طرح نگهداشت و افزایش تولید ۲۷ مخزن

HAZOP REPORT FOR COMPRESSOR STATION

نگهداشت و افزایش تولید میدان نفتی بینک

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IFC: Issued For Comment
IFA: Issued For Approval
AFD: Approved For Design
AFC: Approved For Construction
AFP: Approved For Purchase
AFQ: Approved For Quotation
IFI: Issued For Information
AB-R: As-Built for CLIENT Review
AB-A: As-Built –Approved
FI: Final Issue

REVISION RECORD SHEET

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CONTENTS

1.0 INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also, PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

As a part of the Project, a New Gas Compressor Station (adjacent to existing Binak GCS) shall be constructed to gather of 15 MMSCFD (approx.) associated gases and compress & transfer them to Siahmakan GIS.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – Surface Facilities; New Gas Compressor Station
EPD/EPC CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR:	Joint Venture of: Hirgan Energy – Design & Inspection (D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPD/EPC CONTRACTOR (GC) and approved by CLIENT (in writing) for the inspection of goods.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

2.0 SCOPE

The scope of HAZOP study covers all P&IDs for New Gas Compressor Station. The list of P&IDs is presented in appendix B.

3.1 NORMATIVE REFERENCES

3.2 INTERNATIONAL CODES AND STANDARDS

- IEC 61882:2016 Hazard and Operability studies (HAZOP Studies) – Application guide

3.3 THE PROJECT DOCUMENTS

- BK-GNRAL-HD-000-PR-DB-0001-D05 Process Basis of Design
- BK-GCS-PEDCO-120-PR-BD-0001 ESD Block Diagram

4.1 PURPOSE

The purpose of this document is to provide the results of “HAZOP Study” for **Binak Oilfield Development – Surface Facilities; New Gas Compressor Station**.

The objective of HAZOP study is to perform and achieve the following tasks and goals as far as practicable given the latest piping and instrumentation diagrams (P&ID’s) to identify any potential hazards associated with the system and its utility systems:

- To identify any potential operating difficulties,
- Examine the effectiveness of those measures already incorporated in the design to mitigate the frequency and/or consequences of such hazards;
- To raise action items for addressing those hazards that the present design does not satisfactorily address.

5.0 HAZOP STUDY OVERVIEW

Meetings were conducted in 4 sessions from June 26 to 29, 2022 held in Neyshekar Hotel main meeting hall, Ahvaz.

A team comprising of experts from different disciplines of National Iranian South Oilfields Company (NISOC), Petro Iran Development Company (PEDCO) and Hirgan Energy Company conducted the study with a third-party HAZOP Chairman and Scribe. The list of team members is presented in appendix A.

6.0 PROCEDURE

The review methodology will be the "Guide Word" HAZOP technique and will be performed in accordance with the guidelines published by the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE) and also noted in IEC 61882.

The purpose of the review should not be only to resolve the action items but also to identify credible deviations from the design intent. The method identifies hazards and postulates possible accident sequences resulting from such hazards; Innovative thinking then identifies the consequences of these scenarios. The process demonstrates to the Owner/Management that prudent steps which have been taken to provide a safe installation and operation.

The scope of the HAZOP shall be therefore, on identifying potential process hazards or operability concerns, not on finding solutions to reduce or eliminate these concerns. Attempting to solve problems by the HAZOP team can result in a long and inefficient study process. At the same time, the HAZOP study cannot be intended as a review of Project Design Basis and Operating Philosophies, since these must be considered as resolved when the HAZOP study will be carried out.

Each system or equipment should be divided into subsystems by consensus of the review team. The selected system shall be identified by a study node numbers and for easy reference a color code can also be inserted on the related P&ID prior to the review and worksheet during the review.

List of possible parameters and guidewords

Deviations	Guide Word	Parameter
No/Less Flow	No/Less	Flow
More Flow	More	Flow
Reverse/Misdirected Flow	Reverse/Misdirected	Flow
High Temperature	High	Temperature
Low Temperature	Low	Temperature
High Pressure	High	Pressure
Low Pressure	Low	Pressure
High Level	High	Level
Low Level	Low	Level
Maintenance Hazards	Other than	Maintenance
Leakage	As well as	Flow
Corrosion	As well as	Operation
Composition	As well as	Composition

Deviations	Guide Word	Parameter
Start-up/Shutdown Hazards	Other than	Start-up/Shutdown
Loss of Utilities	Other than	Operation
Miscellaneous	As well as	Operation

7.0 HAZOP OUTCOMES

In order to facilitate the study, the process was broken down into 20 nodes. The node list is presented in appendix C. A total of 131 recommendations were obtained which are shown in appendix D. The recommendations are categorized in two groups, namely OPEN and CLOSED.

Closed recommendations are those that the team have arrived at a consensus that it is required to be done. 128 closed recommendation were obtained in the meetings. Open recommendations are those that need more information from vendor for the final decision. 3 open recommendations were proposed during the meetings.

Appendix E consists of detailed HAZOP Worksheets of the study.

8.1 ATTACHMENTS

8.2 APPENDIX A –TEAM MEMBERS

First Name	Last Name	Company	Expertise
S.Mehdi	Ashrafian	NISOC	Project Manager
Shamsolah	Bahadori	NISOC	Construction Manager
Fatemeh	Ghodsi	NISOC	Head of I&C
Mohammad	Torfi	NISOC	Process
Sahar	Saba	NISOC	Process
Niloofar	Rezaei Baba ahmadi	NISOC	Process
Mohammad Reza	Cheraghchi	NISOC	Process
Fazel	Moafi	NISOC	Instrument
Behzad	Zandian	NISOC	Instrument
Peyman	Sarvarian	NISOC	Mechanic
Hojjat	Jafarpour	NISOC	Mechanical
Faride	Parvin	NISOC	Mechanical
Mohammad	Khamisi	NISOC	HSE
Mohammad	Shirali	NISOC	Commissioning
Ali	Hamidan	NISOC	Commissioning
Naji	Hamid	NISOC	Commissioning
Khodadad	Kavosi	NISOC	Commissioning
Reza	Gholgheysari	NISOC	Process Engineer
Mobin	Saeedi	NISOC	Instrument
Mohammad	Bakhshi Mohammadi	Gachsaran NISOC	Production Engineer
Shahram	Valizadeh	Gachsaran NISOC	Production Engineer
Vahid	Mussavi	Gachsaran NISOC	Production Engineer
Mohammad	Fakoor	PEDCO	Process Engineer
Farshid	Amiri	PEDCO	Piping Lead Engineer
Hadi	Mozaffari	PEDCO	Electrical Engineer
Mahdi	Karimi	PEDCO	Head of Electrical Department
Pouria	Bavarsad	PEDCO	Piping Engineering
Sadegh	Gharacheh	PEDCO	Process
Morteza	Taherkhani	PEDCO	Head of I&C
Sepideh	Akbari	PEDCO	I&C Engineer
Sasan	Faramarzpour	PEDCO	Head of Process and Safety Department
Pouya	Maleki	PEDCO	Process Engineer

First Name	Last Name	Company	Expertise
Mehdi	Sadeghian	PEDCO	Surface Manager
Vahid	Abdeshadi	PEDCO	Project Engineer Manager
Masoud	Asgharnejad	Hirgan Energy	Engineering Manager
Mohsen	Aryafar	Hirgan Energy	Process
Saeed	Ghanbari	Hirgan Energy	Process
Parisa	Hajisadeghi	Hirgan Energy	Head of I&C
Mohammad	Fakharian	Hirgan Energy	Project Manager
Ali	Baghaei	HAZOP Consultant	Process Safety
Firoozeh	Khosravi	HAZOP Consultant	Process Safety

8.3 APPENDIX B – DRAWINGS LIST

Drawing No.	Drawing Title	Place(s) Used
BK-GCS-PEDCO-120-PR-PI-0002_D03	Gas Compression Inlet Gas Pipeline (Binak)	Nodes: 1
BK-GCS-PEDCO-120-PR-PI-0003_D03	Gas Compression Inlet Gas Pipeline (Golkhari)	Nodes: 2
BK-GCS-PEDCO-120-PR-PI-0004_D03	Slug Catcher System (2 sheets)	Nodes: 3
BK-GCS-PEDCO-120-PR-PI-0005_D03	Gas Compression Inlet Knock Out Drum	Nodes: 4
BK-GCS-PEDCO-120-PR-PI-0006_D03	1st Stage Gas Compression Suction Drums (3 sheets)	Nodes: 5
BK-GCS-PEDCO-120-PR-PI-0007_D03	1st Stage Gas Compression Compressors (3 sheets)	Nodes: 5
BK-GCS-PEDCO-120-PR-PI-0008_D03	1st Stage Gas Compression Air Coolers (3 sheets)	Nodes: 5
BK-GCS-PEDCO-120-PR-PI-0009_D03	2nd Stage Gas Compression Suction Drums (3 sheets)	Nodes: 6
BK-GCS-PEDCO-120-PR-PI-0010_D03	2nd Stage Gas Compression Compressors (3 sheets)	Nodes: 6
BK-GCS-PEDCO-120-PR-PI-0011_D03	2nd Stage Gas Compression Air Coolers (3 sheets)	Nodes: 6
BK-GCS-PEDCO-120-PR-PI-0012_D03	2nd Stage Gas Compression Discharge Drum	Nodes: 7
BK-GCS-PEDCO-120-PR-PI-0013_D03	Gas Compression Dehydration Package (3 sheets)	Nodes: 8
BK-GCS-PEDCO-120-PR-PI-0014_D03	Lean Glycol Storage Tank	Nodes: 9
BK-GCS-PEDCO-120-PR-PI-0015_D03	Instrument & Plant Air System	Nodes: 10
BK-GCS-PEDCO-120-PR-PI-0016_D03	Nitrogen Generation System	Nodes: 11
BK-GCS-PEDCO-120-PR-PI-0017_D03	Closed Drain System (2 sheets)	Nodes: 12
BK-GCS-PEDCO-120-PR-PI-0018_D03	Corrosion Inhibitor Package	Nodes: 13
BK-GCS-PEDCO-120-PR-PI-0019_D03	Methanol Injecktion Package	Nodes: 14
BK-GCS-PEDCO-120-PR-PI-0020_D03	LP Flare System (3 sheets)	Nodes: 15
BK-GCS-PEDCO-120-PR-PI-0021_D03	Oily Water Sewer	Nodes: 16
BK-GCS-PEDCO-120-PR-PI-0022_D03	Fuel Gas System	Nodes: 17
BK-GCS-PEDCO-120-PR-PI-0023_D03	Diesel Oil System (2 sheets)	Nodes: 18
BK-GCS-PEDCO-120-PR-PI-0024_D03	Potable Water System	Nodes: 19
BK-GCS-PEDCO-120-PR-PI-0025_D03	Glycol Sump Drum	Nodes: 20

