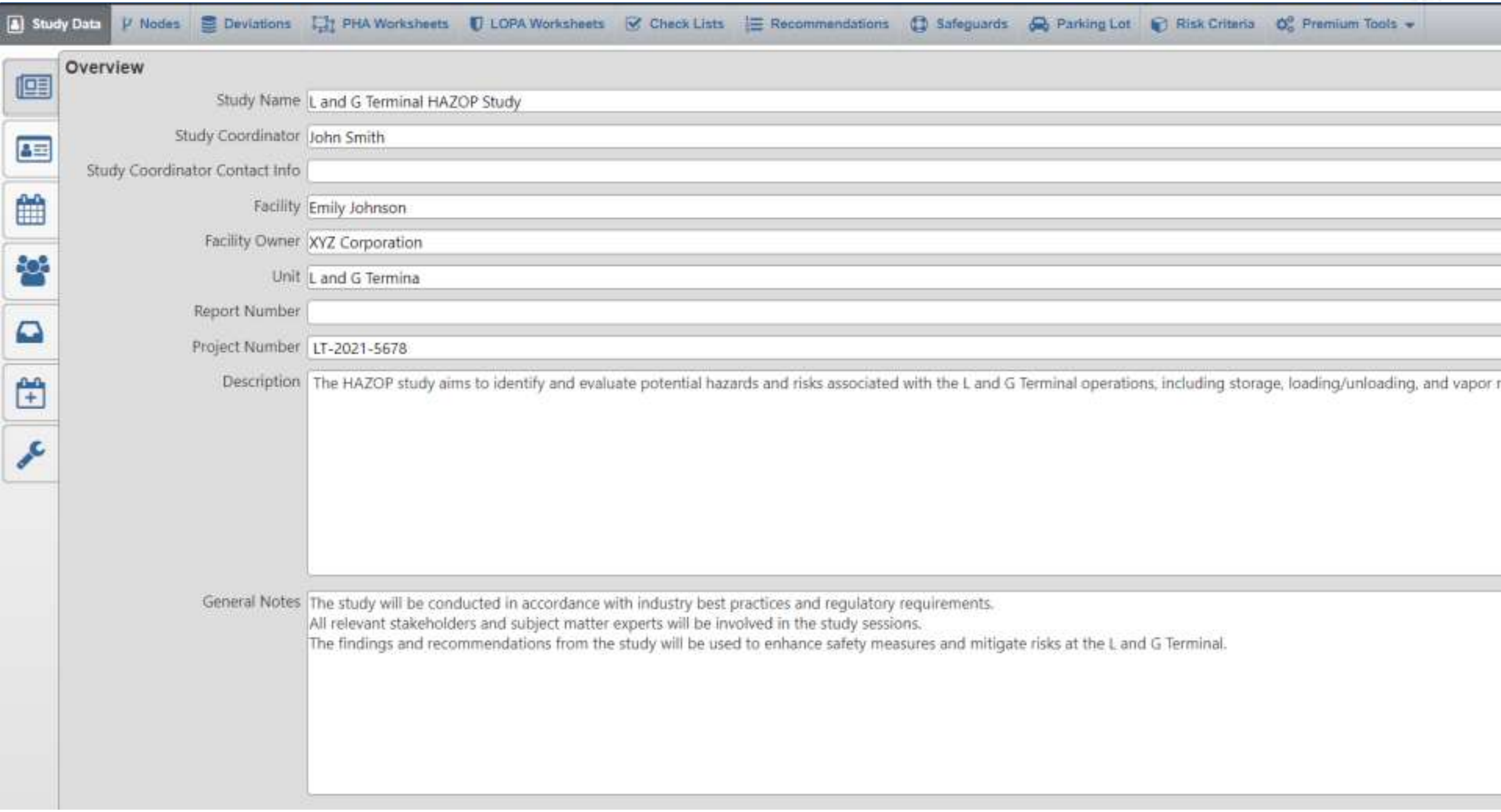
HAZOP REPORT

HAZOP Report- LNG terminal



Overview

Study Name: L and G Terminal HAZOP Study

Study Coordinator: John Smith

Study Coordinator Contact Info:

Facility: Emily Johnson

Facility Owner: XYZ Corporation

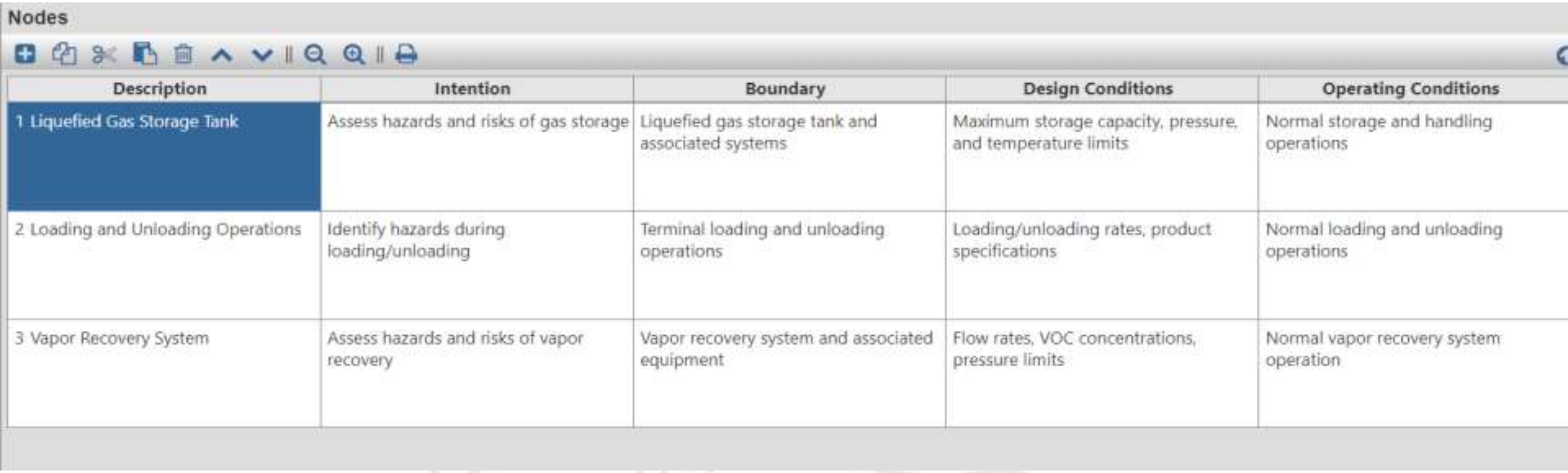
Unit: L and G Termina

Report Number:

