTHING SYSTEMS, CABLES & ELECTRODES	Electric trip - loss of monitoring/ control		N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
CMS - PLC/DCS SYSTEM	Loss of local control	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
CMS - STATION PROCESS CONTROL SYSTEM	Loss of local control	N	N	N	Y	N		N	N	Y		N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
COMPRESSOR SEAL SYSTEM (DRY)	Loss of gas unit	N	N	N	Y	N	Y	N	N	Y	N	N	Y	Y	N	N
COMPRESSOR SEAL SYSTEM (WET)	Loss of gas unit	N	N	N	Y	Y	Y	N	N	Y	N	N	Y		N	N
COMPRESSOR SEAL SYSTEM (WET)	Oil spill from wet seal	N	N	N	Y	Y	Y	N	N	Y	N	N	Y	Y	N	N
CONDENSATE TANK SYSTEM	Vessel corrosion	N	N		Y			N	N	N	Y	N	Y	N	N	N
CONDENSATE TANK SYSTEM	Vessel failure significant gas release	N	N	Y	Y		Y	N	N	N	Y	N	Y	Y	N	N
Control Loop	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	N	N	N
Control Loop	Loss of site - trip	N	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N
CONTROL MONITORING & PROTECTION SYSTEM	Unit failure to operate	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
EARTHING, CABLES & ELECTRODES SYSTEM	Electric trip - loss of monitoring/ control		N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
ELECTRIC COMPRESSOR PACKAGE SYSTEM	Loss of electric drive unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	N	N	N
ELECTRIC DRIVE OIL SYSTEM	Loss of electric drive unit - trip	N	N	N	Y		Y	N	N	Y	N	N	Y	N	N	N
ELECTRIC SURFACE HEATING	Loss of preheat - pipework ices up	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
ELECTRICAL GENERAL	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
ELECTRICAL SYSTEM	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
EMERGENCY LIGHTING	Loss of illumination in emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
EMERGENCY LIGHTING CIRCUITS SYSTEM	Loss of illumination in emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
ENGINE & ENGINE ENCLOSURE SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	N	N	N
ENGINE GOVERNOR SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	N	N	N
ENHANCED GAS SYSTEM	Loss of gas quality information	N	N	N	N	N	N		N	N	N	Y	Y	N	N	N
ENHANCED GAS SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	?	N	N	N	Y	Y	N	N	N
EXHAUST SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y		N	Y	N	N	Y		N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
EXHAUST SYSTEM	Loss of environmental protection / monitoring	N	N	N	Y	N	Y	Y	N	Y	N	N	Y	Y	N	N
FILTER	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
FILTRATION STREAM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
FILTER	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
FILTRATION STREAM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
FILTER	Gas leak significant	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	Y	N	N
FILTRATION STREAM	Gas leak significant	N	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	N	N
FIRE & GAS SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	Y	N	Y	N	N	N
FIRE SYSTEM	Loss of unit - trip	N	N		Y		Y	N	N	Y	Y	N	Y		N	N
FIRE SYSTEM	Loss of site - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	N	N	N
FIRE SYSTEM	Loss of fire protection if incident occurs	Y	N	N	Y	N	N	N	N		N	N	Y	N	N	N
FIRE WATER SYSTEM	Loss of fire protection if incident occurs	Y	N	N	Y	Y	N	Y	N		Y	N	Y	Y	N	N
FIXED TOOLS SYSTEM	Unable to maintain equipment	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
FLOW WEIGHTED AVERAGE GAS SYSTEM	Loss of gas quality information	N	N	N	N	N	N	?	N	N	N	Y	Y	N	N	N
FUEL GAS SYSTEM	Loss of unit	N	N		Y	N	Y	N	N	Y	Y	N	Y	Y	N	N
FUEL GAS SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	N	N
FUEL GAS SYSTEM	Gas leak significant	N	Y	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	N	N
FWACV METERING SYSTEM	Loss of gas quality information	N	N		N	N	N	N	N	N	N	Y	Y	N	N	N
GAS COMPRESSOR SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y		N	N
GAS GENERATOR STARTER PACKAGE SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y		N	N
GAS GENERATOR SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	Y	N	N
GAS METERING SYSTEM GENERAL ASSETS	Metering fault inaccurate reading	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N	N
GAS METERING SYSTEM GENERAL ASSETS	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
GAS METERING SYSTEM GENERAL ASSETS	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N		Y	N	N	N
GAS METERING SYSTEM GENERAL ASSETS	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	Y	Y	Y	N	N
GAS QUALITY MEASUREMENT SYSTEM	Loss of gas quality information	N	N	N	N	N	N	?	N	N	N	Y	Y	N	N	N
BATTERY CHARGER & BATTERIES SYSTEM	Power failure leading to loss of unit	Y	N	N	Y	N	Y	N	N		Y	N	Y	N	N	N
BATTERY CHARGER & BATTERIES SYSTEM	Power failure leading to loss of station	Y	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N
DISTRIBUTION BOARD + POWER CIRCUITS SYS	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
DISTRIBUTION BOARDS SYSTEM	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
DISTRIBUTION BOARD & POWER CIRCUITS SYS	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