8.4 APPENDIX C – NODES LIST

Nodes	Color	Type	Drawings	Equipment ID	Date
1. Gas Compression Inlet Gas Pipeline (Binak)	Red	Pig Receiver	BK-GCS-PEDCO-120-PR-PI-0002_D03	PR-1002	2. 06/26/2022
2. Gas Compression Inlet Gas Pipeline (Golkhari)	Violet	Pig Receiver	BK-GCS-PEDCO-120-PR-PI-0003_D03	PR-2102	2. 06/26/2022
3. Slug Catcher System	L Blue	Drum	BK-GCS-PEDCO-120-PR-PI-0004_D03	V-2104	2. 06/26/2022
		Pump		P-2101A/B	
4. Gas Compression Inlet Knock Out Drum	Yellow	Drum	BK-GCS-PEDCO-120-PR-PI-0005_D03	V-2105	3. 06/27/2022
5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers	Blue	Drum	BK-GCS-PEDCO-120-PR-PI-0006_D03	V-2101A/B/C	3. 06/27/2022
			BK-GCS-PEDCO-120-PR-PI-0007_D03	C-2101A/B/C	
			BK-GCS-PEDCO-120-PR-PI-0008_D03	AE-2101A/B/C	
6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers	Green	Drum	BK-GCS-PEDCO-120-PR-PI-0009_D03	V-2102A/B/C	3. 06/27/2022
			BK-GCS-PEDCO-120-PR-PI-0010_D03	C-2102A/B/C	
			BK-GCS-PEDCO-120-PR-PI-0011_D03	AE-2102A/B/C	
7. 2nd Stage Gas Compression Discharge Drum	Violet	Drum	BK-GCS-PEDCO-120-PR-PI-0012_D03	V-2103	4. 06/28/2022
8. Gas Compression Dehydration Package	Yellow	Package	BK-GCS-PEDCO-120-PR-PI-0013_D03	PK-2101	4. 06/28/2022
9. Lean Glycol Storage Tank	Blue	Tank	BK-GCS-PEDCO-120-PR-PI-0014_D03	TK-2102	4. 06/28/2022
		Pump		P-2102	
				P-2103A/B	
10. Instrument & Plant Air System	Red	Package	BK-GCS-PEDCO-120-PR-PI-0015_D03	PK-DR-2203A/B	4. 06/28/2022
				PK-C-2203A/B	
				V-2203	
11. Nitrogen Generation System	Green	Package	BK-GCS-PEDCO-120-PR-PI-0016_D03	PK-C-2204	4. 06/28/2022
				PK-G-2204	
				V-2204	
12. Closed Drain System	Pink	Drum	BK-GCS-PEDCO-120-PR-PI-0017_D03	V-2202	4. 06/28/2022
		Pump		SU-2201	
				P-2202A/B	
				P-2203A/B	
13. Corrosion Inhibitor Package	Orange	Line	BK-GCS-PEDCO-120-PR-PI-	PK-TK-2207	4. 06/28/2022

Nodes	Color	Type	Drawings	Equipment ID	Date
		Package	0018_D03	PK-2207A/B/C/D	
		Tank		P-2207E	
		Pump			
14. Methanol Injection Package	L Blue	Line	BK-GCS-PEDCO-120-PR-PI-0019_D03	-	4. 06/28/2022
15. LP Flare System	Violet	Line	BK-GCS-PEDCO-120-PR-PI-0020_D03	-	5. 06/29/2022
		Drum		SU-2201	
		Package		V-2201	
		Pump		P-2201A/B	
				IG-2201	
				FST-2201	
16. Oily Water Sewer	Yellow	Sump	BK-GCS-PEDCO-120-PR-PI-0021_D03	SU-2202	5. 06/29/2022
17. Fuel Gas System	Blue	Drum	BK-GCS-PEDCO-120-PR-PI-0022_D03	V-2205	5. 06/29/2022
18. Diesel Oil System	Green	Drum	BK-GCS-PEDCO-120-PR-PI-0023_D03	V-2206A/B	5. 06/29/2022
		Pump		P-2206A/B	
19. Potable Water System	L Blue	Tank	BK-GCS-PEDCO-120-PR-PI-0024_D03	TK-2209	5. 06/29/2022
		Pump		P-2209	
20. Glycol Sump Drum	Violet	Drum	BK-GCS-PEDCO-120-PR-PI-0025_D03	V-2107	5. 06/29/2022
		Pump		P-2104	

8.5 APPENDIX D – RECOMMENDATIONS LIST

Recommendations	Place(s) Used	Responsibility	Status
1. Define in operating procedure that operator should change capacity of compressors according to inlet flow of gas from Binak and Golkhari clusters.	Consequences: 1.1.1.1, 2.1.1.1	Contractor	Closed
2. Define low alarm on PI-2102.	Consequences: 1.1.1.1	Contractor	Closed
3. General recommendation: Proxy limit switch signal of ESDVs in BINAK compressor station should be routed directly to DCS.	Consequences: 1.1.2.1	Contractor	Closed
4. Note on P&ID (BK-GCS-PEDCO-120-PR-PI-0002) Min distance for purge connection of Binak line to barred tee.	Consequences: 1.6.1.1	Contractor	Closed
5. Relocate check valve and corrosion inhibitor injection of Binak gas to V-2105 to upstream of FCV-2101.	Consequences: 1.6.1.1	Contractor	Closed
6. Define low alarm on PI-2104.	Consequences: 2.1.1.1	Contractor	Closed
7. Increase design pressure of piping from Golkhari pipeline tie-in point to FCV-2102 for protection against over pressure due to blocked outlet.	Consequences: 2.1.2.2, 2.4.1.1	NISOC/Contractor	Closed
8. Show on P&ID (BK-GCS-PEDCO-120-PR-PI-0003) purge connection of Golkhari line at min distance to barred tee.	Consequences: 2.6.1.1	Contractor	Closed
9. Ball valve on tie-in point of 10" gas pipeline Golkhari BL should be full bore.	Consequences: 2.8.1.1	Contractor	Closed
10. Consider future connection from Golkhari pipeline to existing gas compressor station downstream of MOV-2102B.	Consequences: 2.8.1.1	Contractor	Closed
11. Remove auto start signal from LIC-2111 on P-2101A/B.	Consequences: 3.1.1.1	Contractor	Closed
12. Define in operating manual of compressor station that on high level of V-2104 operator shall start P-2101A/B and open ESDV-2112.	Consequences: 3.1.1.1	Contractor	Closed
13. Define logic that PALL-2115 should be suppressed during pump P-2101A/B start.	Consequences: 3.1.1.1	Contractor	Closed
14. Inlet isolation of V-2104 should be locked open.	Consequences: 3.1.5.1	Contractor	Closed
15. Define in operating manual of compressor station that always one of bypass valve and inlet valve of V-2104 shall be open.	Consequences: 3.1.5.1	Contractor	Closed
16. Show on P&ID (BK-GCS-PEDCO-120-PR-PI-0004) pump pit for P-2101A/B.	Consequences: 3.1.6.1	Contractor	Closed
17. Install check valve on 2" line from close drain pump P-2202A/B to V-2104.	Consequences: 3.3.1.1	Contractor	Closed
18. Install TRV on pipeline from P-2101A/B to Binak cluster downstream of isolation valve of CGS BL.	Consequences: 3.4.3.1	Contractor	Closed
19. Full vacuum should be considered for design pressure of V-2104.	Consequences: 3.5.1.1	Contractor	Closed
20. 3" drain valves on V-2104 should be connected to close drain.	Consequences: 3.8.1.1	Contractor	Closed