Project Number: LT-2021-5678

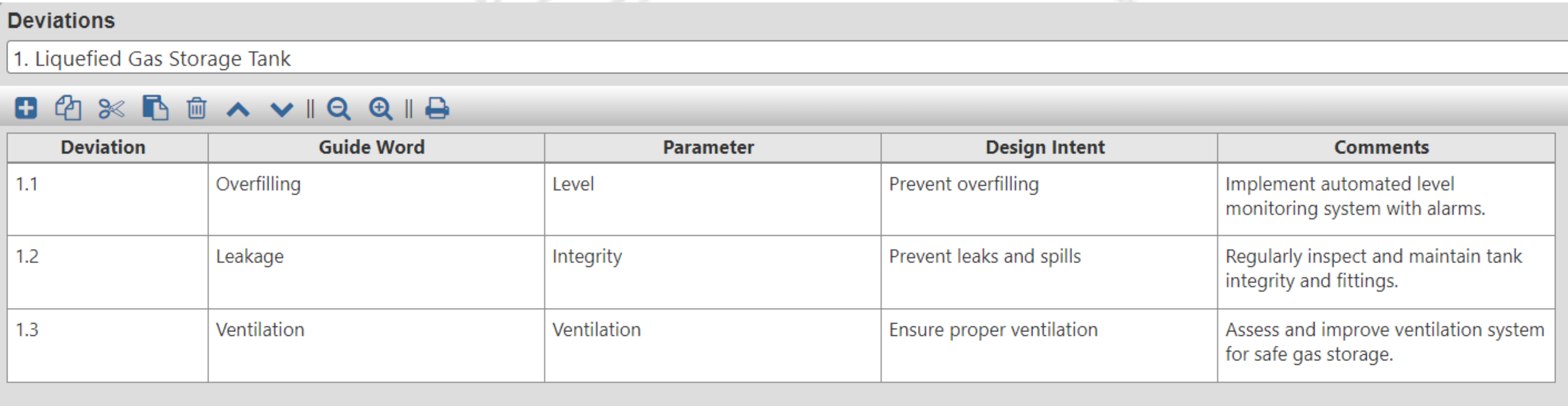
Description: The HAZOP study aims to identify and evaluate potential hazards and risks associated with the L and G Terminal operations, including storage, loading/unloading, and vapor r

General Notes: The study will be conducted in accordance with industry best practices and regulatory requirements.
All relevant stakeholders and subject matter experts will be involved in the study sessions.
The findings and recommendations from the study will be used to enhance safety measures and mitigate risks at the L and G Terminal.



Nodes

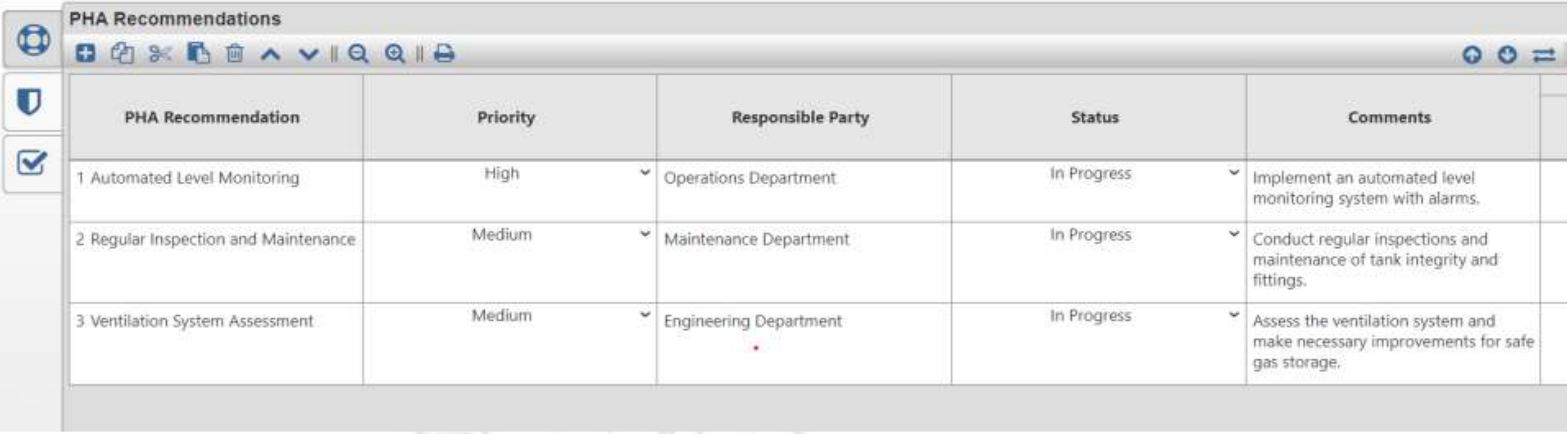
Description	Intention	Boundary	Design Conditions	Operating Conditions
1 Liquefied Gas Storage Tank	Assess hazards and risks of gas storage	Liquefied gas storage tank and associated systems	Maximum storage capacity, pressure, and temperature limits	Normal storage and handling operations
2 Loading and Unloading Operations	Identify hazards during loading/unloading	Terminal loading and unloading operations	Loading/unloading rates, product specifications	Normal loading and unloading operations
3 Vapor Recovery System	Assess hazards and risks of vapor recovery	Vapor recovery system and associated equipment	Flow rates, VOC concentrations, pressure limits	Normal vapor recovery system operation



Deviations

1. Liquefied Gas Storage Tank

Deviation	Guide Word	Parameter	Design Intent	Comments
1.1	Overfilling	Level	Prevent overfilling	Implement automated level monitoring system with alarms.
1.2	Leakage	Integrity	Prevent leaks and spills	Regularly inspect and maintain tank integrity and fittings.
1.3	Ventilation	Ventilation	Ensure proper ventilation	Assess and improve ventilation system for safe gas storage.