DISTRIBUTION TRANSFORMER SYSTEM	Loss of unit	N	N	N	Y	N	N	N	N	Y		N	Y	N	N	N
DISTRIBUTION TRANSFORMER SYSTEM	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
DOMESTIC PRESSURE REDUCTION STREAM	Loss of stream regulator slam shut - trip	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
DOMESTIC PRESSURE REDUCTION STREAM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
DOMESTIC PRESSURE REDUCTION STREAM	Gas leak minor	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	N	N	N
DOMESTIC PRESSURE REDUCTION STREAM	Gas leak significant	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	Y	N	N
DOMESTIC SERVICES SYSTEM	Utility leakage	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N
DRAINAGE & SEWAGE SYSTEM	Environment spill off site	Y	N	N	N	Y	N	Y	N	N	N	N	Y	N	N	N
LAND & BUILDINGS	Structural damage leak affecting electrical control equipment loss of control / monitoring	N	N		Y	N	N	N	N	N	Y	N	N	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
LAND AND BUILDINGS SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	N	N		Y	N	N	N	N	N	Y	N	N	N	N	N
LGT SYSTEM	Loss of odourisation	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
LGT SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
LGT SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	Y	N	N	N	N	Y	N	N	N
LGT SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N
LIFTING EQUIPMENT SYSTEM	Unable to maintain equipment	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
LIGHTING CIRCUITS SYSTEM	Loss of illumination	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
CONTROL MONITORING & PROTECTION SYSTEM	Station failure to operate	N	N	N	Y		N	N	N	N	Y	N	Y	N	N	N
CRITICAL VALVES SYSTEM	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
CRITICAL VALVES SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y		N	N
CRITICAL VALVES SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
DETECTOR	Fire alarm evacuation may cause unit trip	N	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak minor from Pipework	N	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Corrosion on pipework - no leak	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak significant from Pipework	N	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	N	N
DISTRIBUTION BOARD & POWER CIRCUITS SYS	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y		N	Y	N	N	N
DISTRIBUTION BOARD + POWER CIRCUITS SYS	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y		N	Y	N	N	N
METERING GENERAL	Metering fault inaccurate reading	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N	N
METERING STREAM	Metering fault inaccurate reading	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N	N
METERING SYSTEM	Metering fault inaccurate reading	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N	N
METERING GENERAL	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
METERING STREAM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
METERING SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
METERING GENERAL	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
GAS SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	?	N	N	N	Y	Y	N	N	N
GAS TRANSMISSION SUB-SITE	Need further information	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
GG LUBE & HYDRAULIC OIL SYSTEM	Failure of lube oil system leading to unit trip	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
GG LUBE & HYDRAULIC OIL SYSTEM	Oil leak	N	N	N	Y	Y	N	N	N	Y	N	N	Y	N	N	N
GG LUBE & HYDRAULIC OIL SYSTEM	Oil leak leading to cab fire	N	N	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	N	N
GAS VENTING SYSTEM	Loss of vent capability	N	N	N	Y	N	N	Y	Y	Y	N	N	Y	N	N	N
GENERAL PIPEWORK SYS	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N		N
GENERAL PIPEWORK SYS	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	Y	N
GENERAL PIPEWORK SYS	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N
HARMONIC FILTER CONTAINER	Loss of unit - Instrumentation or Electrical fault	N	N		Y	N	N	N	N	Y	N	N	Y	N	N	N
HEATING & VENTILATION SYSTEM	Unable to maintain suitable temperature in control room	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
HEATING PRESSURE REDUCTION STREAM	Low outlet temp	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
HEATING PRESSURE REDUCTION STREAM	Loss of control stream - trip	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
HEATING PRESSURE REDUCTION STREAM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
HEATING PRESSURE REDUCTION STREAM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
HEATING PRESSURE REDUCTION STREAM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
HEATING STREAM	Low outlet temp	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUTDOWN
HEATING STREAM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
HEATING STREAM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
HEATING STREAM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
HIGH VOLTAGE SWITCHBOARD SYSTEM	Loss of electric supply to site	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
