طرح نگهداشت و افزایش تولید ۲۷ مخزن

HAZID REPORT FOR WHF & FLOW LINES

نگهداشت و افزایش تولید میدان نفتی بینک

D00	JUL. 2022	IFI	F. Nourai	M.Fakharian	M.Mehrshad	
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IFA: Issued For Approval
AFD: Approved For Design
AFC: Approved For Construction
AFP: Approved For Purchase
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IFI: Issued For Information
AB-R: As-Built for CLIENT Review
AB-A: As-Built –Approved

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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, construction of well location, access road, wellhead facilities (with electric power supply) for W007S shall be done. In addition, construction of new flowline from aforementioned well location to Binak B/C unit (with extension of relevant manifold) are in the Project scope of work.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – Construction of Well Location, Wellhead Facilities, Electrification Facilities, Flowlines for W007S and Extension of Binak B/C Manifold
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 HAZID Study covers Extension of Binak B/C Manifold.

3.0 NORMATIVE REFERENCES

3.1 INTERNATIONAL CODES AND STANDARDS

- ISO 17776 — Petroleum and natural gas industries — Offshore production installations — Major accident hazard management during the design of new installations

3.2 THE PROJECT DOCUMENTS

- BK-GNRAL-HD-000-PR-DB-0001-D05 Process Basis of Design
- BK-W007S-PEDCO-110-PI-PY-0001 Plot Plan Drawing – Extension of Binak B/C Manifold
- BK-W007S-PEDCO-110-PI-PY-0002 Plot Plan Drawing – W007S

4.0 HAZID STUDY OVERVIEW

Meetings were conducted in two sessions on July 23, 2022 held in Hirgan Energy company office, Tehran.

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 HAZID Chairman. The list of team members is presented in appendix A.

5.0 ABBREVIATIONS

A/C	Air-Conditioning
AC/DC	Alternating Current/Direct Current
ALARP	As Low As Reasonably Practicable
CBA	Cost-Benefit Analysis
EMC	Electromagnetic Compatibility
ESD	Emergency Shut Down
F&G	Fire and Gas
HC	Hydrocarbon
HV	High Voltage
ICAO	International Civil Aviation Organization
IP	Ingress Protection
IRP	Sucker-Rod Pump
LBV	Line Break Valve
LDAR	Leak Detection and Repair

LV	Low Voltage
MV	Medium Voltage
OSBL	Outside Battery Limit
PACS	Project Applicable Codes and Standards
PPE	Personal Protective Equipment
RCD/P	Residual Current Device/Protection
ROW	Right of Way
SCBA	Self-Contained Breathing Apparatus
SIL	Safety Integrity Level
SoW	Scope of Work
SSSV	Sub-Surface Safety Valve
TPD	Third-Party Damage
UPS	Uninterruptible Power Supply
VOC	Volatile Organic Carbon
WHCP	Wellhead Control Panel

6.0 PROCEDURE

HAZID methodology is in accordance with “HAZID Study Procedure” defined by ISO 17776 checklist.

HAZID study is a tool for hazard identification, used early in a project as soon as process flow diagrams, heat and material balances, and plot layouts are available. Existing site infrastructure, weather, and geotechnical data are also required, these being a source of external hazards. The method is a design-enabling tool, influencing HSE deliverables in the project.

HAZID study is undertaken in order to deliver a good identification of hazard, threat control and recovery measures. This Study helps to ensure that:

- ✓ Major Hazards with potential to affect personnel, environment and assets are revealed and identified at an early stage in the project, before significant costs have been incurred
- ✓ Hazards are recorded so that they can be avoided, mitigated or highlighted during design
- ✓ Design or construction delays and budget over-runs are avoided
- ✓ Fewer hazards remain un-revealed at commissioning and operation of facilities

6.1 STUDY METHODOLOGY

A structured approach to identify hazards will be utilized based on studying the various operational phases of the under-study plant through:

- ✓ Identifying hazards.
- ✓ Describing their failure modes.
- ✓ Suggesting risk reducing measures that can prevent or mitigate each hazard.