PHA Recommendations

PHA Recommendation	Priority	Responsible Party	Status	Comments
1 Automated Level Monitoring	High	Operations Department	In Progress	Implement an automated level monitoring system with alarms.
2 Regular Inspection and Maintenance	Medium	Maintenance Department	In Progress	Conduct regular inspections and maintenance of tank integrity and fittings.
3 Ventilation System Assessment	Medium	Engineering Department	In Progress	Assess the ventilation system and make necessary improvements for safe gas storage.

PHA Recommendations

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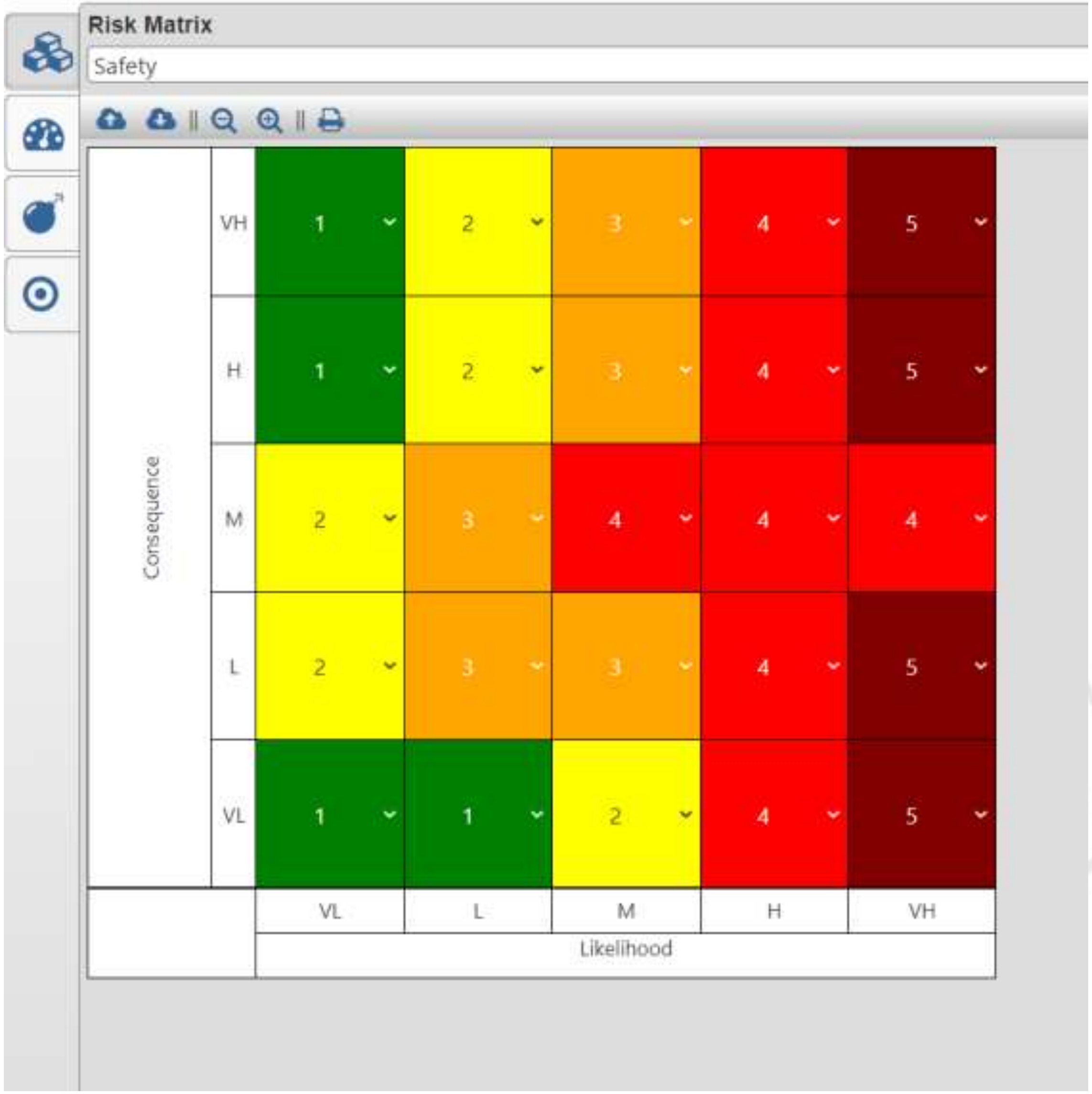
Risk Matrix



Risk Matrix

Safety

Consequence	VH	1	2	3	4	5
	H	1	2	3	4	5
	M	2	3	4	4	4
	L	2	3	3	4	5
	VL	1	1	2	4	5
		VL	L	M	H	VH
		Likelihood				

Steps of Risk Assessment

- Identify the hazards
- Identify the people who might be harmed and how
- Evaluate the risks and decide on precautions
- Record the significant findings & implement them
- Review and update as necessary

RISK= Probability x Serevity

Likelihood-> Chances of occurence (Accident)

