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طرح نگهداشت و افزایش تولید 27 مخزن

CALCULATION NOTE FOR FIRE WATER DEMAND

نگهداشت و افزایش تولید میدان نفتی بینک



D04	NOV. 2022	AFD	A.H.Saber	M.Fakharian	M.Mehrshad	
D03	AUG. 2022	IFA	A.H.Saber	M.Fakharian	M.Mehrshad	
D02	MAY. 2022	IFA	A.H.Saber	M.Fakharian	M.Mehrshad	
D01	JAN. 2022	IFA	A.H.Saber	M.Fakharian	M.Mehrshad	
D00	DEC. 2021	IFC	E.Sadeghi	M.Fakharian	M.Mehrshad	
Rev.	Date	Purpose of Issue/Status	Prepared by:	Checked by:	Approved by:	CLIENT Approval

Class: 2

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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

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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.

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2.0 SCOPE

The design of the fire water system should be such so as to enable the fire to be extinguished whilst cooling adjacent equipment, in order to avoid escalation of the incident.

3.0 NORMATIVE REFERENCES

3.1 CODES AND STANDARDS

- IPS-E-SF-220 Fire Water Distribution and Storage Facilities
- API-RP 2030 Application of Fixed Water Spray Systems for Fire Protection in the Petroleum and Petrochemical Industries
- TOTAL GS-EP-SAF-322 Fixed firewater system
- NFPA 15 Standard for water spray fixed systems for fire protection

3.2 THE PROJECT DOCUMENTS



- BK-GNRL-PEDCO-000-SA-SP-0003 Specification For Fire Water System

3.3 ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No. BK-GNRL-PECO-000-PR-DB-0001".

3.4 ABBREVIATION

AFP	Active Fire Protection
ALARP	As Low As Reasonably Practicable
F&G	Fire & Gas
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HSE	Health, Environment and Safety
ISBL	Inside Boundary Limit
OSBL	Outside Boundary Limit
PFP	Passive Fire Protection
SIL	Safety Integrity Level
CGD	Catalytic Gas Detectors
IRGD	Infrared Gas Detectors

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4.0 CALCULATION BASIS

The firefighting system shall be designed on the basis of only one major fire at a time.

No simultaneous occurrence of fire either at the single or the area more than single shall be considered.

The fire water demand has been determined based on the largest fire water out of the respective area requirement in the process area or building.

The maximum fire water demand is assumed as the sum of following:

- Fire water demand for the simultaneous operation of one water monitors and two hydrants,
- Water spray demand for the protection of pumps, drums and/or compressors areas to be protected.

In the process area, water spray system application rate as per IPS-E-SF-220 are as following:

- 10.2 Lpm/m² for the un-insulated surface of process equipment such as(column, tower, vessel...)
- 20.4 Lpm/m² for pumps that handle flammable liquids.

But there is no clear guideline in IPS-E-SF-220 for compressor application rate. It is recommended NFPA 15 & TOTAL GS-EP-SAF-322 to be used as reference standard for deluge spray rate on compressor area.

The system shall cover the compressor casing, associated piping and valving, gearbox, lube oil console and other auxiliary equipment and Application rate shall be considered 20.4 lit/min/m².

So based on that and as per project data sheet:

- For gas compressor (foundation area +1.5 m outskirt) application rate shall be 20.4 lit/min/m².

According to API-RP-2030:

Hydrant is able to deliver fire water flow minimum 1000 LPM and flow capacity of monitor is not less than 2000 LPM.

10% safety factor for hydraulic imbalance and size extension is considered.

Floor area including 1.5 m outskirt around the compressor foundation shall be covered by water spray. Protection to include the compressor casing, associated piping and valving the gear box and the lube oil console.



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Table 1—Water Spray Application Rates for Exposed Surface Area

Consult the indicated section in text or reference for more detailed information to expand on summary data in table.

Item	Section in API 2030 or Other Indicated Reference	Application Rate: Gallons per Minute per Square Foot	Application Rate: Liters per Minute per Square Meter
Application Rates for General Exposure Protection			
General Exposure Protection	7.2.1	0.10 – 0.25	4.1 – 10.2
Application Rates for Control of Burning			
Control of Burning <i>Varies with Application Scenario</i>	7.2.2	0.50 – 0.20	20.4 – 8.2
Application Rates for Extinguishment— <i>see note 4</i>			
Extinguishment			
Combustible Solid	7.2.3	0.15 – 0.30	6.1 – 12.2
Combustible Liquid	7.2.3	0.35 – 0.50	14.6 – 20.4
Flammable Liquid	7.2.3	(May not be desirable or possible; see text)	
Exposure Protection Application Rates for Specific Equipment & Structures			
Air-fin coolers— <i>see note 1</i>	7.3.4	0.25	10.2
Atmospheric Storage Tanks	7.3.13	0.10–0	4.1–0
Compressors—General	7.3.6	0.25	10.2
—in Buildings	7.3.6	0.30	12.2
Cooling Towers	7.3.10; NFPA 214	0.15 – 0.50	6.1 – 20.4
Fired heater supports	7.3.9	0.25	10.2
LPG loading racks	7.3.11	0.25	10.2
Motors	7.3.8	0.25	10.2
Pipe Racks— <i>see note 2</i>	7.3.2	0.25	10.2
Pressurized storage tanks	7.3.5: API Std 2510 & Publ 2510A		
Radiant Exposure	7.3.5 (distance related)	0 – 0.10	0 – 4.1
Non-pressure Impingement	7.3.5 (design related)	0.25 basic minimum <i>see note 3</i>	10.2 basic minimum <i>see note 3</i>
Pressure Impingement	7.3.5; prefer direct 250 to 500 gpm fire water stream at point of impingement	0.50 minimum plus firewater stream	20.4 minimum plus firewater stream
Process Buildings & Structure	7.3.14; NFPA 13		
Primary		0.30	12.2
Supplemental		0.15	6.1
Pressure Vessels, Exchangers & Towers— <i>see note 3</i>	7.3.5	0.25	10.2
Pumps	7.3.1	0.50	20.4
Transformers	7.3.3	0.25	10.2
Turbines—General	7.3.7	0.25	10.2
—In Buildings	(7.3.6)	0.30	12.2
Well Heads	7.3.12	0.50	20.4