The approach to HAZID is using generic guidewords, generic hazard specified for each hazard identified, the causes (threats), consequences and preventative/mitigation measures identified for the event. Recommendations are recorded when the preventative/mitigation measures do not adequately reduce the risk of the hazard.

HAZID formulates a list of hazards and generic hazardous situations by considering the following process characteristics:

- ✓ Impact of the facility to its surroundings
- ✓ Impact of the surroundings to the facility
- ✓ Interference between main units
- ✓ Location / orientation of plant and equipment
- ✓ Location / orientation of plant and equipment
- ✓ Unplanned releases for isolatable sections or units
- ✓ Environmental hazards and natural hazards.

As each hazardous situation is identified, the causes (threats), consequences, and threats control, recovery measures are listed.

For this study, safety analysis will be performed using selected items from the checklist of ISO 17776 standard for hazard categories and guidewords that lead to create a picture of hazardous situations and then to analyze and specify preventative/mitigation measures typical to the facilities under study. The checklist is presented in Appendix B. Brainstorming approach is an integral part of HAZID study, which is to be performed using a team composed of client, contractors, and subcontractors delegates and a HAZID Leader.

6.2 HAZID REPORTING FORMAT

Results of the HAZID study will be presented in a worksheet that tabulates the causes (threats), consequences, safeguards (Threat Control & Recovery Measures) and recommendations for each hazard identified. The method used for recording is full recording, i.e., all hazard hierarchy relevant to the context were considered and all operational issues or hazardous consequences were recorded along with any other outcome that may not raise a concern, for the sake of completeness and audit ability.

Where the existing safeguards are found to be inadequate for the hazard, recommendations will be raised. Therefore, from the worksheets it should be inferred that wherever the hazard has no recommendation, its corresponding safeguards are considered adequate.

Sample Format for HAZID worksheets

Section:

Hazard Category:

Guideword	Threats (Cause)	Consequences	Threat Control/Recovery Measures	Recommendations

7.0 HAZID STUDY OUTCOMES

A total of 16 recommendations were obtained that are shown in Appendix C. Recommendations are either closed type, i.e., they are final in their description, or open type, which means the final action depends on a study as clearly indicated in the recommendation. One shall note that all recommendations, open or closed, shall be followed up and finalized. Appendix D consists of detailed HAZID Worksheets of the study.

8.0 ATTACHMENTS

8.1 APPENDIX A –TEAM MEMBERS

First Name	Last Name	Company	Expertise
Fatemeh	Ghodsi	NISOC	Head of I&C
Sahar	Saba	NISOC	Process
Peyman	Sarvarian	NISOC	Mechanic
Mohammad	Khamisi	NISOC	HSE
Farid	Hedayat Rad	NISOC	Instrument
Hasan	Salari	NISOC	Process
Bahman	Zarei	NISOC	Maintenance
Ghasem	Shahrooei	NISOC	Engineering
Seyed Ali	Mousavi	Gachsaran NISOC	Process
Mohammad	Navid	Gachsaran NISOC	Production Engineer
Mohammad	Fakoor	PEDCO	Process Engineer
Farshid	Amiri	PEDCO	Process
Sepideh	Akbari	PEDCO	I&C Engineer
Sasan	Faramarzpour	PEDCO	Head of Process and Safety Department
Mehdi	Sadeghian	PEDCO	Surface Manager
Fereidoun	Noei	PEDCO	Process
Sadegh	Gharacheh	PEDCO	Process
Mohammad	Fakharian	Hirgan Energy	Project Manager
Masoud	Asgharnejad	Hirgan Energy	Engineering Manager
Mohsen	Aryafar	Hirgan Energy	Process
Parisa	Haji Sadeghi	Hirgan Energy	Head of I&C
Amir Hossein	Saber	Hirgan Energy	Process Safety
Faramarz	Mosayeb Nejad	Hirgan Energy	Piping
Farshad	Nourai	Consultant	HAZID Leader