Recommendations	Place(s) Used	Responsibility	Status
21. Suction and discharge flanges of P-2101A/B should be 300#.	Consequences: 3.10.1.1	Contractor	Closed
22. Bypass valve of V-2104 should be ball type.	Consequences: 3.10.1.1	Contractor	Closed
23. Show on P&ID (BK-GCS-PEDCO-120-PR-PI-0004) vent connection of P-2101.	Consequences: 3.10.1.1	Contractor	Closed
24. Inlet isolation valve of V-2105 should be locked open.	Consequences: 4.4.1.1	Contractor	Closed
25. Full vacuum should be considered for design pressure of V-2105.	Consequences: 4.5.1.1	Contractor	Closed
26. Remove bypass over XV-2110.	Consequences: 4.5.2.2	Contractor	Closed
27. LAHH-2117 should activate ESD-1.	Consequences: 4.6.1.1	Contractor	Closed
28. LCV-2114 should be FC.	Consequences: 4.7.1.1	Contractor	Closed
29. Valve arrangement on close drain connection of 1st stage gas compression manifold should be as ball valve, spectacle , check valve.	Consequences: 4.8.1.1	Contractor	Closed
30. Consider spectacle blind on 2" drain line of V-2105, nozzle D.	Consequences: 4.8.1.1	Contractor	Closed
31. Change type of 10" bypass valve over V-2105 to ball type.	Consequences: 4.10.1.1	Contractor	Closed
32. Remove TIT-2111 and TIT-2113.	Consequences: 4.10.1.1	Contractor	Closed
33. Remove LG-2115 and LIT-2116 from V-2105 and connect upper leg of LG-2116 and LIT-2119 to nozzle L1 of vessel.	Consequences: 4.10.1.1	Contractor	Closed
34. Define in operating manual of compressor station that operator should adjust compressor capacity according to station flow rate.	Consequences: 5.1.1.1	Contractor	Closed
35. Install check valve at 2nd stage discharge, downstream of spill back branch (at min distance to XV-2133A) and install check valve at inlet to each compressor train upstream of spill back branch.	Consequences: 5.2.1.1	Contractor	Closed
36. Consider limit switch for spill back valve PCV-2123A.	Consequences: 5.2.1.1	Contractor	Closed
37. Study requirement to consider over pressure protection for V-2101 due to opening of spill back valve PCV-2123A.	Consequences: 5.2.1.1	Contractor	Open
38. Correct P&ID of air coolers of compressors according to data sheet.	Consequences: 5.4.3.1, 6.4.3.1	Contractor	Closed
39. Consider block valves for N2 supply lines to compressor packages.	Consequences: 5.10.1.1	Contractor	Closed
40. Consider maintenance lock for fan of air coolers in data sheet.	Consequences: 5.10.1.1	Contractor	Closed
41. Consider drain connection on low point of line between V-2101A and compressor.	Consequences: 5.11.1.1	Contractor	Closed
42. General recommendation: All solenoids with signal in ESD system should have manual reset.	Consequences: 5.12.1.1	Contractor	Closed
43. Relocate sample connections of compressor suctions to Binak and Golkhari inlet lines and also on Inlet KO Drum outlet line.	Consequences: 5.12.1.1	Contractor	Closed

Recommendations	Place(s) Used	Responsibility	Status
44. Provide XV with remote access for depressurizing of 1st stage suction drum of compressors to give more operability during maintenance.	Consequences: 6.7.2.2	NISOC/Contractor	Closed
45. Define high level alarm on LT-2132 also define discrepancy alarm between LT-2131 and LT-2132 in DCS.	SIL determination: 6.8.1.1	Contractor	Closed
46. Consider drain connection on low point of line between V-2102A and compressor.	Consequences: 6.11.1.1	Contractor	Closed
47. Remove sample connection on suction and discharge of compressor 2nd stage.	Consequences: 6.12.1.1	Contractor	Closed
48. Correct on P&ID that outlet pipe of BDV 2141 is connected directly to flare header separated from tail pipe of PSVs and change the class of BDV-2141 from 300 to 600 #.	Consequences: 7. 5.1.1	Contractor	Closed D01
49. Full vacuum should be considered for design pressure of V-2103.	Consequences: 7.5.2.1	Contractor	Closed
50. Show on P&ID stand pipe for LG-2141 and LIT-2141.	Consequences: 7.6.1.1	Contractor	Closed
51. As per drain configuration, consider gate valve, spectacle and globe valve arrangement for bypass of XV-2144 and change the class of XV-2144 from 300 to 600 #..	Consequences: 7.7.1.2	Contractor	Closed D01
52. Consider spectacle blind on B2 nozzle of V-2103.	Consequences: 7.8.1.1	Contractor	Closed
53. Consider spectacle blind on corrosion inhibitor injection line to V-2103 after check valve.	Consequences: 7.8.1.1	Contractor	Closed
54. Show on P&ID line number and inlet reducer of XV-2143.	Consequences: 7.10.1.1	Contractor	Closed
55. Remove TG-2143.	Consequences: 7.10.1.1	Contractor	Closed
56. Define high alarm on PIC-2152.	Consequences: 8.1.1.1	Contractor	Closed
57. Show dedicated control blocks for PCV-2152 and PCV-2151.	Consequences: 8.1.1.1	Contractor	Closed
58. Failure mode of PCV-2151 should be FC and failure mode of PCV-2152 should be FO.	Consequences: 8.1.2.2	Contractor	Closed
59. Class of PCV-2151, PCV-2152 and BDV-2151 should be 600#.	Consequences: 8.1.2.2	Contractor	Closed
60. General recommendation: check size of control valves to be compatible with IPS requirements.	Consequences: 8.1.2.2	Contractor	Closed
61. Consider check valve on 2" closed drain connection from dehydration package.	Consequences: 8.3.1.1	Contractor	Closed
62. Check with vendor requirement for sizing PSV on dehydration package for blocked outlet scenario.	Consequences: 8.4.1.1	Contractor	Open
63. Define low alarm on PIC-2152.	Consequences: 8.5.1.1	Contractor	Closed
64. Show on P&ID of dehydration package detail of corrosion inhibitor injection valving.	Consequences: 8.6.1.1	Contractor	Closed
65. Equalizing valve on bypass of dehydration package should be 2" and gate valve on this bypass should be changed to ball valve.	Consequences: 8.7.1.1	Contractor	Closed
66. Consider block valve of fuel gas supply line to dehydration package.	Consequences: 8.7.1.1	Contractor	Closed

Recommendations	Place(s) Used	Responsibility	Status
67. Show on P&ID of dehydration package, BMS and min required signals to/from plant DCS and ESD.	Consequences: 8.7.1.1	Contractor	Closed
68. HAZOP study of dehydration package shall be performed with participation of package vendor.	Consequences: 8.7.1.1	Contractor	Closed
69. Correct on P&ID min flow (including RO) of P-2103A/B to be connected directly to nozzle B2 of TK-2102.	Consequences: 9.1.1.1	Contractor	Closed
70. Remove auto/manual signal from P-2103A/B.	Consequences: 9.1.1.1	Contractor	Closed
71. Consider check valve on glycol line from P-2103A/B to PK-2101.	Consequences: 9.3.1.1	Contractor	Closed
72. Blanketing of TK-2102 should be with N2.	Consequences: 9.4.1.1	Contractor	Closed
73. Consider safety hatch for TK-2102.	Consequences: 9.4.1.1	Contractor	Closed
74. Consider pressure transmitter with high and low alarm on TK-2102.	Consequences: 9.4.1.1	Contractor	Closed
75. PVSV-2161/2162 should be vented to ATM.	Consequences: 9.4.1.1	Contractor	Closed
76. Show vacuum set point of PVSV-2161/2162.	Consequences: 9.5.1.1	Contractor	Closed
77. LIT-2161 and LIT-2162 should be readable at grade in loading area.	Consequences: 9.6.1.1	Contractor	Closed
78. Consider spectacle blind on 2" drain nozzle D of TK-2102.	Consequences: 9.8.1.1	Contractor	Closed
79. Remove check valve on suction of P-2103A/B.	Consequences: 9.10.1.1	Contractor	Closed
80. Correct P&ID of glycol tank and show nozzle A at top of tank.	Consequences: 9.10.1.1	Contractor	Closed
81. Consider PG on discharge of P-2102.	Consequences: 9.10.1.1	Contractor	Closed
82. Number, signal and set points of PTs (PT-2203) for start/stop of standby air compressor should be according to IPS requirements.	Consequences: 10.1.1.1	Contractor	Closed
83. ESD level on PALL-2201A/B/C should be 1A.	Consequences: 10.1.1.1, 10.1.4.1	Contractor	Closed
84. PCV-2201 should be FC.	Consequences: 10.1.2.1	Contractor	Closed
85. Remove ESDV-2231 and consider solenoid on PCV-2201 to close valve by ESD-3.	Consequences: 10.1.3.1	Contractor	Closed
86. Remove mechanical trap from V-2203 and consider mechanical trap for wet air KO drum.	Consequences: 10.7.1.1	Contractor	Closed
87. PCV-2211 should be FO.	Consequences: 11.1.2.1	Contractor	Closed
88. Consider check valve on nitrogen branches to gas compressors.	Consequences: 11.3.1.1	Contractor	Closed
89. Remove mechanical trap from V-2204 and consider mechanical trap for wet air KO drum inside compressor package.	Consequences: 11.7.1.1	Contractor	Closed
90. Remove HC analyzer from nitrogen package.	Consequences: 11.8.1.1	Contractor	Closed
91. Consider check valve on 2" line from P-2201A/B to existing burn pit.	Consequences: 12.1.1.1	Contractor	Closed
92. Remove 2" line connection from closed drain drum to oily	Consequences: 12.1.1.1	Contractor	Closed

Recommendations	Place(s) Used	Responsibility	Status
water sump.			
93. Globe valve on flare nozzle of V-2202 should be changed to ball type.	Consequences: 12.2.1.1	Contractor	Closed
94. Full vacuum should be considered for design pressure of V-2202.	Consequences: 12.3.1.1	Contractor	Closed
95. LIT-2223A/B should be float type and consider only one common LT for P-2203A/B.	Consequences: 12.4.2.1	Contractor	Closed
96. Relocate PALL-2222A/B to between pumps P-2202A/B and suction strainers.	Consequences: 12.5.1.1	Contractor	Closed
97. Consider spectacle blind on inlet and outlet of P-2201A/B.	Consequences: 12.6.1.1	Contractor	Closed
98. Relocate PIT-2252 (currently PIT-2222A) from closed drain drum to flare KO drum.	Consequences: 12.7.1.1	Contractor	Closed
99. valves down stream of P-2202A/B to V-2104 should be LO.	Consequences: 12.7.1.1	Contractor	Closed
100. Consider PG at discharge of P-2202A/B.	Consequences: 12.7.1.1	Contractor	Closed
101. Consider remote stop for corrosion inhibitor package (XSP corrected to HSP).	Consequences: 13.1.1.1	Contractor	Closed
102. Check coverage of CCTV and if required consider CCTV for flare monitoring in control room.	Consequences: 15.1.1.1	Contractor	Closed
103. Relocate PALL-2251A/B to between pumps P-2201A/B and suction strainers.	Consequences: 15.7.1.1	Contractor	Closed
104. Consider spectacle blinds on suction and discharge isolation valves of P-2201A/B.	Consequences: 15.8.1.1	Contractor	Closed
105. Define in operating manual that operator should ensure that always one discharge route of P-2201A/B is open.	Consequences: 15.8.1.1	Contractor	Closed
106. LIT-2273 should be float type with cage.	Consequences: 16.1.1.1	Contractor	Closed
107. Define low alarm on PI-2271.	Consequences: 17.1.2.1, 17.1.4.1	Contractor	Closed
108. Replace PRV-2272 with local flow gauge, ball valve, check valve and globe valve.	Consequences: 17.1.3.1	Contractor	Closed
109. PSV on V-2205 should be sized for fire case.	Consequences: 17.4.1.1	Contractor	Closed
110. Full vacuum should be considered for design pressure of V-2205.	Consequences: 17.5.1.1	Contractor	Closed
111. Note in duty spec of dehydration package that requirement for fuel gas filter should be checked by vendor.	Consequences: 17.9.1.1	Contractor	Closed
112. Remove fuel gas lines used for blanketing of TK-2102 and V-2107.	Consequences: 17.10.1.1	Contractor	Closed
113. Remove PT-2281A/B from suction of P-2206A/B and consider local pressure gauge.	Consequences: 18.1.3.1	Contractor	Closed
114. Define high high and low low trip interlock on LI-2281A/B to trip P-2206A/B.	Consequences: 18.1.3.1	Contractor	Closed
115. Any surface contamination on diesel oil drum area	Consequences: 18.6.1.1	Contractor	Closed