INRUSH LIMITING RESISTOR SYSTEM	Loss of electric drive unit - trip	N	N		Y	N	N	N	N	Y	N	N	Y	N	N	N
INSTRUMENT POWER SUPPLIES SYSTEM	Loss of unit - Instrumentation or Electrical fault	N	N	N	Y	N	N	N	N	Y		N	Y	N	N	N
INSTRUMENT POWER SUPPLIES SYSTEM	Loss of instrumentation - station	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
INSTRUMENT POWER SUPPLIES SYSTEM	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
INSTRUMENTATION SYSTEM (AGI)	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
INSTRUMENT POWER SUPPLIES SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	Y		N	Y	N	N	N
INSTRUMENTATION SYSTEM (AGI)	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
INTEGRATED SITE SECURITY	Security system failure	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
IRIS TELEMETRY SYSTEM	Loss of remote monitoring / control	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
MCC SWITCHBOARD SYSTEM	Electric trip - loss of monitoring/ control	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
OIL STORAGE SYSTEM	Corrosion no oil leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
OIL SYSTEM	Corrosion no oil leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
OIL STORAGE SYSTEM	Leak oil spill	N	N	N	Y	Y	N	Y	N	N	N	N	Y	Y	N	N
OIL SYSTEM	Leak oil spill	N	N	N	Y	Y	N	Y	N	N	N	N	Y	Y	N	N
PANEL	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N
PIGTRAP SYSTEM	Door seal failure	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
PIGTRAP SYSTEM	Corrosion no leak	N	N	N	Y	N	Y	N	N	N	N	N	Y	N	N	N
PIGTRAP SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUTDOWN
PIPE CP SYSTEM (ICS)	Increased corrosion on pipe	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
POWER CIRCUITS SYSTEM	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
POWER FACTOR CORRECTION SYSTEM	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PRESSURE REDUCTION STREAM	Gas leak minor	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	N	N	N
PRESSURE REDUCTION SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	N	N	N
PRESSURE REDUCTION STREAM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	N	N
PRESSURE REDUCTION SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	N	N
PRESSURE TRANSMITTER (Non Flow)	Loss of gas quality information	N	N	N	Y	N	N	N	N	N	N	Y	Y	N	N	N
PROCESS COMPRESSED AIR SYSTEM	Workshop tools and equipment	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PROCESS OPERATIONS SYSTEM	Pre heat trip low outlet temp	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PROCESS PRE-HEATING SYSTEM	Pre heat trip low outlet temp	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PROCESS OPERATIONS SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PROCESS PRE-HEATING SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
POWER GAS EQUIPMENT SYSTEM	Loss of power - gas supply instrument trip	N	N	N	Y	N	N	N	N		Y	N	Y	N	N	N
POWER GAS EQUIPMENT SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N		Y	N	Y	N	N	N
RESIDUAL CURRENT DEVICES	Electric trip - loss of monitoring/ control	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
RESIDUAL CURRENT DEVICES SYSTEM	Electric trip - loss of monitoring/ control	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PT/COMP OIL SYSTEM	Failure of lube oil system leading to unit trip	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PT/COMP OIL SYSTEM	Oil leak	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
PT/COMP OIL SYSTEM	Oil leak leading to cab fire	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
RECYCLE PROCESS PIPEWORK SYSTEM	Corrosion no leak	N	Y		Y	N			N			N	Y		N	N
RECYCLE PROCESS PIPEWORK SYSTEM	Gas leak minor	N	Y	Y	Y	N	Y		N		Y	N	Y		N	N
RECYCLE PROCESS PIPEWORK SYSTEM	Gas leak significant	N	Y	Y	Y	N	Y		N		Y	N	Y	Y	N	N
SAFETY RELATED PLC/DCS SYSTEM	Loss of unit - Instrumentation or Electrical fault	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
SCRUBBER	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER A SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER B SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER C SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER D SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
SCRUBBER A SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
SCRUBBER B SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
SCRUBBER C SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
SCRUBBER D SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
SCRUBBER	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N
SCRUBBER A SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N
POWER GAS EQUIPMENT SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N		N	N	Y	N	N	N
POWER GAS EQUIPMENT SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N		Y	N	Y	Y	N	N
POWER SUPPLY UNIT (DUAL CAB)	Electric trip - loss of monitoring/ control	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
POWER TRANSFORMERS	Electric trip - loss of monitoring/ control	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