8.1 APPENDIX B –HAZARD CATEGORIES (ISO 17776)

Hazard Category
1. Hydrocarbons
2. Refined Hydrocarbons
3. Other Flammable Materials
4. Hazards Associated with Difference in Height
5. Environmental Hazards
6. Dynamic Situation Hazards
7. Open Flame
8. Electricity
9. Toxic Gases
10. Entrapment

8.1 APPENDIX C – RECOMMENDATIONS LIST

Recommendations	Responsibility	Place(s) Used
1. Client insists on performing SIL verification on ESD system based on IEC 61511. Contractor justification for not performing SIL verification will be submitted to Client subsequently.	N-C	Consequences: 1.1.1.1
2. Ensure operators (end-user) to be present in the forthcoming 3D model review (90%).	N-C	Consequences: 1.1.3.1, 4.1.1.1
3. Consider LDAR program for operation phase.	N	Consequences: 1.1.4.1
4. Verify whether or not automatic fire alarm for transformers in electrical buildings in wellhead areas are provided.	C	Consequences: 2.2.1.1
5. Prepare a cost-benefit analysis (CBA) report for increasing safety of transformers in wellhead area by replacing LVS with MVS and its requirements, acc. to PACS and considering ALARP area requirements.	C	Consequences: 2.2.2.1
6. Study and report application and costs of providing F&G (H_2 and other detectors) acc. to PACS, regarding ALARP requirements and practical limitations and also referencing relevant SOW.	C	Consequences: 3.1.1.1, 8.2.1.2
7. Plan for development of environmental contingency plans incl. communication with local meteorological institute.	N	Consequences: 5.2.1.2, 8.1.1.2
8. Study application of latest water pollution minimization techniques and tools, including dispersant or anti-static agents and spill collection and containment equipment.	N	Consequences: 5.2.1.2
9. Provide sunshade for electrical motor of manifold area sump pump exposed to sunlight.	C	Consequences: 5.2.3.2
10. Develop a procedure for minimizing site work in times of extreme environmental conditions and provide adequate and appropriate PPE.	N	Consequences: 5.2.4.4
11. Include fire protection requirements for helipads at wellhead areas in Operating Manual.	C	Consequences: 6.2.1.1
12. In consultation with IRP vendor, consider separate discharge wells for electrical, lightning and instrumentation earthing systems with surge diverters.	C	Consequences: 8.1.1.1
13. Study application of RCPs in wellhead and manifold areas acc. to PACS and relevant SOW.	C	Consequences: 8.2.2.1
14. Ensure that armored LV cables, if any, are armored off and connected to earth system, as	C	Consequences: 8.2.3.1

Recommendations	Responsibility	Place(s) Used
required by PACS.		
15. Plan for improving process safety culture, and effectiveness of training incl. H_2S awareness, and enforcing appropriate PPE.	N	Consequences: 9.1.1.1, 9.1.2.1, 9.2.1.1, 10.1.1.1
16. Check and report whether or not electrical and instrument cable covers in the existing Manifold Area Control Building are low-smoke type, subject to availability of documents.	C	Consequences: 10.1.1.2

8.2 ATTACHMENT E – HAZID WORKSHEETS

Hazard Category: 1. Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. Gas and condensate	1. Leakage due to corrosion, erosion, or rupture due to TPD, etc.	1.1. Fire and explosion with possibility of injury/fatality	1	B	H	1.1.1. Material selection	3	C	M	1. Client insists on performing SIL verification on ESD system based on IEC 61511. Contractor justification for not performing SIL verification will be submitted to Client subsequently.	N-C
						1.1.2. Corrosion coupons and probes in manifold area					
						1.1.3. Corrosion allowance					
						1.1.4. Minimizing dead points and pockets in piping design					
						1.1.5. Drain connections at dead points					
						1.1.6. Maximum allowable fluid velocity to minimize erosion					
						1.1.7. Stone trap at wellhead area					
						1.1.8. Controlled entry of vehicles in wellhead area (fence) and manifold area					
						1.1.9. Access roads to flowlines have standard clearance to avoid TPD					
						1.1.10. Considerable					