Recommendations	Place(s) Used	Responsibility	Status
should be directed to oily water header.			
116. Remove steam out connection for V-2206A/B.	Consequences: 18.8.1.1	Contractor	Closed
117. Relocate globe valve at discharge of P-2206A/B to downstream of tank filling branch.	Consequences: 18.8.1.1	Contractor	Closed
118. Consider drain connection at suction and discharge of P-2206A/B.	Consequences: 18.8.1.1	Contractor	Closed
119. Remove ESD-1 signal from P-2209.	Consequences: 19.1.1.1	Contractor	Closed
120. Remove start signal from LT-2293 on P-2104.	Consequences: 20.1.1.1	Contractor	Closed
121. Consider proper type for LIT-2293.	Consequences: 20.1.1.1	Contractor	Open
122. Consider PSV on V-2107 sized for regulator failure and fire case scenario.	Consequences: 20.3.1.1, 20.3.2.1	Contractor	Closed D01
123. Consider PT with high alarm on V-2107.	Consequences: 20.3.3.1	Contractor	Closed
124. Full vacuum should be considered for design pressure of V-2107.	Consequences: 20.4.1.1	Contractor	Closed
125. Consider isolation valve downstream of PRV-2291.	Consequences: 20.7.1.1	Contractor	Closed
126. Consider spectacle on inlet and outlet lines (nozzle A, nozzle B and pump outlet) of V-2107.	Consequences: 20.7.1.1	Contractor	Closed
127. Consider drain connection under V-2107.	Consequences: 20.7.1.1	Contractor	Closed
128. Consider slop for V-2107 towards pump side.	Consequences: 20.7.1.1	Contractor	Closed
129. Consider connection from P-2104 to oily water system.	Consequences: 20.8.1.1	Contractor	Closed
130. ESD level on P-2104 should be ESD-1A.	Consequences: 20.9.1.1	Contractor	Closed
131. Consider connection for loading spent glycol to truck downstream of P-2104.	Consequences: 20.9.1.1	Contractor	Closed

8.6 APPENDIX E – HAZOP WORKSHEETS

Node: 1. Gas Compression Inlet Gas Pipeline (Binak)

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. No/less flow from upstream due to any reason	1. Low suction pressure for station and waste of energy	1. Low suction pressure protection of compressor	1. Define in operating procedure that operator should change capacity of compressors according to inlet flow of gas from Binak and Golkhari clusters.
		2. Low pressure alarm on compressor 1st stage and spill back control	2. Define low alarm on PI-2102.
		3. FAL-2101	
2. ESDV-2101 closed by failure or error	1. Low suction pressure for station and decreased production	1. Low suction pressure protection of compressor	3. General recommendation: Proxy limit switch signal of ESDVs in BINAK compressor station should be routed directly to DCS.
		2. Low pressure alarm on compressor 1st stage and spill back control	
		3. Limit switch on valve	
		4. FAL-2101	
	2. Increased pressure upstream of valve with possibility of damage to pipeline	1. High pressure protection in Binak Cluster	
	3. High pressure at inlet of existing station	1. High pressure protection (flare) in existing Binak gas station inlet K.O drum	
3. FCV-2101 closed more by a failure in any elements of its control loop	1. Same as above	1. Low suction pressure protection of compressor	
		2. Low pressure alarm on compressor 1st stage and spill back control	
		3. FAL-2101 (dependent)	
		4. High pressure protection in Binak Cluster	
		5. High pressure protection (flare) in existing Binak gas station inlet K.O drum	

Node: 1. Gas Compression Inlet Gas Pipeline (Binak)

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. FCV-2101 open more by a failure in any elements of its control loop	1. Increased pressure in compressor suction with no hazardous consequence for compressors but decreased efficiency of dehydration package	1. See Dehydration package node for safeguard 2. FAH-2101 (dependent)	

Node: 1. Gas Compression Inlet Gas Pipeline (Binak)

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where			

Node: 1. Gas Compression Inlet Gas Pipeline (Binak)

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. High pressure from Binak cluster due to any	1. No hazardous consequence due to design pressure		
2. Shutdown of downstream compressor station	1. Increased pressure up to Binak cluster max pressure with possibility of damage to inlet K.O drum	1. PAHH-2116 that will activate ESD-1 2. PSV-2113/2114 on V-2105	

Node: 1. Gas Compression Inlet Gas Pipeline (Binak)

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. No new issue was identified			

Node: 1. Gas Compression Inlet Gas Pipeline (Binak)

Deviation: 6. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			4. Note on P&ID (BK-GCS-PEDCO-120-PR-PI-0002) Min distance for purge connection of Binak line to barred tee. 5. Relocate check valve and corrosion inhibitor injection of Binak gas to V-2105 to upstream of FCV-2101.

Node: 1. Gas Compression Inlet Gas Pipeline (Binak)

Deviation: 7. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Moisture and sulphur content in gas	1. Damage to equipment and piping	1. Corrosion monitoring (CP/CC)	
		2. Corrosion inhibitor injection	

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. No/less flow from upstream due to any reason	1. Low suction pressure for station and waste of energy	1. Low suction pressure protection of compressor	1. Define in operating procedure that operator should change capacity of compressors according to inlet flow of gas from Binak and Golkhari clusters.
		2. Low pressure alarm on compressor 1st stage and spill back control	6. Define low alarm on PI-2104.
		3. FAL-2102	
2. MOV-2102B closed by error	1. Low suction pressure for station and decreased production	1. Low suction pressure protection of compressor	
		2. Low pressure alarm on compressor 1st stage and spill back control	
		3. Limit switch on valve	
		4. FAL-2102	
	2. Increased pressure upstream of valve with possibility of damage to piping upstream of valve		7. Increase design pressure of piping from Golkhari pipeline tie-in point to FCV-2102 for protection against over pressure due to blocked outlet.
3. ESDV-2102 closed by failure or error	1. Low suction pressure for station and decreased production	1. Low suction pressure protection of compressor	
		2. Low pressure alarm on compressor 1st stage and spill back control	
		3. Limit switch on valve	
		4. FAL-2102	
	2. Increased pressure upstream		

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
	of valve with possibility of damage to piping upstream of valve		
4. FCV-2102 closed more by a failure in any elements of its control loop	1. Same as above	1. Low suction pressure protection of compressor 2. Low pressure alarm on compressor 1st stage and spill back control 3. FAL-2102 (dependent)	

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. FCV-2102 open more by a failure in any elements of its control loop	1. Increased pressure in compressor suction with no hazardous consequence for compressors but decreased efficiency of dehydration package	1. See Dehydration package node for safeguard 2. FAH-2102 (dependent)	

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where			

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. High pressure from Golkhari cluster due to any reason	1. Possibility of damage to piping due to over pressure and fire and personnel injury		7. Increase design pressure of piping from Golkhari pipeline tie-in point to FCV-2102 for protection against over pressure due to blocked outlet.
2. Shutdown of downstream compressor station	1. Increased pressure up to Golkhari cluster max pressure with possibility of damage to slug catcher	1. PAHH-2111 that will activate ESD-1 2. PSV-2111/2112 on V-2104	

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. No new issue was identified			

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 6. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			8. Show on P&ID (BK-GCS-PEDCO-120-PR-PI-0003) purge connection of Golkhari line at min distance to barred tee.

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 7. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Moisture and sulphur content in gas	1. Damage to equipment and piping	1. Corrosion monitoring (CP/CC)	
		2. Corrosion inhibitor injection	

Node: 2. Gas Compression Inlet Gas Pipeline (Golkhari)

Deviation: 8. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			9. Ball valve on tie-in point of 10" gas pipeline Golkhari BL should be full bore.
			10. Consider future connection from Golkhari pipeline to existing gas compressor station downstream of MOV-2102B.

Node: 3. Slug Catcher System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. P-2101A/B fail to start when required	1. Accumulation of liquid in slug catcher with no hazardous consequence	1. LAH-2111	11. Remove auto start signal from LIC-2111 on P-2101A/B.
		2. Standby pump	12. Define in operating manual of compressor station that on high level of V-2104 operator shall start P-2101A/B and

Node: 3. Slug Catcher System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
			open ESDV-2112.
			13. Define logic that PALL-2115 should be suppressed during pump P-2101A/B start.
2. Plugging of pump strainer	1. Possibility of damage to pump	1. PALL-2114A/B that will activate ESD-3 and stop pump P-2101A/B	
		2. Local PDG-2114A/B	
3. FCV-2111 closed more by a failure in any elements of its control loop	1. Possibility of damage to pump due to high pressure	1. PAHH-2116A/B that will activate ESD-3	
4. ESDV-2112 closed by failure or error	1. Same as above	1. Limit switch on valve	
5. Downstream compressor shutdown	1. High pressure of V-2104 up to Golkhari cluster pressure with possibility of damage, fire and injury	1. PAHH-2111 that will activate ESD-1	14. Inlet isolation of V-2104 should be locked open.
		2. PAH-2112	15. Define in operating manual of compressor station that always one of bypass valve and inlet valve of V-2104 shall be open.
		3. PSV-2111/2112 on V-2104	
6. Plugging of demister pad in V-2104	1. Low suction pressure for compressors and also possibility of damage to demister	1. PDAH-2111	16. Show on P&ID (BK-GCS-PEDCO-120-PR-PI-0004) pump pit for P-2101A/B.