Consequnces->Results of Accident

Green- Very less Risk

Yellow- Suitable for work

Red- High Risk

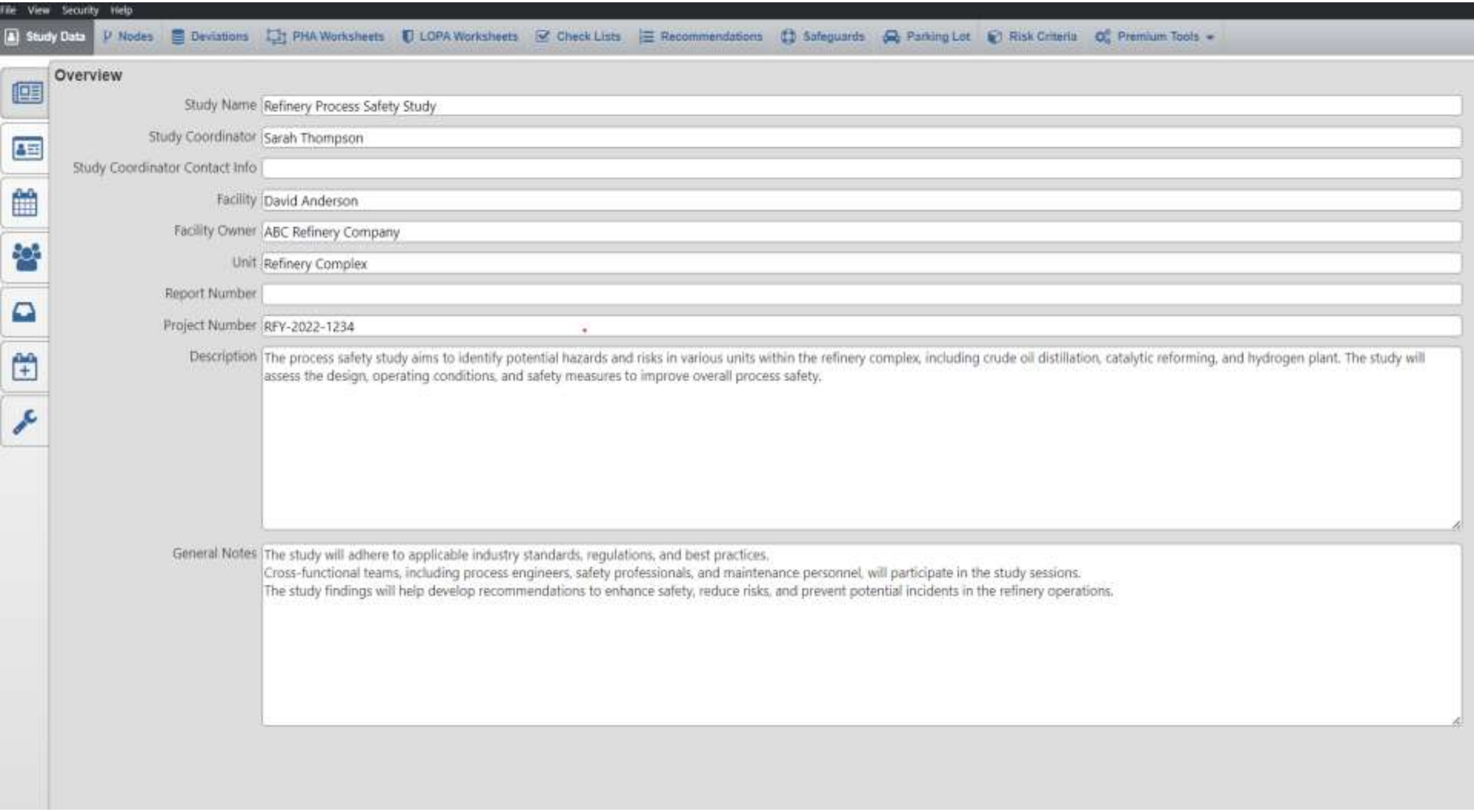
ML Code Form of HAZOP Report

```
import pandas as pd
import numpy as np

# Hypothetical deviations with risk criteria
deviations_data = {
    'Node': ['Liquefied Gas Storage Tank', 'Loading and Unloading Operations','Vapor Recovery 
System'],
    'Intention':['Assess hazards and risks of gas storage','Identify hazards during 
loading/unloading   ','Assess hazards and risks of vapor recovery']
    'Deviation': ['High temperature', 'Low flow rate'],
    'Design Conditions': ['Maximum storage capacity, pressure, and temperature limits', 
'Loading/unloading rates, product specifications','Flow rates, VOC concentrations, pressure limits'],
    'Cause': ['Failure of temperature control system', 'Blockage in the flow line'],
    'IPL': [,'Yes','Yes'],
    'LOPA Requirement':
    'PHA Recommendation': ['Flow rates, VOC concentrations, pressure limits', 'Regular Inspection and 
Maintenance','Ventilation System Assessment'],
    'Priority': ['High', 'Medium', 'Medium'],
    'Responsible Party': ['Operations Department', 'Maintenance Department','Engineering Department'],
    'Status': ['Open', 'Open', 'Open],

    'Safeguard': ['Overfill Protection System', 'Tank Integrity Inspection','Ventilation System 
Monitoring'],
    'Safeguard Effectiveness': ['Highly effective', 'Effective','Yes'],
    'Risk Criteria': ['Tolerable if frequency < 1/year', 'Tolerable if production loss < 5%'],
}
```

```
# Create a DataFrame from the deviations data
deviations_df = pd.DataFrame(deviations_data)

# Risk levels mapping
risk_levels = {
    'Low': 1,
    'Medium': 3,
    'High': 5,
# Map consequence severity and likelihood to risk levels
deviations_df['Consequence Severity Level'] = deviations_df['Consequence'].map(risk_levels)
deviations_df['Likelihood Level'] = deviations_df['Priority'].map(risk_levels)

# Generate the risk matrix (original)
risk_matrix_data = {
    'Consequence \ Likelihood': ['Insignificant', 'Minor', 'Moderate', 'Major', 'Severe'],
    'Level 1': ['Green', 'Green', 'Yellow', 'Red', 'Brown'],
    'Level 2': ['Yellow', 'Orange', 'Orange', 'Red', 'Brown'],
    'Level 3': ['Yellow', 'Orange', 'Red', 'Red', 'Red'],
    'Level 4': ['Green', 'Yellow', 'Orange', 'Red', 'Brown'],
    'Level 5': ['Green', 'Yellow', 'Orange', 'Red', 'Brown'],
}
```

