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| **طرح نگهداشت و افزایش تولید 27 مخزن** | | | | | | |
| **SIL REPORT FOR COMPRESSOR STATION**  **نگهداشت و افزایش تولید میدان نفتی بینک** | | | | | | |
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| D00 | JUL. 2022 | IFI | A.Baghaei | M.Fakharian | M.Mehrshad |  |
| **Rev.** | **Date** | **Purpose of Issue/Status** | **Prepared by:** | **Checked by:** | **Approved by:** | **CLIENT Approval** |
| **Class: 3** | | **CLIENT Doc. Number: F0Z-708726** | | | | |
| **Status:** | | | | | | |
| **IDC: Inter-Discipline Check 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** | | | | | | |

**REVISION RECORD SHEET**

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| **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |
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# 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 SIL study covers all P&IDs for New Gas Compressor Station. The list of P&IDs is presented in appendix B.

# NORMATIVE REFERENCES

## INTERNATIONAL CODES AND STANDARDS

* + - IEC 61511:2016 Functional Safety – Safety Instrumented Systems for

the Process Industry Sector

## 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
    - BK-GCS-PEDCO-120-PR-CE-0001 Cause & Effect Diagram

# 4.0 PURPOSE

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

The objective of SIL study is to identify the target Safety Integrity Levels (SIL) of all the typical instrumented safety-related loops defined as trip interlocks, i.e. safety instrumented functions (SIF) leading to a safe status for people and to a safe state of the process and assets. The results obtained for target SIL of SIF’s then can be used for the design and procurement of the safety instrumented systems and planning of proof test intervals of safety instrumented systems.

# 5.0 SIL STUDY OVERVIEW

SIL study was performed along with HAZOP Study meetings which were conducted in 4 sessions from June 27 to 30, 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/SIL Chairman and Scribe. The list of team members is presented in appendix A.

Piping and Instrumentation Diagrams (P&ID’s) for GCS are listed in appendix B. Each P&ID is used in one or more nodes that is mentioned in the drawing report.

The node list generated during HAZOP Study was also used for SIL Study. Total 31 SIFs were identified and studied. The list of nodes and SIFs in each node is presented in appendix C.

Appendix D describes SIFs in each node and the Target SIL results, and appendix E consists of detailed SIL Worksheets of the study.

# 6.0 PROCEDURE

The SIL Study was performed according to the Risk Graph methodology defined by the SIL Procedure Document “BK-GNRAL-PEDCO-000-GE-PR-0003”.

# 7.0 SIL STUDY OUTCOMES

A total of 31 SIF’s were identified as safety critical systems and assessed. The resulting SIL study worksheets and SIL targets are shown in appendix E. Where multiple scenarios were analysed, the highest value of SIL is selected for the regarding SIF. Following table shows the distribution of Target SIL’s.

|  |  |
| --- | --- |
| **SIL Target** | **No. of SIF’s** |
| **Not Safety Related** | 0 |
| **SIL A** | 10 |
| **SIL 1** | 8 |
| **SIL 2** | 13 |
| **SIL 3** | 0 |
| **SIL 4** | 0 |
| **Total** | 31 |

# ATTACHMENTS

## ATTACHMENT 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 |
| Mehdi | Sadeghian | PEDCO | Surface Manager |
| Vahid | Abdeshadi | PEDCO | Project Engineer Manager |

|  |  |  |  |
| --- | --- | --- | --- |
| **First Name** | **Last Name** | **Company** | **Expertise** |
| 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 |

* 1. **ATTACHMENT B – LIST OF DRAWINGS**

|  |  |  |
| --- | --- | --- |
| **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 Injection 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 |