Node: 3. Slug Catcher System

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. FCV-2111 open more by a failure in any elements of its control loop	1. Possibility of over current for P-2101A/B	1. Over current protection in MCC	

Node: 3. Slug Catcher System

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			17. Install check valve on 2" line from close drain pump P-2202A/B to V-2104.
2. Check valves are considered where required for other streams			

Node: 3. Slug Catcher System

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. External fire case for V-2104	1. Damage to equipment	1. PSV-2111/2112 on V-2104	
2. Blocked outlet at gas line from V-2104	1. Damage to equipment	1. PSV-2111/2112 on V-2104	
3. Line box-in and thermal expansion for pipeline from P-2101A/B to Binak cluster	1. Damage to pipeline		18. Install TRV on pipeline from P-2101A/B to Binak cluster downstream of isolation valve of CGS BL.

Node: 3. Slug Catcher System

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. Maloperation during steam out at startup	1. Vacuum formation and V-2104 collapse		19. Full vacuum should be considered for design pressure of V-2104.

Node: 3. Slug Catcher System

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. Entrance of large amount of liquid to V-2104 due to upset in Golkhari cluster	1. Carry over of liquid to inlet KO drum and compressors with possibility of damage to compressor	1. LAHH-2112 that will activate ESD-1	
		2. LAHH-2117 that will activate ESD-3 on inlet KO drum	
		3. LAHH-2122A/B/C that will activate ESD-2 and trip compressor	

Node: 3. Slug Catcher System

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. P-2101A/B remain in service when not required	1. Damage to pump	1. LAL-2111 that will stop pump	
		2. LALL-2112 that will activate ESD-3 and stop pumps	
		3. PALL-2114A/B that will activate ESD-3 and stop pumps	

Node: 3. Slug Catcher System

Deviation: 8. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			20. 3" drain valves on V-2104 should be connected to close drain.

Node: 3. Slug Catcher System

Deviation: 9. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Corrosion due to sulphur and moisture content	1. Damage to equipment and piping in long term	1. Corrosion monitoring (CP/CC)	
		2. Liquid line from V-2104 to P-2101A/B is Stainless Steel	

Node: 3. Slug Catcher System

Deviation: 10. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			21. Suction and discharge flanges of P-2101A/B should be 300#.
			22. Bypass valve of V-2104 should be ball type.
			23. Show on P&ID (BK-GCS-PEDCO-120-PR-PI-0004) vent connection of P-2101.

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. Compressors shutdown due to any reason	1. Blocked outlet for V-2105 and possibility of damage, fire and personnel injury	1. PAH-2117	
		2. PAHH-2116 that will activate ESD-1	
		3. PSV-2113/2114 on V-2105	
2. Plugging of demister pad in V-2105	1. Low suction pressure for compressors and also possibility of damage to demister	1. PDAH-2112	

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where			

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. External fire case for V-2105	1. Damage to equipment	1. PSV-2113/2114 on V-2105	24. Inlet isolation valve of V-2105 should be locked open.

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. Maloperation during steam out at startup	1. Vacuum formation and V-2105 collapse		25. Full vacuum should be considered for design pressure of V-2105.
2. XV-2110 open by failure or error	1. Waste of gas to flare with environmental effect	1. Limit switch on valve	
		2. PAL-2117	
	2. Loss of suction pressure for compressors	1. Low suction pressure protection of compressor	26. Remove bypass over XV-2110.

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. LCV-2114 remained closed for long time	1. Accumulation of liquid in inlet KO drum and carry over to compressors suction drums and fuel gas KO drum	1. LAH-2119 (dependent)	27. LAHH-2117 should activate ESD-1.
		2. LAHH-2117 that will activate ESD-3	
		3. High level alarm protection on compressor suction drum and fuel gas KO drum	

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
2. ESDV-2113 remained closed by failure or error for long time	1. Same as above		

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. LCV-2114 remained open when not required	1. Low level in V-2105 and gas blowby via closed drain to flare	1. LAL-2119 (dependent)	28. LCV-2114 should be FC.
		2. LALL-2118 that will activate ESD-3 and close ESDV-2113	

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 8. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			29. Valve arrangement on close drain connection of 1st stage gas compression manifold should be as ball valve, spectacle , check valve.
			30. Consider spectacle blind on 2" drain line of V-2105, nozzle D.

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 9. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Corrosion due to sulphur and moisture content	1. Damage to equipment and piping in long term	1. Corrosion monitoring (CP/CC)	
		2. Corrosion inhibitor injection is considered	
		3. Liquid line from V-2105 to LCV-2104 is Stainless Steel	

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 10. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			31. Change type of 10" bypass valve over V-2105 to ball type.

Node: 4. Gas Compression Inlet Knock Out Drum

Deviation: 10. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
			32. Remove TIT-2111 and TIT-2113.
			33. Remove LG-2115 and LIT-2116 from V-2105 and connect upper leg of LG-2116 and LIT-2119 to nozzle L1 of vessel.

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. Decreased flow from upstream due to any reason	1. Low suction pressure with possibility of damage to compressors due to over heating	1. PAL-2121A	34. Define in operating manual of compressor station that operator should adjust compressor capacity according to station flow rate.
		2. PALL-2122A that will activate ESD-2	
		3. PAL-2123A/PAL-2124A/PAL-2132A/FAL-2121A/FAL-2131A inside compressor package	
		4. Spill back valve will open by PIC-2121A	
		5. Internal high temperature protection in compressor package	
2. XV-2121A closed by failure or error (any failure out of UCP)	1. Loss of suction pressure for one compressor with possibility of damage to compressor due to over heating	1. PAL-2121A	
		2. PALL-2122A that will activate ESD-2	
		3. PAL-2123A/PAL-2124A/PAL-2132A/FAL-2121A/FAL-2131A inside compressor package	
		4. Limit switch on valve	
		5. Spill back valve will open by PIC-2121A	
		6. Internal high temperature protection in compressor package	
3. XV-2121A closed by failure	1. Loss of suction pressure for	1. PAL-2121A	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
or error (any failure inside UCP)	one compressor with possibility of damage to compressor due to over heating	2. PALL-2122A that will activate ESD-2	
4. PCV-2123A closed more when required to be open	1. Low suction pressure in compressor with possibility of vacuum formation	1. V-2101A is designed for full vacuum	
		2. PAL-2121A (dependent)	
		3. PALL-2122A that will activate ESD-2	
		4. PAL-2123A/PAL-2124A/PAL-2132A/FAL-2121A/FAL-2131A inside compressor package	
5. Plugging of demister pad	1. Same as above		
	2. Possibility of damage to demister pad	1. PDAH-2121A	
6. Plugging of compressor suction strainer	1. Low suction pressure in compressor and damage to strainer	1. PDIT-2122A inside compressor package	
7. Compressor failure or trip	1. Decreased capacity of station	1. Spare compression train is considered	
	2. Increased pressure upstream of compressor with possibility of damage due to over pressure, leakage and fire	1. PSVs on V-2104 and V-2105 are designed for blocked outlet	
		2. PAHH-2122 that will activate ESD-2	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. PCV-2123A open more when required to be closed	1. High suction pressure with possibility of damage to suction, leakage and fire	1. PAH-2124A/PAH-2123A/PAH-2132A inside compressor package	35. Install check valve at 2nd stage discharge, downstream of spill back branch (at min distance to XV-2133A) and install check valve at inlet to each compressor train upstream of spill back branch.
		2. PAHH-2122A that will activate ESD-2	36. Consider limit switch for spill back valve PCV-2123A.
			37. Study requirement to consider over pressure protection for V-

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
			2101 due to opening of spill back valve PCV-2123A.
	2. High suction temperature with possibility of damage to compressor	1. TAH-2121A	
		2. TAH-2122A inside compressor package	
		3. TAHH-2124A that will activate ESD-2	
		4. High temperature protection inside compressor package	
	3. Low 2nd stage discharge pressure and decreased capacity of train	1. PAL-2132A	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where			

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 4. High Temperature

Causes	Consequences	Safeguards	Recommendations
1. Mechanical failure in compressor package	1. Damage to compressor or discharge piping	1. TAH-2123A inside compressor package	
		2. TAHH-2124A that will activate ESD-2	
2. Decreased flow through compressor	1. Same as above	1. FAL-2121A	
		2. TAH-2123A inside compressor package	
		3. TAHH-2124A that will activate ESD-2	
3. Air cooler fan failure or trip	1. High temperature of 2nd stage with possibility of damage to it	1. TAH-2126A	38. Correct P&ID of air coolers of compressors according to data sheet.
		2. TAHH-2125A that will activate ESD-2	
		3. Two pairs of air coolers are considered	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 5. Low Temperature

Causes	Consequences	Safeguards	Recommendations
1. More cooling in air coolers due to wrong adjustment of pitch	1. Waste of energy with no hazardous consequence	1. TAL-2126A	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 6. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. External fire case for V-2101A	1. Damage to equipment	1. PSV-2121A	
2. Blocked outlet for compressor 1st stage discharge	1. Damage to equipment	1. PSV-2122A/2123A	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 7. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. No new issue was identified			

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 8. High Level

Causes	Consequences	Safeguards	Recommendations
1. XV-2122A remained closed when required to be open	1. Accumulation of liquid in V-2101A and carry over to compressor with possibility of damage	1. LAH-2121A (dependent)	
		2. LAHH-2122A that will activate ESD-2 and trip compressor	
		3. LAHH-2117 that will activate ESD-3 on inlet KO drum	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 9. Low Level

Causes	Consequences	Safeguards	Recommendations
1. XV-2122A remained open	1. Gas blowby via closed drain header to flare and waste of gas	1. LAL-2121A (dependent)	
		2. LALL-2122A that will activate ESD-3 and close XV-2122A	
	2. Slight decreased suction pressure of compressor	1. PAL-2121A	
		2. PAL-2123A/PAL-	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 9. Low Level

Causes	Consequences	Safeguards	Recommendations
		2124A/PAL-2132A/FAL-2121A/FAL-2131A inside compressor package	
		3. Spill back valve will open by PIC-2121A	

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 10. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			39. Consider block valves for N2 supply lines to compressor packages.
			40. Consider maintenance lock for fan of air coolers in data sheet.