POWER TURBINE SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	Y	N	N
PRA STREAMS & SUPPLY SYSTEM	Loss of stream regulator slam shut - trip	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUTDOWN
PRA STREAMS & SUPPLY SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	N	N	N
PRA STREAMS & SUPPLY SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N		N	N	Y	N	N	N
PRA STREAMS & SUPPLY SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	Y	N	N
PRE-HEATING SYSTEM	Pre heat trip low outlet temp	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PRE-HEATING SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PRE-HEATING SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
PRE-HEATING SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
PRESSURE REDUCTION STREAM	Loss of stream regulator slam shut - trip	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
PRESSURE REDUCTION SYSTEM	Loss of stream regulator slam shut - trip	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
PRESSURE REDUCTION STREAM	Corrosion no leak	N	N	N	Y	N	N	N	N		N	N	Y	N	N	N
PRESSURE REDUCTION SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
LIGHTING COLUMN CIRCUITS SYSTEM	Loss of illumination	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
LIU METERING SYSTEM	Metering fault inaccurate reading	N	N	N	Y	N	N	Y	N	N	N	Y	Y	N	N	N
LIU METERING SYSTEM	Corrosion no leak	N	N	N	Y	N	N		N	N	N		Y	N	N	N
LIU METERING SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	Y	N	N	N	N	Y	N	N	N
LIU METERING SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	N	N
LOW VOLTAGE SWITCHBOARD SYSTEM	Electric trip - loss of monitoring/ control	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
LV SWITCHBOARD & CONTROL GEAR SYSTEM	Electric trip - loss of monitoring/ control	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
MACHINERY OPTIMISATION SYSTEM	General instrumentation fault	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
MACHINERY OVER-SPEED PROTECTION SYSTEM	Loss of unit - trip	N	N	N	Y	N	Y	N	N	Y	N	N	Y	Y	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
MAGNETIC PARTICLE DETECTION SYSTEM	Loss of unit - Instrumentation or Electrical fault	N	N	N	Y	N	N	N	N	Y	N	N	Y		N	N
MCC SWITCHBOARD SYSTEM	Loss of electric supply to site	N	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N
TERMINAL PROCESS PIPEWORK SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
TERMINAL PROCESS PIPEWORK SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
TERMINAL PROCESS PIPEWORK SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N
VALVES & EQUIP - CRITICAL NON ROV	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
PROCESS OPERATIONS SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
PROCESS PRE-HEATING SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
PROCESS OPERATIONS SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
PROCESS PRE-HEATING SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
METERING STREAM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
METERING SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
METERING GENERAL	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	N	N
METERING STREAM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	N	N
METERING SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	N	N
MISCELLANEOUS ELECTRICAL EQUIPMENT	Failure to control or monitor plant on site	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
MODULAR BOILER SYSTEM	Low outlet temp	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
MOTOR	Motor inoperable	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
NITROGEN GENERATOR SYSTEM	Failure of compressor gas seal	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
NITROGEN SNUFFING SYSTEM	Unable to snuff out flame from vent stack	Y	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
NON CRITICAL VALVES SYSTEM	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
NON CRITICAL VALVES SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
NON CRITICAL VALVES SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
NON CRITICAL VALVES SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
NON SIL RATED INSTRUMETED LOOP	Loss of remote monitoring / control	N	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N
UNINTERRUPTIBLE POWER SUPPLY SYSTEM	Power failure leading to loss of control	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
FWACV GAS QUALITY SYSTEM	Loss of gas quality information	N	N	N	N	N	N	?	N	N	N	Y	Y	N	N	N
GSMR GAS QUALITY SYSTEM	Loss of gas quality information	N	N	N	N	N	N	?	N	N	N	Y	Y	N	N	N
PROTECTION RELAYS	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
REMOTE CP TR UNITS	Increased corrosion on pipe	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SITE CP SYSTEM (ICS)	Increased corrosion on pipe	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - CRITICAL NON ROV	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - CRITICAL NON ROV	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - CRITICAL NON ROV	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