* 1. **ATTACHMENT C – NODE LIST**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Nodes** | | **Color** | **Drawings** | **SIF Initiator** | | **Target SIL** |
| 1. Gas Compression Inlet Gas Pipeline (Binak) | | Red | BK-GCS-PEDCO-120-PR-PI- 0002\_D03 |  | |  |
| 2. Gas Compression Inlet Gas Pipeline (Golkhari) | | Violet | BK-GCS-PEDCO-120-PR-PI- 0003\_D03 |  | |  |
| 3. Slug Catcher System | | L Blue | BK-GCS-PEDCO-120-PR-PI- 0004\_D03 | 1. | PALL-2114A/B | SIL 1 |
|  | | 2. | PAHH-2116A/B | SIL 1 |
|  | | 3. | PAHH-2111 | SIL 2 |
|  | | 4. | LAHH-2112 | SIL 1 |
|  | | 5. | LALL-2112 | SIL a |
| 4. G  as Compression Inlet Knock Out Drum | | Yellow | BK-GCS-PEDCO-120-PR-PI- 0005\_D03 | 1. | PAHH-2116 | SIL 2 |
| 2. | LAHH-2117 | SIL 1 |
|  | | 3. | LALL-2118 | SIL a |
| 5. 1  C  st Stage Gas ompression Suction  Drums, Compressors and Air Coolers | | Blue | BK-GCS-PEDCO-120-PR-PI- 0006\_D03 | 1. | PALL-2122A | SIL 2 |
| BK-GCS-PEDCO-120-PR-PI- 0007\_D03 | 2. | PAHH-2122A | SIL 2 |
|  | | BK-GCS-PEDCO-120-PR-PI- 0008\_D03 | 3. | TAHH-2124A | SIL 2 |
|  | | 4. | TAHH-2125A | SIL 2 |
|  | | 5. | LAHH-2122A | SIL 2 |
|  | | 6. | LALL-2122A | SIL a |
| 6. 2  C  nd Stage Gas ompression Suction  Drums, Compressors and Air Coolers | | Green | BK-GCS-PEDCO-120-PR-PI- 0009\_D03 | 1. | PALL-2131A | SIL 2 |
| BK-GCS-PEDCO-120-PR-PI- 0010\_D03 | 2. | TAHH-2134A | SIL 2 |
|  | | BK-GCS-PEDCO-120-PR-PI- 0011\_D03 | 3. | TAHH-2136A | SIL 2 |
|  | | 4. | PAHH-2134A | SIL 2 |
|  | | 5. | LAHH-2132A | SIL 2 (with recommenda tion) |
|  | | 6. | LALL-2132A | SIL a |
| 7. 2  nd Stage Gas Compression Discharge Drum | | Violet | BK-GCS-PEDCO-120-PR-PI- 0012\_D03 | 1. | LAHH-2142 | SIL 1 |
| 2. | LALL-2142 | SIL a |
| 8. Gas Compression Dehydration Package | | Yellow | BK-GCS-PEDCO-120-PR-PI- 0013\_D03 |  | |  |
| 9. L  ean Glycol Storage Tank | | Blue | BK-GCS-PEDCO-120-PR-PI- 0014\_D03 | 1. | LALL-2161 | SIL a |
| 10. | Instrument & Plant Air System | Red | BK-GCS-PEDCO-120-PR-PI- 0015\_D03 | 1. | PALL- 2201A/B/C | SIL 1 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Nodes** | | **Color** | **Drawings** | **SIF Initiator** | | **Target SIL** |
|  | |  |  | 2. | PALL-2202 | SIL 1 |
| 11. | Nitrogen Generation System | Green | BK-GCS-PEDCO-120-PR-PI- 0016\_D03 | 1. | PALL-2211 | SIL 2 |
| 12. | Closed Drain System | Pink | BK-GCS-PEDCO-120-PR-PI- 0017\_D03 |  | |  |
| 13. | Corrosion Inhibitor Package | Orange | BK-GCS-PEDCO-120-PR-PI- 0018\_D03 |  | |  |
| 14. | Methanol Injection Package | L Blue | BK-GCS-PEDCO-120-PR-PI- 0019\_D03 |  | |  |
| 15. | LP Flare System | Violet | BK-GCS-PEDCO-120-PR-PI- 0020\_D03 | 1. | LAHH- 2252A/B/C | SIL 1 |
|  |  | 2. | LALL-2253 | SIL a |
|  |  | 3. | PALL-2251A/B | SIL a |
| 16. | Oily Water Sewer | Yellow | BK-GCS-PEDCO-120-PR-PI- 0021\_D03 |  | |  |
| 17. | Fuel Gas System | Blue | BK-GCS-PEDCO-120-PR-PI- 0022\_D03 | 1. | LAHH-2272 | SIL a |
|  |  | 2. | LALL-2272 | SIL a |
| 18. | Diesel Oil System | Green | BK-GCS-PEDCO-120-PR-PI- 0023\_D03 |  | |  |
| 19. | Potable Water System | L Blue | BK-GCS-PEDCO-120-PR-PI- 0024\_D03 |  | |  |
| 20. | Glycol Sump Drum | Violet | BK-GCS-PEDCO-120-PR-PI- 0025\_D03 |  | |  |

