|  |
| --- |
| **طرح نگهداشت و افزایش تولید 27 مخزن** |
| **Fire Water Hydraulic Calculation Note****نگهداشت و افزایش تولید میدان نفتی بینک** |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| D01 | OCT. 2022 | IFA | A.H.Saber | M.Fakharian | M.Mehrshad |  |
| D00 | MAY. 2022 | IFC | A.H.Saber | M.Fakharian | M.Mehrshad |  |
| **Rev.** | **Date** | **Purpose of Issue/Status** | **Prepared by:** | **Checked by:** | **Approved by:** | **CLIENT Approval** |
| **Class: 2** | **CLIENT Doc. Number: F0Z-708988** |
| **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**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |  | **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |
| **1** | X | X |  |  |  | **66** |  |  |  |  |  |
| **2** | X | X |  |  |  | **67** |  |  |  |  |  |
| **3** | X |  |  |  |  | **68** |  |  |  |  |  |
| **4** | X |  |  |  |  | **69** |  |  |  |  |  |
| **5** | X |  |  |  |  | **70** |  |  |  |  |  |
| **6** | X | X |  |  |  | **71** |  |  |  |  |  |
| **7** | X | X |  |  |  | **72** |  |  |  |  |  |
| **8** | X | X |  |  |  | **73** |  |  |  |  |  |
| **9** | X | X |  |  |  | **74** |  |  |  |  |  |
| **10** | X | X |  |  |  | **75** |  |  |  |  |  |
| **11** |  |  |  |  |  | **76** |  |  |  |  |  |
| **12** |  |  |  |  |  | **77** |  |  |  |  |  |
| **13** |  |  |  |  |  | **78** |  |  |  |  |  |
| **14** |  |  |  |  |  | **79** |  |  |  |  |  |
| **15** |  |  |  |  |  | **80** |  |  |  |  |  |
| **16** |  |  |  |  |  | **81** |  |  |  |  |  |
| **17** |  |  |  |  |  | **82** |  |  |  |  |  |
| **18** |  |  |  |  |  | **83** |  |  |  |  |  |
| **19** |  |  |  |  |  | **84** |  |  |  |  |  |
| **20** |  |  |  |  |  | **85** |  |  |  |  |  |
| **21** |  |  |  |  |  | **86** |  |  |  |  |  |
| **22** |  |  |  |  |  | **87** |  |  |  |  |  |
| **23** |  |  |  |  |  | **88** |  |  |  |  |  |
| **24** |  |  |  |  |  | **89** |  |  |  |  |  |
| **25** |  |  |  |  |  | **90** |  |  |  |  |  |
| **26** |  |  |  |  |  | **91** |  |  |  |  |  |
| **27** |  |  |  |  |  | **92** |  |  |  |  |  |
| **28** |  |  |  |  |  | **93** |  |  |  |  |  |
| **29** |  |  |  |  |  | **94** |  |  |  |  |  |
| **30** |  |  |  |  |  | **95** |  |  |  |  |  |
| **31** |  |  |  |  |  | **96** |  |  |  |  |  |
| **32** |  |  |  |  |  | **97** |  |  |  |  |  |
| **33** |  |  |  |  |  | **98** |  |  |  |  |  |
| **34** |  |  |  |  |  | **99** |  |  |  |  |  |
| **35** |  |  |  |  |  | **100** |  |  |  |  |  |
| **36** |  |  |  |  |  | **101** |  |  |  |  |  |
| **37** |  |  |  |  |  | **102** |  |  |  |  |  |
| **38** |  |  |  |  |  | **103** |  |  |  |  |  |
| **39** |  |  |  |  |  | **104** |  |  |  |  |  |
| **40** |  |  |  |  |  | **105** |  |  |  |  |  |
| **41** |  |  |  |  |  | **106** |  |  |  |  |  |
| **42** |  |  |  |  |  | **107** |  |  |  |  |  |
| **43** |  |  |  |  |  | **108** |  |  |  |  |  |
| **44** |  |  |  |  |  | **109** |  |  |  |  |  |
| **45** |  |  |  |  |  | **110** |  |  |  |  |  |
| **46** |  |  |  |  |  | **111** |  |  |  |  |  |
| **47** |  |  |  |  |  | **112** |  |  |  |  |  |
| **48** |  |  |  |  |  | **113** |  |  |  |  |  |
| **49** |  |  |  |  |  | **114** |  |  |  |  |  |
| **50** |  |  |  |  |  | **115** |  |  |  |  |  |
| **51** |  |  |  |  |  | **116** |  |  |  |  |  |
| **52** |  |  |  |  |  | **117** |  |  |  |  |  |
| **53** |  |  |  |  |  | **118** |  |  |  |  |  |
| **54** |  |  |  |  |  | **119** |  |  |  |  |  |
| **55** |  |  |  |  |  | **120** |  |  |  |  |  |
| **56** |  |  |  |  |  | **121** |  |  |  |  |  |
| **57** |  |  |  |  |  | **122** |  |  |  |  |  |
| **58** |  |  |  |  |  | **123** |  |  |  |  |  |
| **59** |  |  |  |  |  | **124** |  |  |  |  |  |
| **60** |  |  |  |  |  | **125** |  |  |  |  |  |
| **61** |  |  |  |  |  | **126** |  |  |  |  |  |
| **62** |  |  |  |  |  | **127** |  |  |  |  |  |
| **63** |  |  |  |  |  | **128** |  |  |  |  |  |
| **64** |  |  |  |  |  | **129** |  |  |  |  |  |

**CONTENTS**

[1.0 INTRODUCTION 4](#_Toc103416585)