SITE CP SYSTEM (ICM)	Increased corrosion on pipe	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
EXIT GAS QUALITY SYSTEM	Loss of gas quality information	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N
SITE CP SYSTEM (SACRIFICIAL ANODE)	Increased corrosion on pipe	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER B SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N
SCRUBBER C SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N
SCRUBBER D SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
SITE CP SYSTEM (MIXED)	Increased corrosion rate	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SITE SECURITY SYSTEM	Security system failure	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SPECIAL GAS QUALITY SYSTEM	Loss of gas quality information	N	N	N	N	N	N	?	N	N	N	Y	Y	N	N	N
STANDBY GENERATOR SYSTEM	Loss of standby power control monitoring issues if required	Y	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
STRUCTURES SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
SUCTION PROCESS PIPEWORK SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SUCTION PROCESS PIPEWORK SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	Y	N		Y	N	N	N
SUCTION PROCESS PIPEWORK SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	Y	N	N	Y	Y	N	N
SUPPLY REGULATOR SYSTEM	Loss of gas supply to preheater or actuators	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SUPPLY REGULATOR SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
SUPPLY REGULATOR SYSTEM	Corrosion minor leak	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
SUPPLY REGULATOR SYSTEM	Corrosion significant leak	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
TELEMETRY SYSTEM	Loss of control / monitoring	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
TERMINAL INCOMER SYSTEM	Loss of pressure temperature information	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VOLUMETRIC REGULATOR STREAM	Corrosion significant leak	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
WATER BATH HEATER (AGI)	Low outlet temp	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
WATER BATH HEATER (AGI)	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
WATER BATH HEATER (AGI)	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUTDOWN
WATER BATH HEATER (AGI)	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	Y	N	Y	Y	N	N
WATER WASH SYSTEM	Unable to wash engine	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N
COMPRESSOR TEE SYSTEM	Need further information	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Corrosion no leak	N	N		Y	N			N			N	Y		N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak minor	N	N	Y	Y	N	Y		N		Y	N	Y		N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Gas leak significant	N	N	Y	Y	N	Y		N		Y	N	Y	Y	N	N
VALVE	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VALVE	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y		N	N
PT/COMP OIL SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
SCRUBBER A SYSTEM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER B SYSTEM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER C SYSTEM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SUCTION PROCESS PIPEWORK SYSTEM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
FILTRATION STREAM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
VOLUMETRIC REGULATOR STREAM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
TERMINAL PROCESS PIPEWORK SYSTEM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
COMPRESSOR SEAL SYSTEM (DRY)	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
COMPRESSOR SEAL SYSTEM (WET)	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
FUEL GAS SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
GG LUBE & HYDRAULIC OIL SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
SUCTION PROCESS PIPEWORK SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
PRA STREAMS & SUPPLY SYSTEM	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
PRA STREAMS & SUPPLY SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
FILTER	Filter blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
COMPRESSOR SEAL SYSTEM (DRY)	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
COMPRESSOR SEAL SYSTEM (WET)	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
DRIVE COOLING SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
ELECTRIC DRIVE OIL SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FUEL GAS SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
GAS COMPRESSOR SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
GG LUBE & HYDRAULIC OIL SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
POWER TURBINE SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PRA STREAMS & SUPPLY SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
VALVE	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N
BUILDING & ENCLOUSURES SYSTEM	Structural damage leak affecting electrical control equipment loss of control / monitoring	N	N		Y	N	N	N	N	N	Y	N	N	N	N	N