* 1. **ATTACHMENT D – SIF DESCRIPTION**

Node: 3. Slug Catcher System

|  |  |  |  |
| --- | --- | --- | --- |
| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | PALL-2114A/B | will activate ESD-3 and stop pump P- 2101A/B | SIL 1 |
| 2. | PAHH-2116A/B | will activate ESD-3 | SIL 1 |
| 3. | PAHH-2111 | will activate ESD-1 | SIL 2 |
| 4. | LAHH-2112 | will activate ESD-1 | SIL 1 |
| 5. | LALL-2112 | will activate ESD-3 and stop pumps | SIL a |

Node: 4. Gas Compression Inlet Knock Out Drum

|  |  |  |  |
| --- | --- | --- | --- |
| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | PAHH-2116 | will activate ESD-1 | SIL 2 |
| 2. | LAHH-2117 | will activate ESD-3 | SIL 1 |
| 3. | LALL-2118 | will activate ESD-3 and close ESDV- 2113 | SIL a |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | PALL-2122A | will activate ESD-2 | SIL 2 |
| 2. | PAHH-2122A | will activate ESD-2 | SIL 2 |
| 3. | TAHH-2124A | will activate ESD-2 | SIL 2 |
| 4. | TAHH-2125A | will activate ESD-2 | SIL 2 |
| 5. | LAHH-2122A | will activate ESD-2 and trip compressor | SIL 2 |
| 6. | LALL-2122A | will activate ESD-3 and close XV-2122A | SIL a |

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

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | PALL-2131A | will activate ESD-2 | SIL 2 |
| 2. | TAHH-2134A | will activate ESD-2 | SIL 2 |
| 3. | TAHH-2136A | will activate ESD-2 | SIL 2 |
| 4. | PAHH-2134A | will activate ESD-2 | SIL 2 |
| 5. | LAHH-2132A | will activate ESD-2 and trip compressor | SIL 2 (with recommendation) |
| 6. | LALL-2132A | will activate ESD-3 and close XV-2131A | SIL a |

Node: 7. 2nd Stage Gas Compression Discharge Drum

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | LAHH-2142 | will activate ESD-1 | SIL 1 |

Node: 7. 2nd Stage Gas Compression Discharge Drum

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 2. | LALL-2142 | will activate ESD-3 and close XV-2144 | SIL a |

Node: 9. Lean Glycol Storage Tank

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | LALL-2161 | will activate ESD-3 and stop P-2103A/B | SIL a |

Node: 10. Instrument & Plant Air System

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | PALL-2201A/B/C | will activate ESD-1A with 2oo3 voting | SIL 1 |
| 2. | PALL-2202 | will activate ESD-3 and closed ESDV- 2231 | SIL 1 |

Node: 11. Nitrogen Generation System

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | PALL-2211 | will activate ESD-1 | SIL 2 |