Values from Table 1 are intended for use by fire protection engineering personnel in conjunction with the explanatory material in the text and references.

Note 1: While NFPA 15 does not specifically address air-fin heat exchangers it recommends a minimum of 0.25 gpm/ft² (10.2 lpm/m²) for protection of vessels (7.4.2) and piping (7.4.3.7). Where the temperature of the of the vessel or its contents should be limited, higher application rates may be required (NFPA 15 7.4.2)

Note 2: Water spray density for the upper level of multilevel pipe racks can be reduced in accordance with NFPA 15 7.4.3.7.3

Note 3: Rate of 0.25 gpm/ft² [10.2 lpm/m²] is the basic minimum but rates between 0.25 and 0.15 gpm/ft² [10.2 and 6.1 lpm/m²] may be used where supported by relevant engineering data, or documented experience, or where other protective measures have been taken.

Note 4: Rates should be established by review of relevant test data for the specific materials (NFPA 15 7.2)

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5.0 CALCULATIONS

Hydrant/monitors are fed by firewater pumps for cooling and firefighting purpose during emergency cases. In addition deluge spray system will be used on compressor and suction drum areas to cool the surface of equipment to prevent any overpressure inside them.

All process area is considered as one fire zone which divided to four separate sub-deluge zones.

Each compressor set are located in sufficient distances from each other which prevent the escalation of fire into other compressor areas. So the mentioned distances divides each compressor set to separate sub-deluge zones.

Slug catcher Drum, Slug pumps, and Inlet Knock out Drum are considered as one sub-deluge zone.

Maximum fire water demand can be seen in below Tables:





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Table 1 Fire water Demand Calculation

Fire Water Demand Calculation for Water Spray System (BINAK)											
Equipment No.	Equipment Name	Location	Diameter Width (m)	Length (m)	Height (m)	Surface to be protected (m ²)	Design Density (Lpm/m ²)	Spray Water Demand (Lpm)	Line Size (Inch)	DV Size (Inch)	Remark
Compressor Area-compressor Shelter 1											
C-2101 & 2102 A	COMPRESSOR PACKAGE (STAGE 1 & 2)	Under Shelter	5.00	10		104.00	20.4	2121.60			
V-2101 A	1st STAGE SUCTION SCRUBBER	At Site-Vertical	1.20	3		12.43	10.2	126.83			
V-2102 A	2nd STAGE SUCTION SCRUBBER	At Site-Vertical	1.00	2.8		9.58	10.2	97.69			
	Subtotal							2580.73	4.93	6	Safety factor=10%
	Monitors	At Site					2000	2000.00			1
	Hydrants	At Site					1000	2000.00			2
	Total							6580.73			394.84
Compressor Area-compressor Shelter 2											
C-2101 & 2102 B	COMPRESSOR PACKAGE (STAGE 1 & 2)	Under Shelter	5.00	10		104.00	20.4	2121.60			
V-2101 B	1st STAGE SUCTION SCRUBBER	At Site-Vertical	1.20	3		12.43	10.2	126.83			
V-2102 B	2nd STAGE SUCTION SCRUBBER	At Site-Vertical	1.00	2.8		9.58	10.2	97.69			
	Subtotal							2580.73	4.93	6	Safety factor=10%
	Monitors	At Site					2000	2000.00			1
	Hydrants	At Site					1000	2000.00			2
	Total							6580.73			394.84
Compressor Area-compressor Shelter 3											
C-2101 & 2102 C	COMPRESSOR PACKAGE (STAGE 1 & 2)	Under Shelter	5.00	10		104.00	20.4	2121.60			
V-2101 C	1st STAGE SUCTION SCRUBBER	At Site-Vertical	1.20	3		12.43	10.2	126.83			
V-2102 C	2nd STAGE SUCTION SCRUBBER	At Site-Vertical	1.00	2.8		9.58	10.2	97.69			
V-2103	2nd Stage Gas Compression Discharge Drum	At Site-Vertical	1.00	2.6		8.95	10.2	91.28			
	Subtotal							2681.14	5.02	6	Safety factor=10%
	Monitors	At Site					2000	2000.00			1
	Hydrants	At Site					1000	2000.00			2
	Total							6681.14			400.87