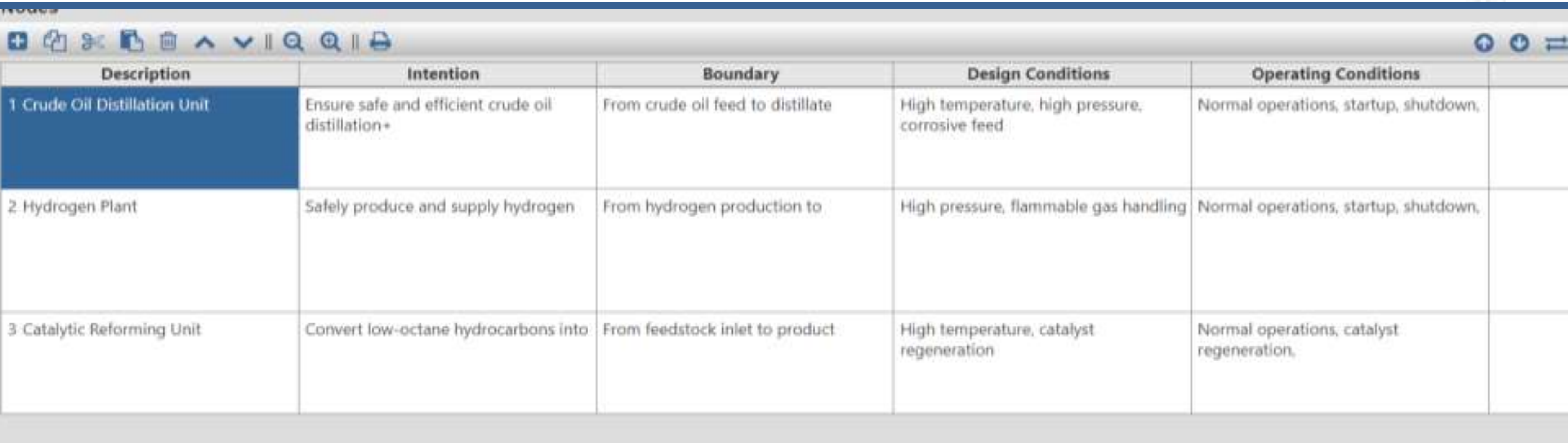
```
# Create a DataFrame for the risk matrix (original)
risk_matrix_df = pd.DataFrame(risk_matrix_data)

# Set the risk levels as index
risk_matrix_df.set_index('Consequence \ Likelihood', inplace=True)

# Add a row and column of zeros to the original risk matrix
zero_row = pd.Series([0] * len(risk_matrix_df.columns), name='Zero')
risk_matrix_df_with_zeros = pd.concat([zero_row, risk_matrix_df], axis=0)
risk_matrix_df_with_zeros = pd.concat([zero_row, risk_matrix_df_with_zeros], axis=1)

# Generate the mirrored risk matrix
upper_triangle = np.triu(risk_matrix_df_with_zeros.values)
mirrored_risk_matrix = np.concatenate((upper_triangle, upper_triangle.T), axis=1)

# Create a DataFrame for the mirrored risk matrix
columns = list(risk_matrix_df_with_zeros.columns)
index = list(risk_matrix_df_with_zeros.index) + list(risk_matrix_df_with_zeros.index)[1:][::-1]
mirrored_risk_matrix_df = pd.DataFrame(mirrored_risk_matrix, columns=columns, index=index)

# Save the DataFrames to Excel files
output_deviations_file = 'hazop_deviations_with_risk_matrix.xlsx'
output_risk_matrix_file = 'hazop_risk_matrix_mirrored.xlsx'
deviations_df.to_excel(output_deviations_file, index=False)
mirrored_risk_matrix_df.to_excel(output_risk_matrix_file)
```

HAZOP Report-Refinery



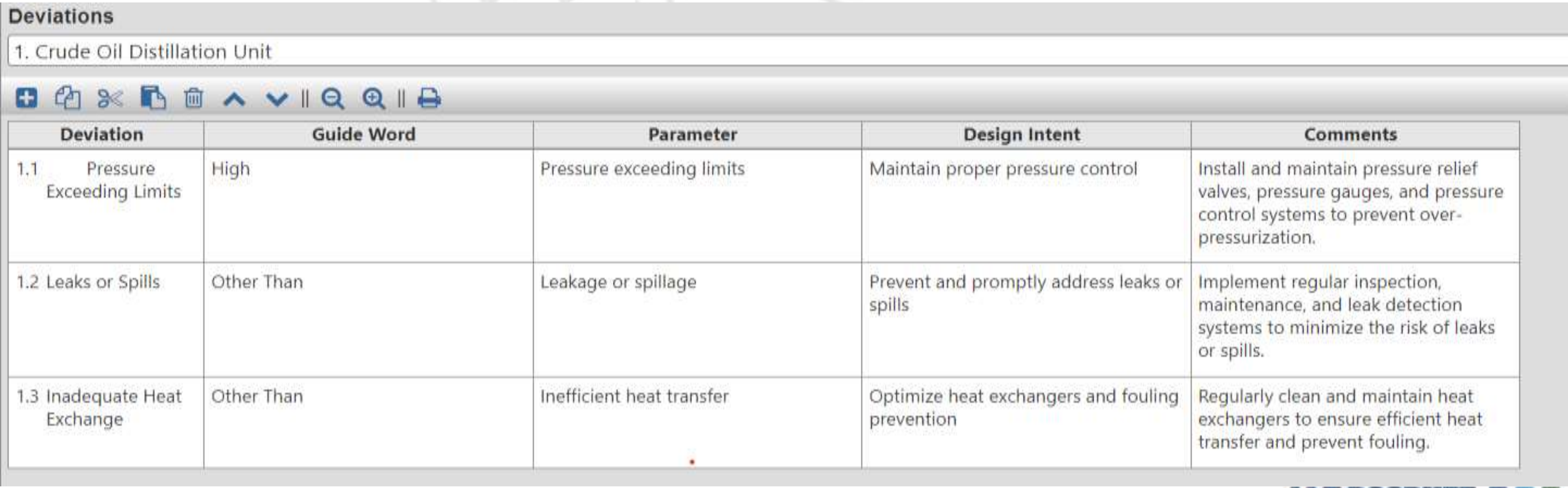
Overview

Study Name	Refinery Process Safety Study
Study Coordinator	Sarah Thompson
Study Coordinator Contact Info	
Facility	David Anderson
Facility Owner	ABC Refinery Company
Unit	Refinery Complex
Report Number	
Project Number	RFY-2022-1234
Description	The process safety study aims to identify potential hazards and risks in various units within the refinery complex, including crude oil distillation, catalytic reforming, and hydrogen plant. The study will assess the design, operating conditions, and safety measures to improve overall process safety.
General Notes	The study will adhere to applicable industry standards, regulations, and best practices. Cross-functional teams, including process engineers, safety professionals, and maintenance personnel, will participate in the study sessions. The study findings will help develop recommendations to enhance safety, reduce risks, and prevent potential incidents in the refinery operations.