Node: 15. LP Flare System

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | LAHH-2252A/B/C | will activate ESD-1 on 2oo3 voting | SIL 1 |
| 2. | LALL-2253 | will activate ESD-3 and stop pumps | SIL a |
| 3. | PALL-2251A/B | will activate ESD-3 and stop pumps | SIL a |

Node: 17. Fuel Gas System

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| **SIF Initiator** | | **Description** | **Target SIL** |
| 1. | LAHH-2272 | will activate ESD-3 and close ESDV- 2272 | SIL a |
| 2. | LALL-2272 | will activate ESD-3 and close XV-2271 | SIL a |

## ATTACHMENT E – SIL WORKSHEETS

Node: 3. Slug Catcher System SIF Initiator: 1. PALL-2114A/B

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Plugging of pump strainer | 1. | Possibility of damage to pump | 1. | Local PDG-2114A/B | Non-IPL |  |  |  |  |  | AA | PB | W2 | SIL 1 |  |  |  |  |  |

Node: 3. Slug Catcher System SIF Initiator: 2. PAHH-2116A/B

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | FCV-2111 closed more by a failure in any elements of its control loop | 1. | Possibility of damage to pump due to high pressure |  | |  |  |  |  |  |  | AA | PB | W2 | SIL 1 |  |  |  |  |  |
| 2. | ESDV-2112 closed by failure or error | 1. | Possibility of damage to pump due to high pressure | 1. | Limit switch on valve | Non-IPL |  |  |  |  |  | AA | PB | W2 | SIL 1 |  |  |  |  |  |

Node: 3. Slug Catcher System SIF Initiator: 3. PAHH-2111

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Downstream compressor shutdown | 1. | High pressure of V- 2104 up to Golkhari cluster pressure with possibility of damage, fire and injury | 1. | PAH-2112 | Non-IPL | SC | FB | PA | W2 | SIL 2 | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | PSV-2111/2112 on V- 2104 | IPL |

Node: 3. Slug Catcher System SIF Initiator: 4. LAHH-2112

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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-2117 that will activate ESD-3 on inlet KO drum | IPL |  |  |  |  |  | AC | PA | W1 | SIL 1 |  |  |  |  |  |
|  |  | 2. | LAHH-2122A/B/C that will activate ESD-2 and trip compressor | IPL |

Node: 3. Slug Catcher System SIF Initiator: 5. LALL-2112

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | P-2101A/B remain in service when not | 1. | Damage to pump | 1. | LAL-2111 that will stop pump | IPL |  |  |  |  |  | AA | PA | W2 | SIL a |  |  |  |  |  |

Node: 3. Slug Catcher System SIF Initiator: 5. LALL-2112

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| **Causes** | **Consequences** | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| required |  | 2. | PALL-2114A/B that will activate ESD-3 and stop pumps | IPL |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Node: 4. Gas Compression Inlet Knock Out Drum SIF Initiator: 1. PAHH-2116

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Compressors shutdown due to any reason | 1. | Blocked outlet for V- 2105 and possibility of damage, fire and personnel injury | 1. | PAH-2117 | Non-IPL | SC | FB | PA | W2 | SIL 2 | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | PSV-2113/2114 on V- 2105 | IPL |

Node: 4. Gas Compression Inlet Knock Out Drum SIF Initiator: 2. LAHH-2117

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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) | Non-IPL |  |  |  |  |  | AC | PA | W1 | SIL 1 |  |  |  |  |  |
|  |  | 2. | High level alarm protection on compressor suction drum and fuel gas KO drum | IPL |
| 2. | ESDV-2113 remained | 1. | Accumulation of liquid in | 1. | LAH-2119 (dependent) | Non-IPL |  |  |  |  |  | AC | PA | W1 | SIL 1 |  |  |  |  |  |

Node: 4. Gas Compression Inlet Knock Out Drum SIF Initiator: 2. LAHH-2117

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| **Causes** | **Consequences** | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| closed by failure or error for long time | inlet KO drum and carry over to compressors suction drums and fuel gas KO drum | 2. | High level alarm protection on compressor suction drum and fuel gas KO drum | IPL |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Node: 4. Gas Compression Inlet Knock Out Drum SIF Initiator: 3. LALL-2118

