THAI OIL PRELIMINARY INHOUSE STUDY

GAS DISOERSION STUDY REPORT
for

HYDROCARBON & TOXIC DISPERSION FROM TOC-3 FLARE FLAME OUT INCIDENT

0		APT	Issued for Approval	QMTS
A		APT	Issued for Review	QMTS
REV.	DATE	BY	DESCRIPTION	APPR. / ENGINEERING APPROVAL
		Kuluwat ADB ()		
REVISION CODE : A = Issued for Review and Approval - 0 = Issued for Final				

Contents

วัตถุประสงค์การศึกษาและขอบเขตงาน (Study Objective and Work Scope)

รายชื่อผู้เข้าร่วม (Attendee list)									
No.	Name	Company	Date of attendance						
			10 Apr 2024						
1	Acharee Tiyabhorn		X						
2	Adison Chanasat		X						

Technical Authority Level 2 (TA 2)		
No.	Name	Status

เอกสารอ้างอิง (Drawing & Reference)				
No.	**Document Name**	**Drawing No**	**Document File**	**Comment**
1	x	ff	TOP EOSL ETL - Weekly Status Update 20240215.pdf	

Node List (PID / PFD และ NODE Marked)							
No.	**Node**	**Design Intent**	**Design Conditions**	**Operating Conditions**	**Node Boundary**	**Drawing No**	**Drawing Page (From-To)**
1	x2						All
2	x3						All

RECCOMENDATION STATUS TRACKING TABLE					
REF.	**NODE**	**RR**	**Recommendation**	**Status**	**Action By (Response & Signature)**
1	x2	L	r	Closed	Aj Wisuthithawornwong
2	x2		x	Open	Apinan Phattharaseesakhon

Major Accident Event (MAE)			
No.	**Node**	**Causes**	**Risk Asseessment Matrix (R)**
1	x2		
2	x3		

Safety Critical Equipment (SCE)			
No	**Equipment Tag No.**	**ผลกระทบที่เกิดขึ้น (Consequences)**	**ระดับความเสี่ยง (Risk)**
1	x2		
2	x2		1.x
3	x3		
4	x3		1.x
5	x3		1.x24

HAZOP STUDY WORKSHEET

Project:		**NODE**	**x3**
Design Intent :		**System**	
Design Conditions:		**HAZOP Boundary**	
Operating Conditions:			
PFD, PID No. :		**Date**	

Guide Word	Deviation	Causes	Consequences	CAT	Unmitigated Risk Assessment			Major Accident Event	Existing Safeguards	Mitigated Risk Assessment Matrix			Action No	Recommendations	Action by
				(P/A/E/R/Q)	S	L	R	(Y/N)		S	L	R			
1.No	1.No Flow		x24	Q									2		
1.No	1.No Flow		x24	R									3		
2.More of	2.More/High Flow			P									1		
3.Less of	3.Less/Low Flow												1		
4.Reverse	4.Reverse Flow												1		
5.Misdirected	5.Misdirected Flow												1		
8.More of	8.More/High Pressur												1		
9.Less of	9.Less/Low Pressure												1		
12.More of	12.More/High Tempe												1		
13.Less of	13.Less/Low Tempe												1		
16.More of	16.More/ High Level												1		
17.Less of	17.Less/ Low Level												1		
20.More of	20.More Viscosity												1		
21.Less of	21.Less Viscosity												1		
24.Composition Cha	24.Composition Cha												1		
25.Contamination	25.Contamination												1		
28.Maintenance / Ins	28.Maintenance / Ins												1		
26.Vent / Purge / Dra	26.Vent / Purge / Dra		x	P									1		
29.Leakage	29.Leakage												1		
27.Start Up / Shut D	27.Start Up / Shut D		x	P									1		
30.Corrosion / Erosic	30.Corrosion / Erosic												1		
31. Utilities Service F	31. Utilities Service F												1		
32.Maintenance Stat	32.Maintenance Stat												1		
33.Spare Equipment	33.Spare Equipment												1		
34.Reaction	34.Reaction												1		
35.External Fire & E	35.External Fire & E												1		
36.Safety & Human I	36.Safety & Human I												1		