Nodes

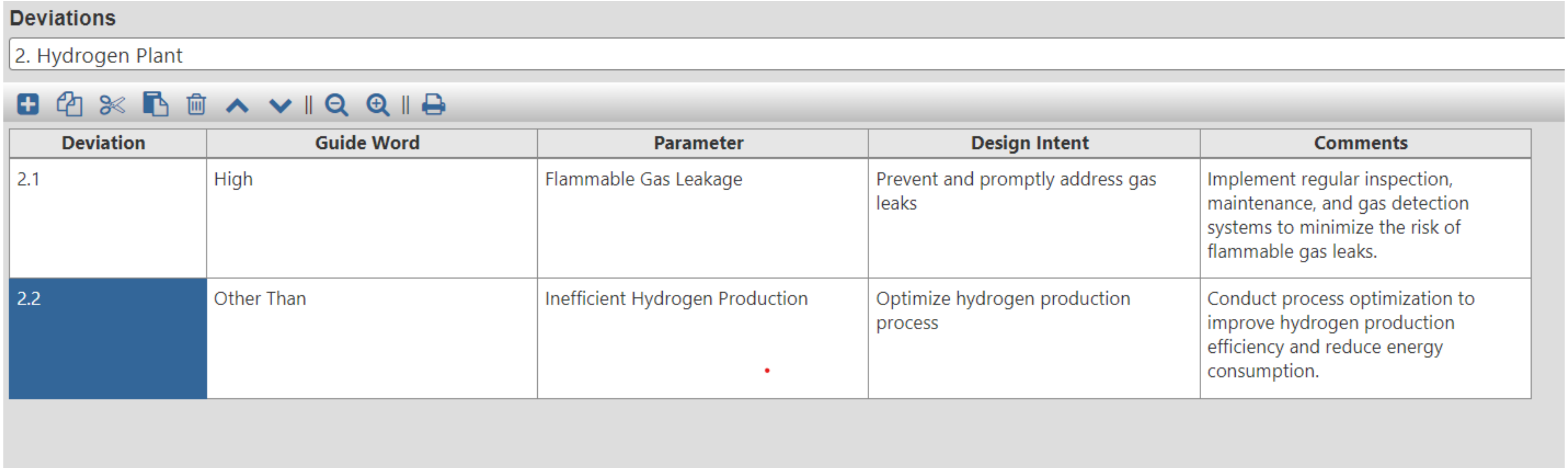
Description	Intention	Boundary	Design Conditions	Operating Conditions
1 Crude Oil Distillation Unit	Ensure safe and efficient crude oil distillation+	From crude oil feed to distillate	High temperature, high pressure, corrosive feed	Normal operations, startup, shutdown,
2 Hydrogen Plant	Safely produce and supply hydrogen	From hydrogen production to	High pressure, flammable gas handling	Normal operations, startup, shutdown,
3 Catalytic Reforming Unit	Convert low-octane hydrocarbons into	From feedstock inlet to product	High temperature, catalyst regeneration	Normal operations, catalyst regeneration,



Deviations

1. Crude Oil Distillation Unit

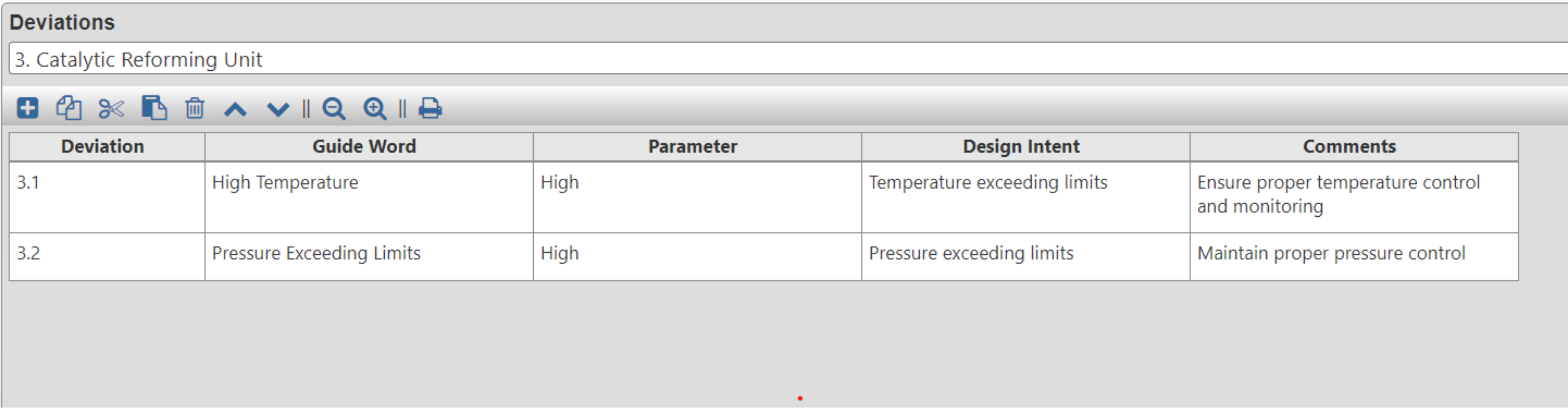
Deviation	Guide Word	Parameter	Design Intent	Comments
1.1 Pressure Exceeding Limits	High	Pressure exceeding limits	Maintain proper pressure control	Install and maintain pressure relief valves, pressure gauges, and pressure control systems to prevent over-pressurization.
1.2 Leaks or Spills	Other Than	Leakage or spillage	Prevent and promptly address leaks or spills	Implement regular inspection, maintenance, and leak detection systems to minimize the risk of leaks or spills.
1.3 Inadequate Heat Exchange	Other Than	Inefficient heat transfer	Optimize heat exchangers and fouling prevention	Regularly clean and maintain heat exchangers to ensure efficient heat transfer and prevent fouling.