REMOTELY OPERABLE VALVES SYSTEM	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
REMOTELY OPERABLE VALVES SYSTEM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
REMOTELY OPERABLE VALVES SYSTEM	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
REMOTELY OPERABLE VALVES SYSTEM	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	N	N	Y	Y	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUTDOWN
OIL SYSTEM	Failure of lube oil system leading to unit trip	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BYPASS PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - loss of monitoring and control	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
RECYCLE PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
SUCTION PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
GENERAL PIPEWORK SYS	Mechanical electrical elements failing - loss of monitoring and control	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
TERMINAL PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - loss of monitoring and control	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
TERMINAL PROCESS PIPEWORK SYSTEM	Mechanical electrical elements failing - trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Temperature control loss - trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
SCRUBBER B SYSTEM	Blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER C SYSTEM	Blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER A SYSTEM	Blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER D SYSTEM	Blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER	Blockage - maintenance	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N
SCRUBBER B SYSTEM	Blockage detection	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SCRUBBER C SYSTEM	Blockage detection	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SCRUBBER A SYSTEM	Blockage detection	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SCRUBBER D SYSTEM	Blockage detection	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SCRUBBER	Blockage detection	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
DISCHARGE PROCESS PIPEWORK SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
DRIVE COOLING SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
ELECTRIC DRIVE OIL SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
GAS COMPRESSOR SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
POWER TURBINE SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
PRESSURE REDUCTION SYSTEM	Filter blockage - unit trip	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
VALVES & EQUIP - CRITICAL ROV	Unable to isolate for remote maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - NON-CRITICAL	Unable to isolate for maint/emergency	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - CRITICAL ROV	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - NON-CRITICAL	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - CRITICAL ROV	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - NON-CRITICAL	Gas leak minor	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
VALVES & EQUIP - CRITICAL ROV	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	Y	N	Y	Y	N	N
VALVES & EQUIP - NON-CRITICAL	Gas leak significant	N	N	Y	Y	N	Y	N	N	N	Y	N	Y	Y	N	N
TEST EQUIPMENT	Need further information	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
VIBRATION MONITORING SYSTEM	Loss of unit - Instrumentation or Electrical fault	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N
VOLUMETRIC REGULATOR STREAM	Loss of stream regulator slam shut - trip	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VOLUMETRIC REGULATOR STREAM	Corrosion no leak	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N
VOLUMETRIC REGULATOR STREAM	Corrosion minor leak	N	N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	N
PRESSURE REDUCTION SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
PT/COMP OIL SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SUCTION PROCESS PIPEWORK SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

SUBPROCESS	FAILURE_MODE_DESCRIPTION	PROB_OF_EXTERNAL_EVENT	CONGESTED_AREA	SAFETY_IGNITION_YN	SAFETY_OTHER_YN	ENVIRONMENT_INCIDENT_YN	EMISSIONS_YN	SITE_PERMIT_BREACH_YN	NOISE_YN	UNIT_UNAVAIL_YN	STATION_UNAVAIL_YN	GAS_VOL_SHRINKAGE	INCREASED_MAINTENANCE	CATASTROPHIC_FAILURE	REDUCTION_IN_PIPELINE_CAPACITY	PIPELINE_SHUT_DOWN
SCRUBBER A SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SCRUBBER B SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SCRUBBER C SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FILTRATION STREAM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
VOLUMETRIC REGULATOR STREAM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
TERMINAL PROCESS PIPEWORK SYSTEM	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FILTER	Filter blockage detection failure	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

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