Note:

HAZOP STUDY WORKSHEET

Project:		**NODE**	**x2**
Design Intent :		**System**	
Design Conditions:		**HAZOP Boundary**	
Operating Conditions:			
PFD, PID No. :		**Date**	

Guide Word	Deviation	Causes	Consequences	CAT	Unmitigated Risk Assessment			Major Accident Event	Existing Safeguards	Mitigated Risk Assessment Matrix			Action No	Recommendations	Action by
				(P/A/E/R/Q)	S	L	R	(Y/N)		S	L	R			
1.No	1.No Flow		x	P						2	B	L	1	r	Aj Wisuthithawornwong
2.More of	2.More/High Flow												1	x	nan Phattharaseesakh
3.Less of	3.Less/Low Flow												1		
4.Reverse	4.Reverse Flow												1		
5.Misdirected	5.Misdirected Flow												1		
8.More of	8.More/High Pressur												1		
9.Less of	9.Less/Low Pressure												1		
12.More of	12.More/High Tempe												1		
13.Less of	13.Less/Low Tempe												1		
16.More of	16.More/ High Level												1		
17.Less of	17.Less/ Low Level												1		
20.More of	20.More Viscosity												1		
21.Less of	21.Less Viscosity												1		
24.Composition Cha	24.Composition Cha												1		
25.Contamination	25.Contamination												1		
26.Vent / Purge / Dra	26.Vent / Purge / Dra		x	P									1		
28.Maintenance / Ins	28.Maintenance / Ins												1		
27.Start Up / Shut D	27.Start Up / Shut D		x	P									1		
29.Leakage	29.Leakage												1		
30.Corrosion / Erosic	30.Corrosion / Erosic												1		
31. Utilities Service F	31. Utilities Service F												1		
32.Maintenance Stat	32.Maintenance Stat												1		
33.Spare Equipment	33.Spare Equipment												1		
34.Reaction	34.Reaction												1		
35.External Fire & E	35.External Fire & E												1		
36.Safety & Human I	36.Safety & Human I												1		

Note:

ภาคผนวก ก
ข้อมูลและตารางอ้างอิงสำหรับการประเมินความเสี่ยง
APPENDIX A
PHA -WORKSHEETS

ตารางการประเมินความเสียง (Risk Assessment Matrix (RAM))

Severity	Consequences					Increasing Likelihood					Opportunity	Opportunity
	People	Assets	Environment	Reputation	Product Quality	A	B	C	D	E	Positive consequence	
						Improbable	Unlikely	Possible	Likely	High		
						Never heard of in Petrochemical/ Refinery Industry	Heard of in Petrochemical/ Refinery Industry	Incident has occurred in Thailand/Asia	Happens several times per year in Thailand/Asia	Happens several times per year in Thaioil		
						> 50.0 y	20.0-50.0 y	5.0-20.0 y	1.0-5.0 y	0.0-1.0 y		
5	Multiple fatalities	Extensive damage > 10 MUSD	Massive effect, persistent severe damage	International impact	Massive effect	5 M (Priority 2)	10 M (Priority 2)	15 H (Priority 1)	20 H (Priority 1)	25 H (Priority 1)	Exceptional Profit increase or cost reduce > 10%	5
4	Permanent Total Disability or 1 to 3 fatalities	Major damage 1-10 MUSD	Major effect, extended breach or wide spread nuisance	National impact	Major effect	4 L (Priority 3)	8 M (Priority 2)	12 M (Priority 2)	16 H (Priority 1)	20 H (Priority 1)	Major Profit increase or cost reduce 5% - 10%	4
3	Major health effect/injury (LWC)	Localised damage 0.1-1 MUSD	Localised effect, repeated breached or many complaints	Considerable impact, Regional media	Considerable effect	3 L (Priority 3)	6 L (Priority 3)	9 M (Priority 2)	12 M (Priority 2)	16 H (Priority 1)	Significant Profit increase or cost reduce 2.5% - 5%	3
2	Minor health effect/injury (MTC)	Minor damage 10-100 KUSD	Minor effect, single breach or complaint	Limit impact, Local media	Limit effect	2 L (Priority 3)	4 L (Priority 3)	6 L (Priority 3)	8 L (Priority 3)	10 M (Priority 2)	Minor Profit increase or cost reduce 1% - 2.5%	2
1	Slight health effect/injury (FAC)	Slight damage ≤ 10 KUSD	Slight effect, within fence	Slight impact	Slight effect	1 L/N (Priority 4)	2 L/N (Priority 4)	3 L (Priority 3)	4 L (Priority 3)	5 L (Priority 3)	Insignificant Profit increase or cost reduce < 1%	1
0	No health effect/injury	No damage	No effect	No impact	No effect	L/N (Priority 4)	L/N (Priority 4)	L/N (Priority 4)	L/N (Priority 4)	L/N (Priority 4)	-	0