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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) | Non-IPL |  |  |  |  |  | AA | PB | W1 | SIL a | EA | PB | W1 | SIL a |  |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 1. PALL-2122A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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 | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | PAL-2123A/PAL- 2124A/PAL-2132A/FAL-  2121A/FAL-2131A inside compressor package | Non-IPL |
|  |  |  |  | 3. | Spill back valve will open | IPL |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 1. PALL-2122A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
|  | |  | | by PIC-2121A | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. | Internal high temperature protection in compressor package | IPL |
| 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 | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | PAL-2123A/PAL- 2124A/PAL-2132A/FAL-  2121A/FAL-2131A inside compressor package | Non-IPL |
|  |  |  | 3. | Limit switch on valve | Non-IPL |
|  |  |  |  | 4. | Spill back valve will open by PIC-2121A | IPL |
|  |  |  | 5. | Internal high temperature protection in compressor package | IPL |
| 3. | XV-2121A closed by failure or error (any failure inside UCP) | 1. | Loss of suction pressure for one compressor with possibility of damage to compressor due to over heating | 1. | PAL-2121A | Non-IPL |  |  |  |  |  | AC | PB | W0 | SIL 1 |  |  |  |  |  |
| 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 | IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | PAL-2121A (dependent) | Non-IPL |
|  |  |  | 3. | PAL-2123A/PAL- 2124A/PAL-2132A/FAL- | Non-IPL |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 1. PALL-2122A

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| **Causes** | **Consequences** | **Safeguards** | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
|  |  | 2121A/FAL-2131A inside compressor package |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 2. PAHH-2122A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Compressor failure or trip | 1. | 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 | IPL | SC | FB | PA | W2 | SIL 2 | AC | PA | W2 | SIL 2 |  |  |  |  |  |
| 2. | 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 | Non-IPL | SC | FB | PB | W1 | SIL 2 | AA | PB | W1 | SIL a |  |  |  |  |  |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 3. TAHH-2124A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | PCV-2123A open | 1. | High suction | 1. | TAH-2121A | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 3. TAHH-2124A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| more when required to be closed | | temperature with possibility of damage to compressor | | 2. | TAH-2122A inside compressor package | Non-IPL |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. | High temperature protection inside compressor package | IPL |
| 2. | Mechanical failure in compressor package | 1. | Damage to compressor or discharge piping | 1. | TAH-2123A inside compressor package | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
| 3. | Decreased flow through compressor | 1. | Damage to compressor or discharge piping | 1. | FAL-2121A | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | TAH-2123A inside compressor package | Non-IPL |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 4. TAHH-2125A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Air cooler fan failure or trip | 1. | High temperature of 2nd stage with possibility of damage to it | 1. | TAH-2126A | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | Two pairs of air coolers are considered | IPL |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 5. LAHH-2122A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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) | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | LAHH-2117 that will activate ESD-3 on inlet KO drum | IPL |