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 11. Loss of Utilities

Causes	Consequences	Safeguards	Recommendations
1. failure of electrical tracing at compressor suction	1. Possibility of condensation in cold season	1. Inspection & maintenance procedures	41. Consider drain connection on low point of line between V-2101A and compressor.

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 12. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			42. General recommendation: All solenoids with signal in ESD system should have manual reset.
			43. Relocate sample connections of compressor suctions to Binak and Golkhari inlet lines and also on Inlet KO Drum outlet line.

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. Decreased flow from upstream due to any reason	1. Low suction pressure with possibility of damage to compressors due to over heating	1. PALL-2131A that will activate ESD-2	
		2. PAL-2123A/PAL-2124A/PAL-2132A/FAL-2121A/FAL-2131A inside compressor package	
		3. Spill back valve will open by PIC-2121A	
		4. Internal high temperature protection in compressor package	
2. Plugging of demister pad	1. Same as above		
	2. Possibility of damage to demister pad	1. PDAH-2131A	
3. Plugging of compressor suction strainer	1. Low suction pressure in compressor and damage to strainer	1. PDIT-2132A inside compressor package	
4. Compressor failure or trip	1. Decreased capacity of station	1. Spare compression train is considered	
	2. Increased pressure upstream of compressor with possibility of damage due to over pressure	1. PSVs on V-2104 and V-2105 are designed for blocked outlet	
		2. PAHH-2122 that will activate ESD-2	
5. XV-2133A closed by failure or error	1. Blocked outlet for compressor and damage to it	1. PSV-2132A/2133A	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where			

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 4. High Temperature

Causes	Consequences	Safeguards	Recommendations
1. Mechanical failure in compressor package	1. Damage to compressor or discharge piping	1. TAH-2133A inside compressor package 2. TAHH-2134A that will activate ESD-2	
2. Decreased flow through compressor	1. Same as above	1. FAL-2131A 2. TAH-2133A inside compressor package 3. TAHH-2134A that will activate ESD-2	
3. Air cooler fan failure or trip	1. High temperature of 2nd stage discharge with possibility of damage to downstream piping	1. TAH-2135A 2. TAHH-2136A that will activate ESD-2 3. Two pairs of air coolers are considered	38. Correct P&ID of air coolers of compressors according to data sheet.

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 5. Low Temperature

Causes	Consequences	Safeguards	Recommendations
1. More cooling in air coolers due to wrong adjustment of pitch	1. Waste of energy with no hazardous consequence	1. TAL-2135A	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 6. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. External fire case for V-2102A	1. Damage to equipment	1. PSV-2131A	
2. Blocked outlet for compressor 2nd stage discharge	1. Damage to equipment, leakage and fire	1. PSV-2132A/2133A 2. PAHH-2134 that will activate ESD-2	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 7. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. BDV-2134A open by failure or error	1. Waste of gas to flare with environmental effect	1. Limit switch on valve	
	2. Low suction pressure for 2nd stage and possibility of	1. PALL-2131A that will activate ESD-2	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 7. Low Pressure

Causes	Consequences	Safeguards	Recommendations
	damage to compressor due to over heating	2. Internal high temperature protection in compressor package	
	3. Low temperature after BDV with no hazardous consequence		
2. BDV-2132A open by failure or error	1. Waste of gas to flare with environmental effect	1. Limit switch on valve	
	2. Low temperature after BDV with possibility of freezing	1. Methanol injection is considered	44. Provide XV with remote access for depressurizing of 1st stage suction drum of compressors to give more operability during maintenance.
3. PCV-2135A open more when required to be	1. Waste of gas to flare with environmental effect	1. PAL-2135A (dependent)	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 8. High Level

Causes	Consequences	Safeguards	Recommendations
1. XV-2131A remained closed when required to be open	1. Accumulation of liquid in V-2102A and carry over to compressor with possibility of damage	1. LAH-2131A (dependent)	
		2. LAHH-2132A that will activate ESD-2 and trip compressor	
		3. Operator will be alerted by high level alarm (recommendation)	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 9. Low Level

Causes	Consequences	Safeguards	Recommendations
1. XV-2131A remained open	1. Gas blowby via closed drain header to flare and waste of gas	1. LAL-2131A (dependent)	
		2. LALL-2132A that will activate ESD-3 and close XV-2131A	
	2. Possibility of high pressure in closed drain drum	1. Closed drain in connected to flare header with locked open valve	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 9. Low Level

Causes	Consequences	Safeguards	Recommendations
	3. Slight decreased suction pressure of compressor	1. FAL-2131A/PAL-2132A inside compressor package	

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 10. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. No new issue was identified			

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 11. Loss of Utilities

Causes	Consequences	Safeguards	Recommendations
1. failure of electrical tracing at compressor suction	1. Possibility of condensation in cold season	1. Inspection & maintenance procedures	46. Consider drain connection on low point of line between V-2102A and compressor.

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers

Deviation: 12. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			47. Remove sample connection on suction and discharge of compressor 2nd stage.

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. XV-2142 closed by failure or error	1. Blocked outlet for compressor station and damage to equipment, fire and personnel injury	1. PSV-2141/2142 2. High pressure safeguards on compressor discharge	
2. XV-2143 closed by failure or error during startup	1. Delay in startup		

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where			

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. External fire case for V-2103	1. Damage to equipment	1. PSV-2141	

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. BDV-2141 open by failure or error	1. Waste of gas to flare with environmental effect	1. Limit switch on valve	48. Correct on P&ID that outlet pipe of BDV 2141 is connected directly to flare header separated from tail pipe of PSVs and change the class of BDV-2141 from 300 to 600 #.
	2. Possibility of freezing of line	1. Methanol injection is considered	
2. Maloperation during steam out at startup	1. Vacuum formation and V-2103 collapse		49. Full vacuum should be considered for design

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. XV-2144 closed by failure or error	1. High level in V-2103 and carry over to dehydration package and degradation of glycol	1. LAH-2141 (dependent)	50. Show on P&ID stand pipe for LG-2141 and LIT-2141.
		2. LAHH-2142 that will activate ESD-1	

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. XV-2144 remained open by failure or error	1. Gas blowby via closed drain header to flare and waste of gas	1. LAL-2141 (dependent)	
		2. LALL-2142 that will activate ESD-3 and close XV-2144	
	2. Possibility of high pressure in closed drain drum	1. Closed drain in connected to flare	51. As per drain configuration, consider gate valve, spectacle

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
		header with locked open valve	and globe valve arrangement for bypass of XV-2144 and change the class of XV-2144 from 300 to 600 #..

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 8. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			52. Consider spectacle blind on B2 nozzle of V-2103.
			53. Consider spectacle blind on corrosion inhibitor injection line to V-2103 after check valve.

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 9. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Corrosion due to sulphur and moisture content	1. Damage to equipment and piping in long term	1. Corrosion monitoring (CP/CC)	
		2. Corrosion inhibitor injection is considered	
		3. Liquid line from V-2103 to XV-2144 is Stainless Steel	

Node: 7. 2nd Stage Gas Compression Discharge Drum

Deviation: 10. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			54. Show on P&ID line number and inlet reducer of XV-2143.
			55. Remove TG-2143.

Node: 8. Gas Compression Dehydration Package

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. Decreased flow to downstream due to any blockage in pipeline or Siahmakan facilities	1. Increased pressure for dehydration package and change in operating condition of it that will lead to more tail gas to flare	1. PIC-2152 will open PCV-2152 to flare	56. Define high alarm on PIC-2152.
			57. Show dedicated control blocks for PCV-2152 and PCV-2151.

Node: 8. Gas Compression Dehydration Package

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
2. PCV-2151 closed more by a failure in any elements of its control loop	1. Same as above	1. PIC-2152 will open PCV-2152 to flare (dependent)	
	2. Blocked outlet for compressor station and damage to equipment, fire and personnel injury	1. Upstream PSVs are designed for blocked outlet	58. Failure mode of PCV-2151 should be FC and failure mode of PCV-2152 should be FO.
			59. Class of PCV-2151, PCV-2152 and BDV-2151 should be 600#.
			60. General recommendation: check size of control valves to be compatible with IPS requirements.

Node: 8. Gas Compression Dehydration Package

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. PCV-2151 open more by a failure in any elements of its control loop	1. Decreased pressure and more flow through dehydration package and increased moisture in gas to pipeline	1. Moisture analyzer inside package with high alarm	

Node: 8. Gas Compression Dehydration Package

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			61. Consider check valve on 2" closed drain connection from dehydration package.

Node: 8. Gas Compression Dehydration Package

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. Blocked outlet	1. Damage to equipment		62. Check with vendor requirement for sizing PSV on dehydration package for blocked outlet scenario.