Risk Assessment Matrix : 5X5

HAZOP Guide Words

Deviations	Guide Word	Process Deviation (Examples of Cause)	Area of Application
		Flow	
Less/Low Flow	Less of	Line blockage– filter blockage – fouling in vessels – defective pumps – restrictor or orifice plates – etc.	System
Misdirected Flow	Misdirected	Flow directed to stream other than intended due to misalignment of valves – etc.	System
More/High Flow	More of	Increased pumping capacity – reduced delivery head – increased suction pressure – static generation under high velocity – pump gland leaks – e	System
No Flow	No	Incorrect routing – blockage – burst pipe – large leak – equipment failure (C.V., isolation valve, pump, vessel, etc.) – incorrect pressure differentia	System
Reverse Flow	Reverse	Incorrect pressure differential – two-way flow – emergency venting – incorrect operation – in-line spare equipment – etc.	System
		Level	
Less/ Low Level	Less of	Inlet flow stops – leak – outflow greater than inflow – control failure – faulty level measurement – draining of vessel – etc.	optional
More/ High Level	More of	Outlet isolated or blocked – inflow greater than outflow – control failure – faulty level measurement – etc.	optional
		Optional Guidewords	
Confined Space/ Esc	Confined Space/ Esc	Lift and manual handling, Work permit system, Rescue plan, Training	optional
Corrosive	Corrosive	Cathodic protection arrangements (internal and external) –Coating applications –Corrosion monitoring methods and –frequencies – Materials spe	optional
Hot/ Cold Surface	Hot/ Cold Surface	Hot surfaces – Cold Surface	optional
Human Factor & Erg	Human Factor & Erg	Access - Equipment Operation - Labelling– identification– instructions– training– qualifications– etc.	optional
Information	Information	Confusing – Inadequate – Missing –Misinterpreted – Partial–Stress –Wrong information– etc.	optional
Instrumentation	Instrumentation	Analyzer - flow measurement- location of instrumentation/alarm – indicators – recorders – etc.	Vessel or unit
Maintenance / Inspe	Maintenance / Inspe	Provision and adequacy for testing of equipment and product – location of sampling points – consistent philosophy –vibration detection – control s	optional
Mixing	Mixing	Fast mixing –Slow mixing–No mixing – etc.	optional
Operations / Start Up	Operations / Start Up	Purging – flushing – clearing blockages – steam out – start-up – normal shutdown – emergency shutdown – emergency operations – inspection c	optional
Phase	Phase	Phase change	optional
Sampling	Sampling	Sampling Point location, sampling point specification / feature, etc.	Vessel or unit
Time	Time	Too long–Too short –Wrong time– Time for analysis results – too soon– etc.	optional
Toxic	Toxic	Feed stream impurities (e.g., mercury, H 2S, CO 2) –Dust generation–Powder handling– etc.	optional
Traffic	Traffic	Vehicles crash to equipment, unit	optional
		Other	
Other	Other	Other	Other
		Other Than	
Utilities Service Fail	Utilities Service Fail	Loss of electricity – instrument air – fuel gas – cooling water– steam – nitrogen – etc.	Vessel or unit
Composition Change	Composition Change	passing isolation valves, etc.	System