	<p>نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>																									
شماره پیمان: 053 - 073 - 9184	<table><tr><th colspan="8">CALCULATION NOTE FOR FIRE WATER DEMAND</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادرکننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>D04</td><td>0002</td><td>CN</td><td>SA</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table>	CALCULATION NOTE FOR FIRE WATER DEMAND								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	D04	0002	CN	SA	120	PEDCO	GCS	BK	شماره صفحه : 10 از 13
CALCULATION NOTE FOR FIRE WATER DEMAND																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه																			
D04	0002	CN	SA	120	PEDCO	GCS	BK																			

Fire Water Demand Calculation for Water Spray System (BINAK)											
Equipment No.	Equipment Name	Location	Diameter Width (m)	Length (m)	Height (m)	Surface to be protected (m ²)	Design Density (Lpm/m ²)	Spray Water Demand (Lpm)	Line Size (Inch)	DV Size (Inch)	Remark
Slug Catcher Area											
V-2104	Slug Catcher Drum	At Site-Horizontal	3.60	10.5		139.04	10.2	1418.20			
V-2105	Inlet Knock Out Drum	At Site-Vertical	1.10	3.2		12.95	10.2	132.12			
P-2101 A/B	Slug Pumps	At Site	3	3		35.28	20.4	719.71	2270.03		
	Subtotal							2497.03	4.85	4	Safety factor=10%
	Monitors	At Site					2000	2000.00			1
	Hydrants	At Site					1000	2000.00			2
	Total							6497.03			389.82

*Calculated demands are based on equipment preliminary sizes and will be finalized according to Vendor Data.



	<p>نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>								
شماره پیمان: 053 – 073 – 9184	CALCULATION NOTE FOR FIRE WATER DEMAND								شماره صفحه : 11 از 13
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	
	BK	GCS	PEDCO	120	SA	CN	0002	D04	

5.1 DELUGE SYSTEM CALCULATION

The deviation between theoretical and hydraulic calculation for deluge system can be seen in table below:

Table 2 Deluge system calculation

DV-No.	Theoretical Flow Rate Calculated (LPM)	Hydraulic Flow Rate Calculated (LPM)	Total Deviation
DV-2301	2270	2407	6%
DV-2302	2347	2459	4.7 %
DV-2303	2347	2459	4.7 %
DV-2304	2437	2496	2.4%

	<p>نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض</p> <p>احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک</p>																									
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CALCULATION NOTE FOR FIRE WATER DEMAND																										
پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	GCS	PEDCO	120	SA	CN	0002	D04																			

5.2 NOZZLE CALCULATION



The details of spray nozzles for each deluge valve and related covered equipment based on fire water demand calculation can be seen in table below:

Table 3 Nozzle details

DV-No.	Size (Inch)	Covered Equipment No.	No. of Nozzle	K Factor	Q (LPM)
DV-2301	4	V-2104	24	35	60
		V-2105	6	18	30
		P-2101 A/B	8	51	90
DV-2302	6	C-2101 & 2102 A	18	64	118
		V-2101 A	2	35	64
		V-2102 A	2	30	48.9
DV-2303	6	C-2101 & 2102 B	18	64	118
		V-2101 B	2	35	64
		V-2102 B	2	30	48.9
DV-2304	6	C-2101 & 2102 C	18	64	118
		V-2101 C	2	35	64
		V-2102 C	2	26	48.9
		V-2103	2	26	48.9

6.0 CONCLUSIONS

As the result of maximum fire water demand as listed before, the largest fire water demand rate is 6681.14 Lpm (401 m³/h) and created by Compressor Area (compressor Shelter 3 Area). Fire water will be supplied by two identical fire pumps; each pump shall be capable of supplying the 100% fire water demand (401 m³/h). fire water pumps shall be located in a safe area. The main fire water

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CALCULATION NOTE FOR FIRE WATER DEMAND																										
پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	GCS	PEDCO	120	SA	CN	0002	D04																			

pump shall be driven by an electric pump with one backup pumps powered by diesel. Firewater pumps rates as per NFPA 20 will be 7570 LPM (454.2 m3/hr).

Firewater will be provided by two firewater storage tanks for duration of 4 hours for hydrant /Monitors and also deluge spray system. Working capacity of fire water tanks based on IPS-E-SF-220 is 60% total required fire water capacity .with consideration of above philosophy:

Max demand firewater system= 401 M³/hr

Required Firewater for 4 hours = 401 X 4 = 1603 m³

Tank Capacities = 60% Total capacity= 962 M³

Firewater tank standard capacities based on IPS-E-SF-220 will be 1135.50 m³.

7.0 ATTACHMENTS

Attachment1. Calculation Note Fire Water Demand

Attachment2. Firewater Tank Capacity