Node: 8. Gas Compression Dehydration Package

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. BDV-2151 open by failure or error	1. Waste of gas to flare with environmental effect	1. Limit switch on valve	63. Define low alarm on PIC-2152.
2. PCV-2152 open more by a failure in any elements of its control loop	1. Waste of gas to flare with environmental effect		

Node: 8. Gas Compression Dehydration Package

Deviation: 6. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Corrosion due to sulphur and moisture content	1. Damage to equipment and piping in long term	1. Corrosion monitoring (CP/CC)	64. Show on P&ID of dehydration package detail of corrosion inhibitor injection valving.
		2. Corrosion inhibitor injection is considered	

Node: 8. Gas Compression Dehydration Package

Deviation: 7. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			65. Equalizing valve on bypass of dehydration package should be 2" and gate valve on this bypass should be changed to ball valve.
			66. Consider block valve of fuel gas supply line to dehydration package.
			67. Show on P&ID of dehydration package, BMS and min required signals to/from plant DCS and ESD.
			68. HAZOP study of dehydration package shall be performed with participation of package vendor.

Node: 9. Lean Glycol Storage Tank

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. P-2103A/B failure or trip	1. Delay in makeup glycol flow to dehydration	1. Standby pump is considered	69. Correct on P&ID min flow (including RO) of P-2103A/B to be connected directly to nozzle B2 of TK-2102.

Node: 9. Lean Glycol Storage Tank

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
		2. Intermittent operation	70. Remove auto/manual signal from P-2103A/B.

Node: 9. Lean Glycol Storage Tank

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 9. Lean Glycol Storage Tank

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			71. Consider check valve on glycol line from P-2103A/B to PK-2101.

Node: 9. Lean Glycol Storage Tank

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. PRV-2162 open more by failure	1. Possibility of damage to tank	1. PVSV-2161/PVSV-2162	72. Blanketing of TK-2102 should be with N2.
			73. Consider safety hatch for TK-2102.
			74. Consider pressure transmitter with high and low alarm on TK-2102.
			75. PVSV-2161/2162 should be vented to ATM.
2. PRV-2161 closed more by failure during tank	1. Same as above	1. PVSV-2161/PVSV-2162	
3. External fire case for TK-2101	1. Damage to tank	1. PVSV-2161/PVSV-2162	
4. Blocked outlet for P-2103A/B	1. High pressure of pump discharge	1. Min flow is considered	

Node: 9. Lean Glycol Storage Tank

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. PRV-2161 closed more by failure during tank level	1. Vacuum formation and TK-	1. PVSV-2161/PVSV-	76. Show vacuum set point of

Node: 9. Lean Glycol Storage Tank

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
decreasing	2102 collapse	2162	PVSV-2161/2162.

Node: 9. Lean Glycol Storage Tank

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. Operator error and over filling of tank	1. Over flow from tank and waste of material	1. LAH-2162 2. Dike	77. LIT-2161 and LIT-2162 should be readable at grade in loading area.

Node: 9. Lean Glycol Storage Tank

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. TK-2102 not refilled at proper time due to error	1. Loss of fresh glycol to dehydration package	1. LAL-2162	
	2. Possibility of damage to P-2103A/B	1. LALL-2161 that will activate ESD-3 and stop P-2103A/B	

Node: 9. Lean Glycol Storage Tank

Deviation: 8. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			78. Consider spectacle blind on 2" drain nozzle D of TK-2102.

Node: 9. Lean Glycol Storage Tank

Deviation: 9. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Corrosion	1. Damage to equipment and piping in long term	1. Corrosion monitoring (CC)	

Node: 9. Lean Glycol Storage Tank

Deviation: 10. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			79. Remove check valve on suction of P-2103A/B. 80. Correct P&ID of glycol tank and show nozzle A at top of tank.

Node: 9. Lean Glycol Storage Tank

Deviation: 10. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
			81. Consider PG on discharge of P-2102.

Node: 10. Instrument & Plant Air System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. Any failure inside instrument air package and compressors	1. Low pressure of instrument air and loss of plant control	1. Instrument air receiver V-2203 with 15 min holdup	82. Number, signal and set points of PTs (PT-2203) for start/stop of standby air compressor should be according to IPS requirements.
		2. Fault alarm on package	83. ESD level on PALL-2201A/B/C should be 1A.
		3. PAL-2201	
		4. PALL-2202 that will activate ESD-3 and closed ESDV-2231	
		5. PAL-2203	
		6. PALL-2201A/B/C with 2oo3 voting that will activate ESD-1A	
	2. Low pressure of plant air with no hazardous consequence		
2. PCV-2201 closed more by a failure in any elements of its control loop	1. Low pressure of plant air with no hazardous consequence		84. PCV-2201 should be FC.
3. ESDV-2231 closed by failure or error	1. Same as above		85. Remove ESDV-2231 and consider solenoid on PCV-2201 to close valve by ESD-3.
4. PRV-2201 closed by failure	1. Low pressure of instrument air and loss of plant control	1. PALL-2201A/B/C with 2oo3 voting that will activate ESD-1	83. ESD level on PALL-2201A/B/C should be 1A.

Node: 10. Instrument & Plant Air System

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 10. Instrument & Plant Air System

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 10. Instrument & Plant Air System

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. external fire case for V-2203	1. Damage to equipment	1. PSV-2201A/B	
2. PRV-2201 open by failure	1. No hazardous consequence		
3. PCV-2201 open more by a failure in any elements of its control loop	1. High pressure of plant air header and possible low pressure of instrument air header	1. PAL-2201 (dependent) 2. PALL-2202 that will activate ESD-3 and closed ESDV-2231	

Node: 10. Instrument & Plant Air System

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. High consumption rate of plant air	1. Low pressure of instrument air and loss of plant control	1. Instrument air receiver V-2203 with 15 min holdup 2. Fault alarm on package 3. PAL-2201 4. PALL-2202 that will activate ESD-3 and closed ESDV-2231 5. PAL-2203 6. PIC-2201 will control PCV-2201	

Node: 10. Instrument & Plant Air System

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. Accumulation of liquid in V-2203	1. Possibility of damage to instrumentation	1. Local LG-2201 may be checked by operator	

Node: 10. Instrument & Plant Air System

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. Failure of mechanical trap	1. Waste of instrument air		86. Remove mechanical trap from V-2203 and consider mechanical trap for wet air KO drum.

Node: 10. Instrument & Plant Air System

Deviation: 8. Composition

Causes	Consequences	Safeguards	Recommendations
1. Loss of performance of dryers	1. Increased moisture content of instrument air and damage to instrumentation	1. Moisture analyzer inside package with high alarm	

Node: 11. Nitrogen Generation System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. Any failure inside Nitrogen package and compressors	1. Low pressure of nitrogen and loss of seal gas for compressor and also leakage of gas to ATM with possible personnel injury	1. Nitrogen receiver V-2204 with 15 min holdup	
		2. Fault alarm on package	
		3. PAL-2213	
		4. PAL-2211 inside package	
		5. PALL-2211 that will activate ESD-1	
		6. Low seal pressure protection inside compressor package	
	2. Low pressure of nitrogen for utility with no hazardous consequence		
2. PCV-2211 closed more by a failure in any elements of its control loop	1. Same as above		87. PCV-2211 should be FO.

Node: 11. Nitrogen Generation System

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. PCV-2211 open more by a failure in any elements of its control loop	1. Slightly high pressure of nitrogen header with no hazardous consequence		

Node: 11. Nitrogen Generation System

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			88. Consider check valve on nitrogen branches to gas compressors.

Node: 11. Nitrogen Generation System

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. external fire case for V-2204	1. Damage to equipment	1. PSV-2211A/B	

Node: 11. Nitrogen Generation System

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. No new issue was identified			

Node: 11. Nitrogen Generation System

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. Accumulation of liquid in V-2204	1. Possibility of damage to compressor seal	1. Local LG-2211 may be checked by operator	

Node: 11. Nitrogen Generation System

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. Failure of mechanical trap	1. Waste of nitrogen		89. Remove mechanical trap from V-2204 and consider mechanical trap for wet air KO drum inside compressor package.

Node: 11. Nitrogen Generation System

Deviation: 8. Composition

Causes	Consequences	Safeguards	Recommendations
1. Loss of performance of PSA	1. Increased moisture/oxygen content of nitrogen and damage to compressor seal	1. Moisture analyzer inside package with high alarm	90. Remove HC analyzer from nitrogen package.
		2. oxygen analyzer	

Node: 11. Nitrogen Generation System

Deviation: 8. Composition

Causes	Consequences	Safeguards	Recommendations
		inside package with high alarm	

Node: 12. Closed Drain System

Deviation: 1. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			91. Consider check valve on 2" line from P-2201A/B to existing burn pit.
			92. Remove 2" line connection from closed drain drum to oily water sump.

Node: 12. Closed Drain System

Deviation: 2. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. No issue since V-2202 is connected to flare header with LO valve			93. Globe valve on flare nozzle of V-2202 should be changed to ball type.

Node: 12. Closed Drain System

Deviation: 3. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. Maloperation during steam out at startup	1. Vacuum formation and V-2202 collapse		94. Full vacuum should be considered for design pressure of V-2202.

Node: 12. Closed Drain System

Deviation: 4. High Level

Causes	Consequences	Safeguards	Recommendations
1. Accumulation of liquid in V-2202	1. Carry over of liquid to flare KO drum	1. LIC-2221 will start 1st pump on H1 setpoint and 2nd pump on H2	
		2. LAH-2221	
2. Accumulation of surface water/rain in closed drain sump	1. Damage to equipment in sump	1. LIC-2222A/B will start sump pump	95. LIT-2223A/B should be float type and consider only one common LT for P-2203A/B.

Node: 12. Closed Drain System

Deviation: 5. Low Level

Causes	Consequences	Safeguards	Recommendations
1. Pump remained in service when not required	1. Damage to pump	1. PALL-2222A/B that will activate ESD-3 and stop pump	96. Relocate PALL-2222A/B to between pumps P-2202A/B and suction strainers.
		2. LAL-2221	

Node: 12. Closed Drain System

Deviation: 6. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			97. Consider spectacle blind on inlet and outlet of P-2201A/B.

Node: 12. Closed Drain System

Deviation: 7. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			98. Relocate PIT-2252 (currently PIT-2222A) from closed drain drum to flare KO drum.
			99. valves down stream of P-2202A/B to V-2104 should be LO.
			100. Consider PG at discharge of P-2202A/B.