Hazard Category: 1. Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
						thickness of the flow lines acc. to their pressure class in case of physical damage					
						1.1.11. In manifold area, maximum available space is used for clearance					
						1.1.12. Fail safe design of WHCP in case of rupture					
						1.1.13. Fusible plugs on X-mas trees in wellhead area that initiate wellhead shutdown through WHCP					
						1.1.14. Manual shut down through WHCP push buttons					
						1.1.15. Paving is provided instead of gravel to minimize probability of explosion upon gas leakage					
						1.1.16. Slope and open drain connection for					

Hazard Category: 1. Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
						collection and disposal of liquid leaks in X-mas tree cellar and peripheral area					
						1.1.17. Hazardous area classification					
						1.1.18. Portable and wheeled fire extinguishers and other necessary devices (fire shed for wellheads with IRP)					
						1.1.19. See also Entrapment category					
		1.2. Toxic release with possibility of fatality; see Toxic Gas category									
		1.3. Environmental pollution	2	B	H	1.3.1. Material selection	3	C	M		
						1.3.2. Corrosion coupons and probes in manifold area					
						1.3.3. Corrosion allowance					
						1.3.4. Minimizing dead points and pockets in piping design					
						1.3.5. Drain connections at					

Hazard Category: 1. Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
						dead points					
						1.3.6. Maximum allowable fluid velocity to minimize erosion					
						1.3.7. Stone trap at wellhead area					
						1.3.8. Controlled entry of vehicles in wellhead area (fence) and manifold area					
						1.3.9. Access roads to flowlines have standard clearance to avoid TPD					
						1.3.10. In manifold area, maximum available space is used for clearance					
						1.3.11. Fail safe design of WHCP in case of rupture					
						1.3.12. Manual shut down through WHCP push buttons					
						1.3.13. Slope and open drain connection for collection and disposal					

Hazard Category: 1. Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
						of liquid leaks in X-mas tree cellar and peripheral area					
		1.4. Loss of product, loss of production and damage to assets in case of fire/explosion, which also causes loss of reputation	2	B	H	1.4.1. Material selection	3	C	M		
						1.4.2. Corrosion coupons and probes in manifold area					
						1.4.3. Corrosion allowance					
						1.4.4. Minimizing dead points and pockets in piping design					
						1.4.5. Drain connections at dead points					
						1.4.6. Maximum allowable fluid velocity to minimize erosion					
						1.4.7. Stone trap at wellhead area					
						1.4.8. Controlled entry of vehicles in GCS					
						1.4.9. Controlled entry of vehicles in wellhead area (fence) and manifold area					
						1.4.10. Access roads to flowlines have					

Hazard Category: 1. Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
						standard clearance to avoid TPD					
						1.4.11. In manifold area, maximum available space is used for clearance					
						1.4.12. Fail safe design of WHCP in case of rupture					
						1.4.13. Manual shut down through WHCP push buttons					
	2. See also Environmental Hazards category										
	3. Bad Operation or Maintenance due to human error	3.1. Extreme process conditions or overload of equipment, also damage due to impact and similar events, which leads to leakage and fire/explosion or toxic release	2	C	S	3.1.1. Operating manual	3	D	M	2. Ensure operators (end-user) to be present in the forthcoming 3D model review (90%).	N-C
						3.1.2. Maintenance requirements are foreseen in plant layout					
						3.1.3. Training for the operation phase					
						3.1.4. Level of automation to minimize human error					

Hazard Category: 1. Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
		3.2. See also HAZOP Report									
	4. VOC	4.1. Personnel exposure may cause chronic health problems and also environmental problem	3	B	S	4.1.1. Operational controls like training and PPE	3	C	M	3. Consider LDAR program for operation phase.	N
	5. Damage to pipeline due to surge; see HAZOP Report										
	6. See also Toxic Gas category										
	7. Dispersion of HC vapors upon draining into Open Drain in routine operations										