Contamination	Contamination	wrong material, wrong operation, ingress of air, shutdown and start up conditions, etc.	System
Corrosion / Erosion	Corrosion / Erosion	Corrosion / Erosion – Internal / External Corrosion at flare tips – etc. Internal/ external corrosion protection – engineering specifications – stress c	Vessel or unit
External Fire & Explo	External Fire & Explo	Adjacent facillity exposure from fire/explosion Lagging – firefighting — safety showers – security –Adjacent facility exposures – etc.	Unit
Leakage	Leakage	From tube side to shell side of exchanger, roof drain leakage - etc.	Vessel or unit
Maintenance / Inspe	Maintenance / Inspe	Maintenance / Inspection Activities	Vessel or unit
Maintenance Static	Maintenance Static	System drainage (how and where to) – isolation of equipment and prep for maintenance shutdown and start up (how) – etc.	Vessel or unit
Reaction	Reaction	Reaction by-products, missing reactions	Reactor or Unit
Safety & Human Fac	Safety & Human Fac	Lagging, fire fighting, toxic gas, safety shower, hot/cold surface etc., security Hot work –Hot surfaces –Electrical classification –Auto-ignition or p	Vessel or unit
Spare Equipment	Spare Equipment	Installed or not installed–Availability of spares –Modified specifications –Storage of spares – etc.	Vessel or unit
Start Up / Shut Down	Start Up / Shut Down	Start Up / Shut Down / Commissioning Activities	Vessel or unit
Vent / Purge / Drain	Vent / Purge / Drain	Vent/ Purge / Drain of Toxic / Flammable	Vessel or unit
		Pressure	
Less/Low Pressure	Less of	Generation of vacuum condition – restricted pump/ compressor suction line – vessel drainage – etc.	System
More/High Pressure	More of	Surge problems (line and flange sizes) – relief philosophy (process / fire etc.) – connection to high pressure system – gas breakthrough (inadequa	System
		Temperature	
Less/Low Temperatu	Less of	Ambient conditions – reducing pressure – loss of heating – depressurisation of liquefied gas – Joule Thompson effect – line freezing – etc.	System
More/High Temperat	More of	Ambient conditions – fire situation – high than normal temperature – fouled cooler tubes – cooling water temperature wrong –cooling water failure	System
		Viscosity	
Less Viscosity	Less of	as above	System
More Viscosity	More of	incorrect material spec, temperature etc.	System

HAZOP RECOMMENDATION RESPONSE SHEET			
Project Title:			
Project No:HAZOP-2024-0000046			
Node:			
Action By:	Aj Wisuthithawornwong	**Response By:**	Aj Wisuthithawornwong
Action No.	1		
Drawing and Documents			
Action Description			
Deviation:	No/No Flow		
Cause:			
Consequences:	x		
Safeguards:			
Recommendation:	r		
Action Response:			

Action Close-out Details	By whom	Signature	Date
Response			
Ownner Approval			

HAZOP RECOMMENDATION RESPONSE SHEET			
Project Title:			
Project No:HAZOP-2024-0000046			
Node:			
Action By:	Apinan Phattharaseesakhon	**Response By:**	Apinan Phattharaseesakhon
Action No.	1		
Drawing and Documents			
Action Description			
Deviation:	More of /More/High Flow		
Cause:			
Consequences:			
Safeguards:			
Recommendation:	x		
Action Response:			

Action Close-out Details	**By whom**	**Signature**	**Date**
Response			
Ownner Approval			

ภาคผนวก - PIDs / PFDs