Node: 13. Corrosion Inhibitor Package

Deviation: 1. Loss of Performance

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			101. Consider remote stop for corrosion inhibitor package (XSP corrected to HSP).

Node: 14. Methanol Injection Package

Deviation: 1. Loss of Performance

Causes	Consequences	Safeguards	Recommendations
1. No HAZOP issue was identified			

Node: 15. LP Flare System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. No/less flow of fuel gas for pilots due to any reason	1. Pilot flame-off and possibility of dispersion of flammable/toxic gas at flare tip	1. Pilot status indication 2. LPG bottle 3. Auto ignition for pilots	102. Check coverage of CCTV and if required consider CCTV for flare monitoring in control room.

Node: 15. LP Flare System

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. Flare system is designed for Max flare scenario			
2. More flow of fuel gas for pilots due to any reason	1. Pilot flame-out and possibility of dispersion of flammable/toxic gas at flare tip	1. Pilot status indication 2. LPG bottle 3. Auto ignition for pilots	

Node: 15. LP Flare System

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where required			

Node: 15. LP Flare System

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. Emergency flaring	1. Pressurizing of flare header and problem for operation of PSVs due to back pressure	1. flare system is designed for max back pressure	

Node: 15. LP Flare System

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 15. LP Flare System

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. Accumulation of liquids in flare KO drum due to	1. Carry over of liquid to stack and damage to it and also	1. LIC-2251 will start 1st pump on H1 setpoint	

Node: 15. LP Flare System

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
process upset	possibility of personnel injury	and 2nd pump on H2	
		2. LAHH-2252A/B/C that will activate ESD-1 on 2oo3 voting	

Node: 15. LP Flare System

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. P-2201A/B remain in service when not required	1. Damage to pump	1. LAL-2251 will stop pump (dependent)	103. Relocate PALL-2251A/B to between pumps P-2201A/B and suction strainers.
		2. LALL-2253 that will activate ESD-3 and stop pumps	
		3. PALL-2251A/B that will activate ESD-3 and stop pumps	

Node: 15. LP Flare System

Deviation: 8. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			104. Consider spectacle blinds on suction and discharge isolation valves of P-2201A/B.
			105. Define in operating manual that operator should ensure that always one discharge route of P-2201A/B is open.

Node: 16. Oily Water Sewer

Deviation: 1. High Level

Causes	Consequences	Safeguards	Recommendations
1. Accumulation of water in sumo	1. Over flow from sump to open ditch with environmental effect	1. LAH-2273	106. LIT-2273 should be float type with cage.

Node: 17. Fuel Gas System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. ESDV-2272 closed by	1. Loss of fuel gas and loss of	1. PAL-2272	

Node: 17. Fuel Gas System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
failure or error	operating glycol regeneration	2. Limit switch on valve	
	2. Loss of fuel gas to flare pilots	1. LPG bottle	
	3. Loss of flare sweep gas and possibility of flame back to flare stack	1. Molecular seal is considered for flare	
2. PCV-2272 closed more by a failure in any elements of its control loop	1. Same as above	1. PAL-2272 (dependent)	107. Define low alarm on PI-2271.
3. PRV-2272 closed by failure	1. Loss of flare sweep gas and possibility of flame back to flare stack	1. Molecular seal is considered for flare	108. Replace PRV-2272 with local flow gauge, ball valve, check valve and globe valve.
4. Plugging of demister	1. Low pressure of fuel gas system		107. Define low alarm on PI-2271.

Node: 17. Fuel Gas System

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. PCV-2272 open more by a failure in any elements of its control loop	1. No hazardous consequence	1. PAH-2272	

Node: 17. Fuel Gas System

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where required			

Node: 17. Fuel Gas System

Deviation: 4. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. external fire case for V-2205	1. Damage to equipment	1. PSV-2271A/B	109. PSV on V-2205 should be sized for fire case.

Node: 17. Fuel Gas System

Deviation: 5. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. Maloperation during steam out at startup	1. Vacuum formation and V-2205 collapse		110. Full vacuum should be considered for design pressure of V-2205.

Node: 17. Fuel Gas System

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. Accumulation of liquid in V-2205 due to carry over from inlet KO drum	1. Carry over of liquid to fuel gas header and disturbance for users	1. LAH-2271 2. LIC-2271 will open XV-2271 3. LAHH-2272 that will activate ESD-3 and close ESDV-2272	

Node: 17. Fuel Gas System

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. XV-2271 remained open	1. Gas blowby via closed drain header to flare and waste of gas	1. LAL-2271 (dependent) 2. LIC-2271 will close XV-2271 (dependent) 3. LALL-2272 that will activate ESD-3 and close XV-2271	

Node: 17. Fuel Gas System

Deviation: 8. Corrosion

Causes	Consequences	Safeguards	Recommendations
1. Corrosion due to sulphur and moisture content	1. Damage to equipment and piping in long term	1. Corrosion monitoring (CP/CC) 2. Corrosion inhibitor injection is considered	

Node: 17. Fuel Gas System

Deviation: 9. Composition

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			111. Note in duty spec of dehydration package that requirement for fuel gas filter should be checked by vendor.

Node: 17. Fuel Gas System

Deviation: 10. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			112. Remove fuel gas lines used for blanketing of TK-2102 and V-2107.

Node: 18. Diesel Oil System

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. P-2206A failure or trip	1. No flow to PK-2207 or fire water pump	1. Intermittent operation	
2. P-2206B failure or trip	1. No flow to diesel generator	1. Intermittent operation	
3. Plugging of strainer	1. Possibility of damage to pump	1. Intermittent operation	113. Remove PT-2281A/B from suction of P-2206A/B and consider local pressure gauge.
			114. Define high high and low low trip interlock on LI-2281A/B to trip P-2206A/B.

Node: 18. Diesel Oil System

Deviation: 2. More Flow

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 18. Diesel Oil System

Deviation: 3. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where required			

Node: 18. Diesel Oil System

Deviation: 4. Low Temperature

Causes	Consequences	Safeguards	Recommendations
1. No issue was identified			

Node: 18. Diesel Oil System

Deviation: 5. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. Blocked in and thermal expansion	1. Damage to piping	1. TSV-2281A/B	

Node: 18. Diesel Oil System

Deviation: 6. High Level

Causes	Consequences	Safeguards	Recommendations
1. Over filling of vessel by operator error	1. Over flow from vent and waste of material	1. LAH-2281A/B	115. Any surface contamination on diesel oil drum area should be directed to oily water header.

Node: 18. Diesel Oil System

Deviation: 7. Low Level

Causes	Consequences	Safeguards	Recommendations
1. Tank not refilled at proper time by error	1. Delay in filling daily tank	1. Intermittent operation	
		2. LAL-2281A/B	

Node: 18. Diesel Oil System

Deviation: 8. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			116. Remove steam out connection for V-2206A/B.
			117. Relocate globe valve at discharge of P-2206A/B to downstream of tank filling branch.
			118. Consider drain connection at suction and discharge of P-2206A/B.

Node: 19. Potable Water System

Deviation: 1. Loss of Performance

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			119. Remove ESD-1 signal from P-2209.

Node: 20. Glycol Sump Drum

Deviation: 1. No/Less Flow

Causes	Consequences	Safeguards	Recommendations
1. P-2104 failure or trip	1. Delay in transferring glycol from V-2107	1. Intermittent operation	120. Remove start signal from LT-2293 on P-2104.
		2. LAH-2293	121. Consider proper type for LIT-2293.

Node: 20. Glycol Sump Drum

Deviation: 2. Reverse/Misdirected Flow

Causes	Consequences	Safeguards	Recommendations
1. Check valves are considered where			

Node: 20. Glycol Sump Drum

Deviation: 3. High Pressure

Causes	Consequences	Safeguards	Recommendations
1. PRV-2291 open by failure	1. Damage to V-2107		122. Consider PSV on V-2207 sized for regulator failure and fire case scenario.
2. External fire case for V-2107	1. Damage to equipment		122. Consider PSV on V-2207 sized for regulator failure and fire case scenario.
3. PRV-2292 closed by failure when level in V-2107 is increasing	1. Damage to V-2107		123. Consider PT with high alarm on V-2107.

Node: 20. Glycol Sump Drum

Deviation: 4. Low Pressure

Causes	Consequences	Safeguards	Recommendations
1. Maloperation during steam out at startup	1. Vacuum formation and V-2107 collapse		124. Full vacuum should be considered for design pressure of V-2107.
2. PRV-2291 closed by failure when level in V-2107 is decreasing	1. Possibility of vacuum formation and damage to equipment		

Node: 20. Glycol Sump Drum

Deviation: 5. High Level

Causes	Consequences	Safeguards	Recommendations
1. Accumulation of liquid in V- 2107	1. Over filling of vessel and carry over of glycol to vent	1. LAH-2293	

Node: 20. Glycol Sump Drum

Deviation: 6. Low Level

Causes	Consequences	Safeguards	Recommendations
1. P-2104 remain in service when not required	1. Damage to pump	1. LAL-2293 that will stop pump	

Node: 20. Glycol Sump Drum

Deviation: 7. Maintenance Hazards

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			125. Consider isolation valve downstream of PRV-2291.
			126. Consider spectacle on inlet and outlet lines (nozzle A, nozzle B and pump outlet) of V-2107.
			127. Consider drain connection under V-2107.
			128. Consider slop for V-2107 towards pump side.

Node: 20. Glycol Sump Drum

Deviation: 8. Composition

Causes	Consequences	Safeguards	Recommendations
1. Off spec spent glycol	1. Contamination of glycol in dehydration package		129. Consider connection from P-2104 to oily water system.

Node: 20. Glycol Sump Drum

Deviation: 9. Miscellaneous

Causes	Consequences	Safeguards	Recommendations
1. See Recommendation			130. ESD level on P-2104 should be ESD-1A.
			131. Consider connection for loading spent glycol to truck downstream of P-2104.

8.7 APPENDIX F – MARKED-UP P&IDS