Hazard Category: 2. Refined Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. Diesel Fuel for Emergency Generator (only in wellheads with IRP, which are also manned)	1. Leakage or spillage due to TPD	1.1. Environmental pollution due to soil contamination in case of spillage	3	B	S	1.1.1. Paved area	4	B	M		
		1.2. Small local fire in case of ignition	3	C	M	1.2.1. Portable and wheeled type fire extinguishers are provided	4	C	L		
2. Transformer Oil (only in wellheads with IRP, which are also manned)	1. Leakage due to corrosion, TPD, maloperation, etc.	1.1. Local fire with possibility of damage to transformer	4	C	L	1.1.1. Portable and wheeled fire extinguishers	4	C	L	4. Verify whether or not automatic fire alarm for transformers in electrical buildings in wellhead areas are provided.	C
	2. Transformer oil evaporation due to overcurrent	2.1. Severe damage to transformers	2	D	M	2.1.1. Buchholz relay and relief valve	3	D	M	5. Prepare a cost-benefit analysis (CBA) report for increasing safety of transformers in wellhead area by replacing LVS with MVS and its requirements, acc. to PACS and considering ALARP area requirements.	C
3. Hydraulic oil (WHCP)	1. Leakage due to TPD	1.1. Local fire with possibility of damage to	4	C	L	1.1.1. Portable and wheeled fire extinguishers 1.1.2. Fence is provided for	4	D	L		

Hazard Category: 2. Refined Hydrocarbons

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
		WHCP				WHCP					
						1.1.3. Tubing is protected by trays					
						1.1.4. Separate reservoir for return oil from SSSV in case of gas mixed with hydraulic oil					

Hazard Category: 3. Other Flammable Materials

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. Hydrogen in Battery Room in switchgear room in wellheads with IRP	1. Leakage in case of battery charging	1.1. Explosion and damage to Battery Room	2	B	H	1.1.1. Explosion-proof exhaust fan and other electrical devices for hydrogen service in Battery Room	3	D	M	6. Study and report application and costs of providing F&G (H_2 and other detectors) acc. to PACS, regarding ALARP requirements and practical limitations and also referencing relevant SOW.	C

Hazard Category: 4. Hazards Associated with Difference in Height

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. Personnel working at height or depth	1. Trip and fall	1.1. Personnel injury with possibility of fatality	1	C	H	1.1.1. Platforms for maintenance are provided with adequate floor, access stairway or ladders with appropriate fall protection and handrails	2	D	M	2. Ensure operators (end-user) to be present in the forthcoming 3D model review (90%).	N-C
						1.1.2. Monkey ladders for lighting fixtures					
						1.1.3. Access concrete stairway for wellhead cellars					
						1.1.4. Cages for monkey ladders on switchgear buildings, guard houses, potable water tank and diesel storage tank					
						1.1.5. Operational controls and PPE					
2. Overhead equipment and objects	1. Fall of load	1.1. Personnel injury with possibility of fatality, and also damage to equipment	1	C	H	1.1.1. Toe boards are provided on platforms in case of hand tools, etc.	2	D	M		
						1.1.2. Cross-over bridges on flow lines reduce impact from personnel movements					

Hazard Category: 5. Environmental Hazards

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. Tectonic	1. Natural disasters like earthquake or other earth movement	1.1. Damage to equipment and possible injury/fatality for personnel	1	B	H	1.1.1. Geotechnical study	3	C	M		
						1.1.2. Seismic design acc. to PACS					
						1.1.3. Operational controls like contingency plans, drills, etc.					
						1.1.4. For other safeguards, see Hydrocarbons category					
						1.1.5. For other safeguards, see Entrapment category					
		1.2. Possibility of spillage from flow lines or pipelines with subsequent pollution problems	2	B	H	1.2.1. For other safeguards, see Hydrocarbons category	3	C	M		
						1.2.2. Operational controls like contingency plans, drills, etc.					
2. Weather	1. Flood	1.1. Damage to flow lines and equipment due to flooding	2	C	S	1.1.1. Environmental design data	4	E	L		
						1.1.2. Ground slope, ditches and trenches lead to open drain for surface					