Node: 5. 1st Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 6. LALL-2122A

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | XV-2122A remained open | 1. | Gas blowby via closed drain header to flare and waste of gas | 1. | LAL-2121A (dependent) |  |  |  |  |  |  | AA | PA | W2 | SIL a | EA | PA | W2 | SIL a |  |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 1. PALL-2131A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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-2123A/PAL- 2124A/PAL-2132A/FAL-  2121A/FAL-2131A inside compressor package | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  |  |  | 2. | Spill back valve will open by PIC-2121A | IPL |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 1. PALL-2131A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
|  | |  | | 3. | Internal high temperature protection in compressor package | IPL |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. | BDV-2134A open by failure or error | 1. | Low suction pressure for 2nd stage and possibility of damage to compressor due to over heating | 1. | Internal high temperature protection in compressor package | IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 2. TAHH-2134A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Mechanical failure in compressor package | 1. | Damage to compressor or discharge piping | 1. | TAH-2133A inside compressor package | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  |  |  | 2. | High temperature protection inside compressor package | IPL |
| 2. | Decreased flow through compressor | 1. | Same as above | 1. | FAL-2131A | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  |  | 2. | TAH-2133A inside compressor package | Non-IPL |
|  |  |  |  | 3. | High temperature protection inside compressor package | IPL |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 3. TAHH-2136A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Air cooler fan failure or trip | 1. | High temperature of 2nd stage discharge with possibility of damage to downstream piping | 1. | TAH-2135A | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  |  |
|  |  | 2. | Two pairs of air coolers are considered | IPL |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 4. PAHH-2134A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Blocked outlet for compressor 2nd stage discharge | 1. | Damage to equipment, leakage and fire | 1. | PSV-2132A/2133A | IPL | SC | FB | PA | W2 | SIL 2 | AC | PA | W2 | SIL 2 |  |  |  |  |  |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 5. LAHH-2132A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** | |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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) | Non-IPL |  |  |  |  |  | AC | PA | W2 | SIL 2 |  |  |  |  | 1. | Define high level alarm on LT- 2132 also define |
|  |  | 2. | Operator will be alerted by high level alarm (recommendation) | IPL |  |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 5. LAHH-2132A

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| **Causes** | **Consequences** | **Safeguards** | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | discrepanc y alarm between LT-2131  and LT- 2132 in DCS. |

Node: 6. 2nd Stage Gas Compression Suction Drums, Compressors and Air Coolers SIF Initiator: 6. LALL-2132A

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | XV-2131A remained open | 1. | Gas blowby via closed drain header to flare and waste of gas | 1. | LAL-2131A (dependent) | Non-IPL |  |  |  |  |  | AA | PB | W1 | SIL a | EA | PB | W1 | SIL a |  |

Node: 7. 2nd Stage Gas Compression Discharge Drum SIF Initiator: 1. LAHH-2142

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | XV-2144 closed by failure or error | 1. | High level in V-2103 and carry over to dehydration package and degradation of | 1. | LAH-2141 (dependent) | Non-IPL |  |  |  |  |  | AA | PB | W2 | SIL 1 |  |  |  |  |  |

Node: 7. 2nd Stage Gas Compression Discharge Drum SIF Initiator: 1. LAHH-2142

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| **Causes** | **Consequences** | **Safeguards** | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
|  | glycol |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Node: 7. 2nd Stage Gas Compression Discharge Drum SIF Initiator: 2. LALL-2142

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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) | Non-IPL |  |  |  |  |  | AA | PB | W1 | SIL a | EA | PB | W1 | SIL a |  |

Node: 9. Lean Glycol Storage Tank SIF Initiator: 1. LALL-2161

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | TK-2102 not refilled at proper time due to error | 1. | Possibility of damage to P-2103A/B | 1. | LAL-2162 | Non-IPL |  |  |  |  |  | AA | PA | W2 | SIL a |  |  |  |  |  |

Node: 10. Instrument & Plant Air System SIF Initiator: 1. PALL-2201A/B/C

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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 | Non-IPL |  |  |  |  |  | AA | PB | W2 | SIL 1 |  |  |  |  |  |
|  |  | 2. | Fault alarm on package | Non-IPL |
|  |  |  |  | 3. | PAL-2201 | Non-IPL |
|  |  |  |  | 4. | PALL-2202 that will activate ESD-3 and closed ESDV-2231 | Non-IPL |
|  |  | 5. | PAL-2203 | Non-IPL |
| 2. | PRV-2201 closed by failure | 1. | Low pressure of instrument air and loss of plant control | 1. | Instrument air receiver V- 2203 with 15 min holdup | Non-IPL |  |  |  |  |  | AA | PB | W2 | SIL 1 |  |  |  |  |  |
|  |  |  | 2. | Fault alarm on package | Non-IPL |
|  |  |  |  | 3. | PAL-2201 | Non-IPL |
|  |  |  |  | 4. | PALL-2202 that will activate ESD-3 and closed ESDV-2231 | Non-IPL |
|  |  |  | 5. | PAL-2203 | Non-IPL |