Deviations

2. Hydrogen Plant

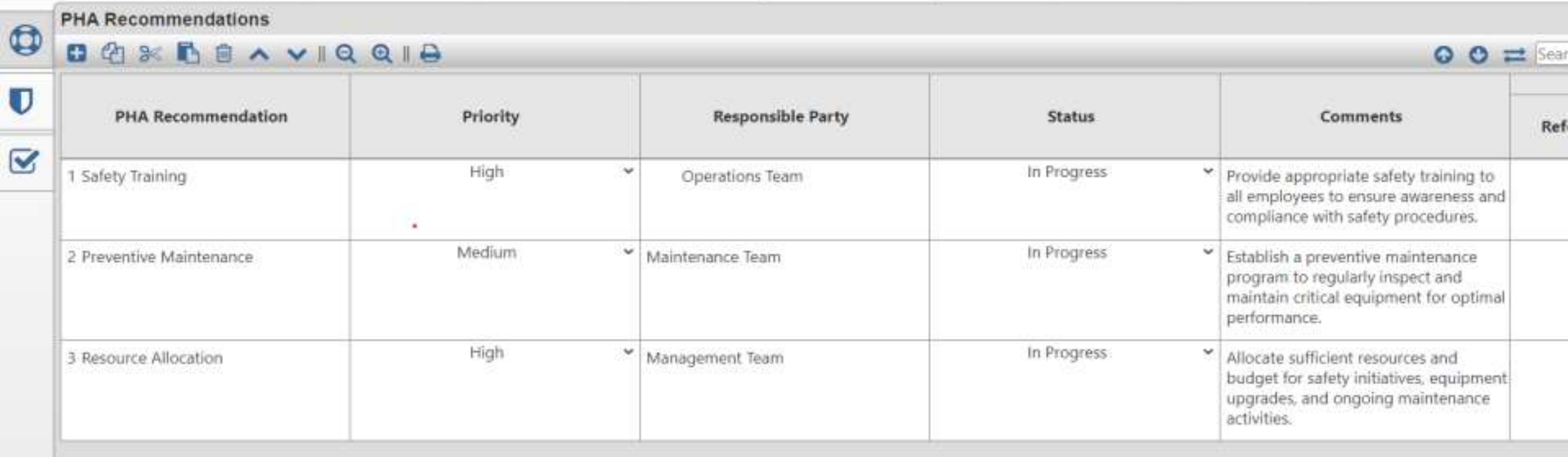
Deviation	Guide Word	Parameter	Design Intent	Comments
2.1	High	Flammable Gas Leakage	Prevent and promptly address gas leaks	Implement regular inspection, maintenance, and gas detection systems to minimize the risk of flammable gas leaks.
2.2	Other Than	Inefficient Hydrogen Production	Optimize hydrogen production process	Conduct process optimization to improve hydrogen production efficiency and reduce energy consumption.



Deviations

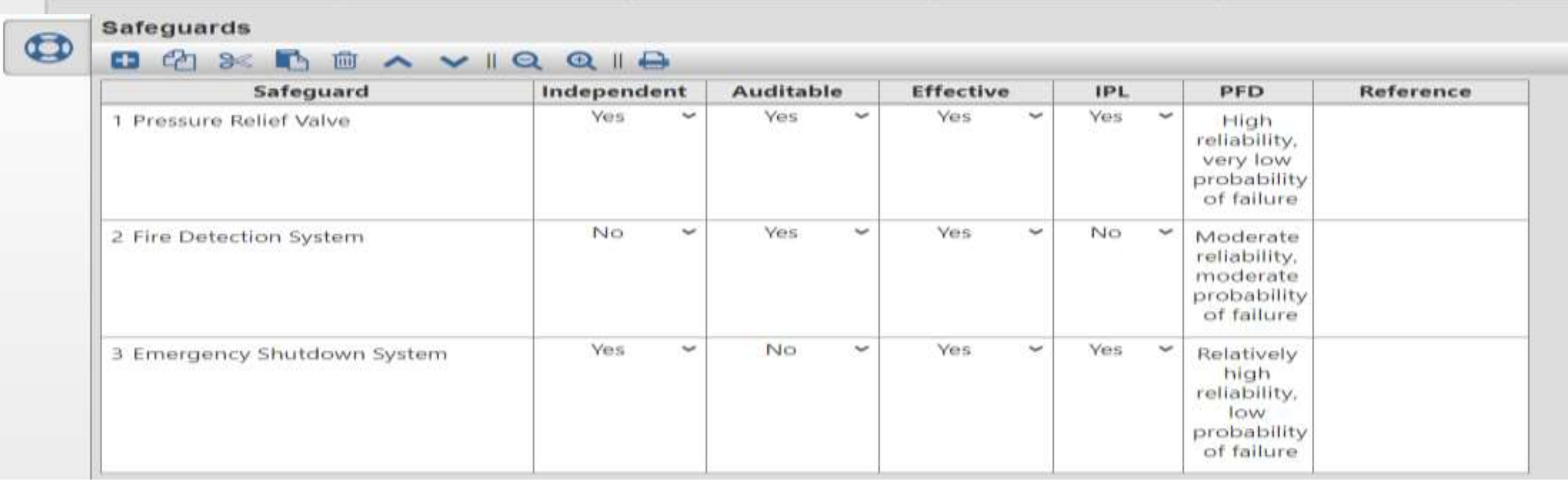
3. Catalytic Reforming Unit

Deviation	Guide Word	Parameter	Design Intent	Comments
3.1	High Temperature	High	Temperature exceeding limits	Ensure proper temperature control and monitoring
3.2	Pressure Exceeding Limits	High	Pressure exceeding limits	Maintain proper pressure control