Hazard Category: 5. Environmental Hazards

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
						run-off					
						1.1.3. Area topology reduces likelihood of wellhead area flooding					
						1.1.4. Diversion channel					
						1.1.5. Flood control study based on hydrology survey results					
						1.1.6. Reinforced flow lines support for seasonal rivers in project area					
		1.2. Possibility of soil and water pollution	2	C	S	1.2.1. Surface run-off leads to Waste Pit OSBL, which accommodates annual rainfall statistics	4	D	L	7. Plan for development of environmental contingency plans incl. communication with local meteorological institute.	N
										8. Study application of latest water pollution minimization techniques and tools, including dispersant or anti-static agents and spill collection and containment equipment.	N
		1.3. Soil pollution in burn pit either by	4	E	L	1.3.1. Environmental design data	4	D	L		

Hazard Category: 5. Environmental Hazards

Hazard	Causes	Consequences	Risk Matrix S	L	RR	Safeguards	Risk Matrix S	L	RR	Recommendation	Resp.
		overflow in rain or penetration				1.3.2. Burn pit capacity					
	2. High winds, storm	2.1. Possibility of damage to plant equipment and injury to personnel	3	C	M	2.1.1. Environmental design data 2.1.2. Mechanical design for buildings and structures/piping	4	D	L		
	3. Temperature extremes	3.1. Interference in performance of instrumentation	2	B	H	3.1.1. Environmental design data 3.1.2. Sunshade for WHCP to avoid impact by sunlight 3.1.3. Electrical and control cables are either run in ducts or trays	3	C	M		
		3.2. Damage or performance reduction of sun-exposed electrical equipment	3	A	S	3.2.1. Environmental design data 3.2.2. Electrical cables are either run in ducts or trays	4	B	M	9. Provide sunshade for electrical motor of manifold area sump pump exposed to sunlight.	C
		3.3. Fatigue, injury and increased risk of human error in case of maintenance	3	A	S	3.3.1. Environmental design data 3.3.2. Operational controls and PPE	4	B	M		
		3.4. Reduced	2	B	H	3.4.1. Environmental design	4	C	L		

Hazard Category: 5. Environmental Hazards

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
		performance or damage to A/C equipment, which may reduce performance of indoor instrumentation and other equipment				data 3.4.2. Sunshade is provided for A/C equipment					
	4. Dust	4.1. Damage to electrical equipment, instrumentation/telecom equipment	2	B	H	4.1.1. Environmental design data 4.1.2. IP protection of instrumentation, telecom and electrical enclosures	3	C	M		
		4.2. Reduced performance of Diesel Generators	3	B	S	4.2.1. Environmental design data 4.2.2. Intake Air Filter for Emergency Diesel Generators 4.2.3. Emergency Diesel Generators operation is intermittent	4	C	L		
		4.3. Reduced quality of conditioned air and damage to	3	C	M	4.3.1. Environmental design data 4.3.2. Inspection &	3	C	M		

Hazard Category: 5. Environmental Hazards

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
		A/C Compressors				maintenance procedures					
		4.4. Personnel injury and health problems and increased possibility of human error	2	B	H	4.4.1. Environmental design data 4.4.2. Operational controls and PPE	2	C	S	10. Develop a procedure for minimizing site work in times of extreme environmental conditions and provide adequate and appropriate PPE.	N

Hazard Category: 6. Dynamic Situation Hazards

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. Vehicles in Wellheads/manifold Area	1. TPD	1.1. Leakage or spillage due to impact; see Hydrocarbons category for details [Note: No pipe racks in wellheads/manifold area]	2	C	S	1.1.1. Controlled entry of vehicles in wellhead area (fence) and manifold area 1.1.2. Access roads to flowlines have standard clearance to avoid TPD 1.1.3. In manifold area, maximum available space is used for clearance 1.1.4. Operational controls for in-site traffic	3	D	M		