Node: 10. Instrument & Plant Air System SIF Initiator: 2. PALL-2202

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | High consumption rate of plant air | 1. | Low pressure of instrument air and loss | 1. | Instrument air receiver V- 2203 with 15 min holdup | Non-IPL |  |  |  |  |  | AA | PA | W3 | SIL 1 |  |  |  |  |  |

Node: 10. Instrument & Plant Air System SIF Initiator: 2. PALL-2202

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | **Consequences** | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
|  | of plant control | 2. | Fault alarm on package | Non-IPL |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. | PAL-2201 | Non-IPL |
| 4. | PAL-2203 | Non-IPL |
| 5. | PIC-2201 will control PCV-2201 | IPL |

Node: 11. Nitrogen Generation System SIF Initiator: 1. PALL-2211

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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 | Non-IPL | SC | FB | PA | W2 | SIL 2 | AB | PA | W2 | SIL 1 |  |  |  |  |  |
|  |  | 2. | Fault alarm on package | Non-IPL |
|  |  |  | 3. | PAL-2213 | Non-IPL |
|  |  |  | 4. | PAL-2211 inside package | Non-IPL |
|  |  |  | 5. | Low seal pressure protection inside compressor package | IPL |

Node: 15. LP Flare System

SIF Initiator: 1. LAHH-2252A/B/C

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | Accumulation of liquids in flare KO drum due to process upset | 1. | Carry over of liquid to stack and damage to it and also possibility of personnel injury | 1. | LIC-2251 will start 1st pump on H1 setpoint and 2nd pump on H2 | IPL | SB | FA | PA | W1 | No safety requir ement s | AC | PA | W1 | SIL 1 |  |  |  |  |  |

Node: 15. LP Flare System SIF Initiator: 2. LALL-2253

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | P-2201A/B remain in service when not required | 1. | Damage to pump | 1. | LAL-2251 will stop pump (dependent) | Non-IPL |  |  |  |  |  | AA | PA | W2 | SIL a |  |  |  |  |  |
|  |  |  | 2. | PALL-2251A/B that will activate ESD-3 and stop pumps | IPL |

Node: 15. LP Flare System SIF Initiator: 3. PALL-2251A/B

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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | P-2201A/B remain in service when not required | 1. | Damage to pump | 1. | LAL-2251 will stop pump | Non-IPL |  |  |  |  |  | AA | PA | W2 | SIL a |  |  |  |  |  |
|  |  |  | 2. | LALL-2253 that will activate ESD-3 and stop | IPL |

Node: 15. LP Flare System SIF Initiator: 3. PALL-2251A/B

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| **Causes** | **Consequences** | **Safeguards** | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
|  |  | pumps |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Node: 17. Fuel Gas System SIF Initiator: 1. LAHH-2272

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 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 | Non-IPL |  |  |  |  |  | AA | PA | W2 | SIL a |  |  |  |  |  |
|  |  | 2. | LIC-2271 will open XV- 2271 | IPL |

Node: 17. Fuel Gas System SIF Initiator: 2. LALL-2272

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Causes** | | **Consequences** | | **Safeguards** | | | **Risk Graph-Safety** | | | | | **Risk Graph-Asset** | | | | **Risk Graph- Environment** | | | | **Recommend ations** |
| **Protection Layer** | | **Category** | **C** | **F** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** | **C** | **P** | **W** | **SIL** |
| 1. | XV-2271 remained open | 1. | Gas blowby via closed drain header to flare and waste of gas | 1. | LAL-2271 (dependent) | Non-IPL |  |  |  |  |  | AA | PB | W1 | SIL a | EA | PB | W1 | SIL a |  |
|  |  | 2. | LIC-2271 will close XV- 2271 (dependent) | IPL |