PHA Recommendations

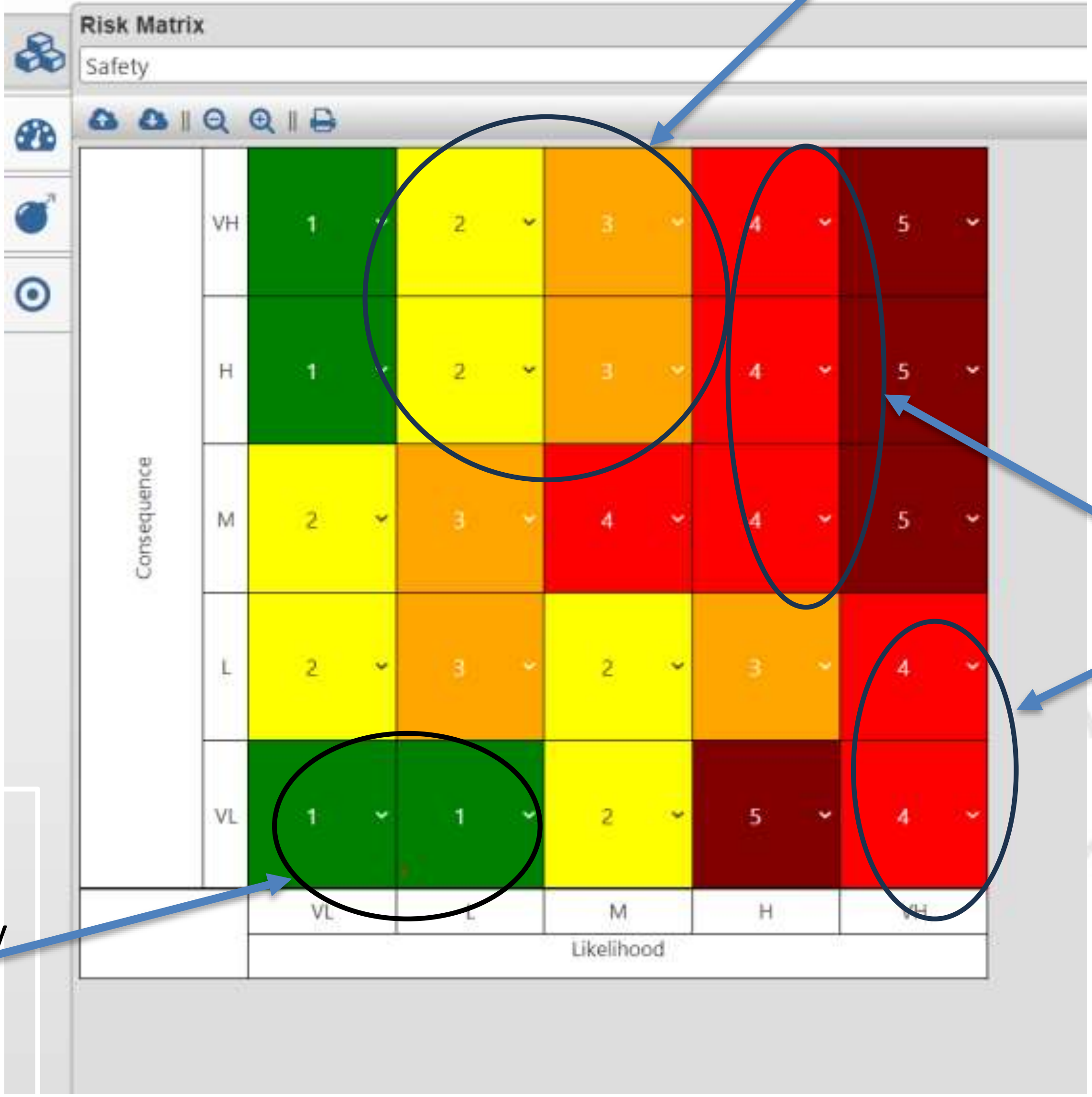
PHA Recommendation	Priority	Responsible Party	Status	Comments	Ref
1 Safety Training	High	Operations Team	In Progress	Provide appropriate safety training to all employees to ensure awareness and compliance with safety procedures.	
2 Preventive Maintenance	Medium	Maintenance Team	In Progress	Establish a preventive maintenance program to regularly inspect and maintain critical equipment for optimal performance.	
3 Resource Allocation	High	Management Team	In Progress	Allocate sufficient resources and budget for safety initiatives, equipment upgrades, and ongoing maintenance activities.	



Safeguards

Safeguard	Independent	Auditable	Effective	IPL	PFD	Reference
1 Pressure Relief Valve	Yes	Yes	Yes	Yes	High reliability, very low probability of failure	
2 Fire Detection System	No	Yes	Yes	No	Moderate reliability, moderate probability of failure	
3 Emergency Shutdown System	Yes	No	Yes	Yes	Relatively high reliability, low probability of failure	

Risk Matrix



Risk Matrix

Safety

Consequence

	VL	L	M	H	VH
VH	1	2	3	4	5
H	1	2	3	4	5
M	2	3	4	4	5
L	2	3	2	3	4
VL	1	1	2	5	4

Likelihood

Region of Intermediate Risk

Region of Very High Risk

Region of Very Low Risk

ML Code Form

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deviations_data = {
    'Node': ['Crude Oil Distillation Unit', 'Hydrogen Plant','Catalytic Reforming Unit'],
    'Deviation': [' Pressure Exceeding Limits', 'Leaks or Spills','Inadequate Heat Exchange']
    'Guide Word': ['High', 'Other Than','Other Than'],
    'Parameter': ['Pressure exceeding limits', 'Leakage or spillage','Prevent and promptly address
leaks or spills','Optimize heat exchangers and fouling prevention'],
    'Design Intent': ['Maintain proper pressure control ', 'React chemicals A and B to form compound
X'],
    'Cause': ['Failure of temperature control system', 'Blockage in the flow line'],
    'Consequence Category': ['Fire/Explosion', 'Quality/Productivity'],
    'IPL Requirement': ['Temperature sensor with alarm and automatic shutdown', 'Flow rate monitoring
system with interlock'],
    'LOPA Requirement': ['Safety interlock and emergency shutdown system', 'Additional flow sensors
for redundancy'],
    'PHA Recommendation': ['Safety Training', 'Preventive Maintenance','Resource Allocation'],
    'Priority': ['High', 'Medium','High'],
    'Responsible Party': [' Operations Team', 'Maintenance Team','Management Team'],
    'Status': ['Open', 'Open','Open'],
    'Comments': ['Provide appropriate safety training to all employees to ensure awareness and
compliance with safety procedures.',
'Establish a preventive maintenance program to regularly inspect and maintain critical equipment for
optimal performance.','Allocate sufficient resources and budget for safety initiatives, equipment
upgrades, and ongoing maintenance activities.
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'
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Thank you