Hazard Category: 6. Dynamic Situation Hazards

Hazard	Causes	Consequences	Risk Matrix S	Risk Matrix L	Risk Matrix RR	Safeguards	Risk Matrix S	Risk Matrix L	Risk Matrix RR	Recommendation	Resp.
						1.1.5. Safety signs, incl. traffic 1.1.6. For other safeguards, see Hydrocarbons category					
2. Helicopter at wellhead areas	1. Ground impact, especially during landing	1.1. Damage to helicopter and possibility of fire/explosion and personnel injury/fatality	1	D	S	1.1.1. Area lighting in wellheads with IRP 1.1.2. Helipad design based on Iranian ICAO guidelines	1	E	M	11. Include fire protection requirements for helipads at wellhead areas in Operating Manual.	C

Hazard Category: 7. Open Flame

Hazard	Causes	Consequences	Risk Matrix S	Risk Matrix L	Risk Matrix RR	Safeguards	Risk Matrix S	Risk Matrix L	Risk Matrix RR	Recommendation	Resp.
1. Burn Pit	1. Exposure of grass in nearby area	1.1. Fire and subsequent pollution and injury to personnel and fauna	4	C	L	1.1.1. Operational controls like regular inspection and removal of excess grass 1.1.2. Burn pit location and clearance acc. to standard drawings and requirements	4	C	L		

Hazard Category: 8. Electricity

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. Lightning Discharge	1. Local atmospheric conditions cause lightning strike	1.1. Damage to electrical equipment and instrumentation	1	B	H	1.1.1. Lightning arrester for wellhead areas with (electrical) IRP	3	D	M	12. In consultation with IRP vendor, consider separate discharge wells for electrical, lightning and instrumentation earthing systems with surge diverters.	C
		1.2. Personnel injury with possibility of fatality	1	C	H	1.2.1. Lightning arrester for wellhead areas with (electrical) IRP	3	D	M	7. Plan for development of environmental contingency plans incl. communication with local meteorological institute.	N
						1.2.2. Operational controls					
		1.3. Possibility of fire/explosion	1	B	H	1.3.1. Lightning arrester for wellhead areas with (electrical) IRP	3	D	M		
						1.3.2. For safeguards, see Hydrocarbons category					
2. Electrical equipment including but not limited to Diesel Generator, electric motor, panels, transformers,	1. Electrical fire and explosion (indoors/outdoors)	1.1. In case of outdoors, damage to electrical equipment, which can lead to loss of production	2	C	S	1.1.1. Protection relays	3	D	M		
						1.1.2. Electrical and control cables are either run in ducts or trays					
						1.1.3. Buried cables are less sensitive to damage by fire					
						1.1.4. In manifold area, ESD					

Hazard Category: 8. Electricity

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
AC/DC UPS, lighting towers and cables						cables are fire-resistant					
						1.1.5. Electrical and control cables are flame retardant, except for lighting towers					
						1.1.6. Fire protection in wellhead/manifold area in the form of ABC fire portable and wheeled extinguishers					
		1.2. In case of indoors, damage to electrical equipment; also, personnel injury with possibility of fatality	1	C	H	1.2.1. Protection relays	3	D	M	6. Study and report application and costs of providing F&G (H_2 and other detectors) acc. to PACS, regarding ALARP requirements and practical limitations and also referencing relevant SOW.	C
						1.2.2. ESD and F&G cables are fire-resistant in manifold area					
						1.2.3. Electrical and control cables are flame retardant in manifold area					
						1.2.4. Smoke and Heat-Smoke detectors in Manifold Area Control Room					
						1.2.5. Fire protection in Manifold Area Control Room and wellhead area buildings in the					

Hazard Category: 8. Electricity

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
						form of ABC fire extinguishers					
	2. Electrocution	2.1. Personnel injury with possibility of fatality	1	C	H	2.1.1. Earthing	3	D	M	13. Study application of RCPs in wellhead and manifold areas acc. to PACS and relevant SOW.	C
						2.1.2. Protection relays					
						2.1.3. Cable termination					
						2.1.4. Limited exposure in electrical panels					
						2.1.5. Personnel protection earth relays in electrical racks					
						2.1.6. Existing plant clinic					
	3. Induction	3.1. Interference in performance of instrumentation	2	C	S	3.1.1. Segregation between instrument and LV electrical cables	3	D	M	14. Ensure that armoured LV cables, if any, are armoured off and connected to earth system, as required by PACS.	C
						3.1.2. Instrument cables screen shields					
						3.1.3. 3-core arrangement for electrical cables					
						3.1.4. EMC level of instrumentation					
						3.1.5. Minimum safe distance between existing and new cables in case of crossings, to minimize EMC influence					

Hazard Category: 8. Electricity

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
	4. Power failure	4.1. Severe disturbance in production with risk of accidents, and also loss of production	1	A	H	4.1.1. Fail safe design of IRP pumps and ESD system at manifold area 4.1.2. 100% redundancy in power supply through Emergency Diesel Generators, which supports LV relays, emergency lighting and DC UPS at wellhead areas	3	D	M		
	5. Existing aerial HV line in case of crane operation; no major concern, as the line only crosses an access road and crane passes through the road in non-operational condition.										

Hazard Category: 9. Toxic Gases

Hazard	Causes	Consequences	Risk Matrix			Safeguards	Risk Matrix			Recommendation	Resp.
			S	L	RR		S	L	RR		
1. H_2S in Process Streams	1. Leakage	1.1. Personnel injury with possibility of fatality	1	C	H	1.1.1. Operational controls and PPE 1.1.2. Portable H_2S detector 1.1.3. For other safeguards, see Hydrocarbons category 1.1.4. Safety signs for H_2S service	2	D	M	15. Plan for improving process safety culture, and effectiveness of training incl. H_2S awareness, and enforcing appropriate PPE.	N
	2. Burn pit flame out	2.1. Personnel injury with possibility of fatality	1	C	H	2.1.1. Operational controls and PPE 2.1.2. Portable H_2S detector 2.1.3. For other safeguards, see Hydrocarbons category 2.1.4. Safety signs for H_2S service	2	D	M	15. Plan for improving process safety culture, and effectiveness of training incl. H_2S awareness, and enforcing appropriate PPE.	N
2. SO_2	1. Burn pit	1.1. Personnel exposure may cause health problems and also environmental problem	3	C	M	1.1.1. Safety signs for toxic service 1.1.2. Operational controls and PPE	3	C	M	15. Plan for improving process safety culture, and effectiveness of training incl. H_2S awareness, and enforcing appropriate PPE.	N

Hazard Category: 10. Entrapment

Hazard	Causes	Consequences	Risk Matrix S	L	RR	Safeguards	Risk Matrix S	L	RR	Recommendation	Resp.
1. Emergency Case	1. Limited access to escape routes	1.1. In case of accidents in manifold and wellheads areas, personnel injury with possibility of fatality	1	C	H	1.1.1. Portable H_2S detector 1.1.2. Escape routes with safety signs 1.1.3. Wind sock 1.1.4. Escape mask as regular PPE (not regularly used) 1.1.5. SCBA 1.1.6. Photo-luminescent escape route signs in process area 1.1.7. For other safeguards, see Hydrocarbons category 1.1.8. For other safeguards, see Environment category	2	C	S	15. Plan for improving process safety culture, and effectiveness of training incl. H_2S awareness, and enforcing appropriate PPE.	N
		1.2. In case of accidents inside Manifold Area Control Building, personnel injury with possibility of fatality	1	C	H	1.2.1. Relatively small size of Manifold Area Control Building means quick access to exit door 1.2.2. For other safeguards, see Electricity category	2	C	S	16. Check and report whether or not electrical and instrument cable covers in the existing Manifold Area Control Building are low-smoke type, subject to availability of documents.	C