[2.0 Scope 5](#_Toc103416586)

[3.0 NORMATIVE REFERENCES 5](#_Toc103416587)

[3.1 Codes and Standards 5](#_Toc103416588)

[3.2 The Project Documents 5](#_Toc103416589)

[3.3 ENVIRONMENTAL DATA 5](#_Toc103416590)

[3.4 abbreviation 5](#_Toc103416591)

[4.0 Metodology 6](#_Toc103416592)

[5.0 HYDRAULIC CALCULATION 6](#_Toc103416593)

[5.1 Calculation Software 6](#_Toc103416594)

[5.2 PIPENETModel and Input Data 6](#_Toc103416595)

[5.3 Scenarios 7](#_Toc103416596)

[6.0 CALCULATION RESULTS 7](#_Toc103416597)

[6.1 Scenario 1 – Calculate the ring size and fire water pumps discharge presuure based on maximum firewater demand scenarios 7](#_Toc103416598)

[6.2 Scenario 2 – Calculate THE fire water pumps discharge presuure based on maximum firewater demand scenarios with A strategic blocked pipe 8](#_Toc103416599)

[6.3 Scenario 3 – Calculate the size of each deluge line based on calculated Most remote nozzle calculation 8](#_Toc103416600)

[7.0 CONCLUSION 9](#_Toc103416601)

[8.0 ATTACHMENTS 10](#_Toc103416602)

1. **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 Fcilities; 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. |

1. **Scope**

The purpose of this calculation document is to establish the hydraulic performance and fire equipment capacities for the new Fire water systems associated with the Construction of Gas Compressor station Equipment.

1. **NORMATIVE REFERENCES**

## Codes and Standards

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

## The Project Documents

* BK-GCS-PEDCO-120-SA-DB-0001 Active Fire Protection and Safety Concept
* BK-GCS-PEDCO-120-SA-CN-0002 Calculation Note For Fire Water Demand
* BK-GCS-PEDCO-120-SA-PY-0001 Fire Water Network Layout

## ENVIRONMENTAL DATA

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

## 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  |

1. **Metodology**

Demand (flow and pressure) were established as per Calculation Note For Fire Water Demand to Doc. NO. BK-GCS-PEDCO-120-SA-CN-0002.

The following methodology is followed for the hydraulics calculations for verification of the adequacy of the specified performance requirements of the firewater system.

* Generate/select various fire water demand scenarios.
* Select the proper firewater pump
1. **HYDRAULIC CALCULATION**

## Calculation Software

The hydraulic calculations are performed by software PIPENET VISION Spray/Sprinkler Module, Version 1.8.

## PIPENETModel and Input Data

This section provides details of input/assumption utilized for the hydraulic calculations by software PIPENET VISION Spray/Sprinkler Module.

**Piping Data:** ANSI B36.10 Sch.40, C factor = 120,

D01

Design maximum velocity (Main lines & headers) = 3.5 m/sec

Standard valves and fittings equivalent length: PIPENET built-in data as per NFPA standard

Firewater Medium: Raw water

Density = 1030 kg/m3 @15°C

Viscosity = 0.001 Pas.

Details of pipe fittings and valves present on the pipe sections, node elevations, pipe lengths and pipe configuration will be later based on piping isometrics generated from the 3D-Model. This assumption will be thus updated once isometrics are available for the network piping.

Friction losses within the system are calculated by PIPENET using the Hazen-Williams equation.

## Scenarios

Firewater will be fed from 1 x 100% firewater pumps based on the result of firewater demand report with capacity of 454.2 m3/hr.

Below scenarios should be studied in this report to calculate the required pressure of firewater pump, ring, deluge valve and also size of the ring and other facilities. For this purpose:

1. Ring main should be studied for maximum demand of flow rate to calculate the size of ring main and deluge valve feed lines. For this case two additional conditions should be studied if the ring main is broken in some areas.
2. Calculation implemented to design the required pressure at discharge of the firewater pump.
3. Deluge valve will be studied for the size of deluge lines according to most remote nozzle required flow rate.
4. **CALCULATION RESULTS**

## Scenario 1 – Calculate the ring size and fire water pumps discharge presuure based on maximum firewater demand scenarios

The following table reflects the required pressured at fire water pumps discharge header, size of ring main and other facilities based on PIPENET hydraulic calculation results (see attached Appendices).

Table 1: Firewater ring main size and fire water pumps discharge header pressure based on PIPENET calculation without any blocked pipe section in fire water network

D01

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fire Scenario Description** | **Required****Flow Rate (lpm)****Note 1** | **Minimum Required Pressure at users (barg)- Note 2** | **Calculated Maximum ring size ( inch)** | **Calculated Pressure at Fire Water Pump Discharge Header (barg)** |
| Fire in Most Remote Point of Fire Water Network, without any blocked pipe section in fire water network | 6496 | 10 | 10 | 10.33 |

1. Based on Calculation Note For Fire Water Demand, BK-GCS-PEDCO-120-SA-CN-0002
2. At the inlet flange of firefighting equipment (hydrant valve) – based on IPS-E-SF-220

As per NFPA-20, the suction and discharge size of each firewater pump with capacity of 454.2 m3/hr is 10”.

Hydrant is 4” and hydrant/monitor is 6” based on standards and also NISOC recommendations.

Based on the above calculated sizes, pressure at discharge of firewater pumps will be as the result of scenario 2.

## Scenario 2 – Calculate THE fire water pumps discharge presuure based on maximum firewater demand scenarios with A strategic blocked pipe

The following table reflects the summary of firewater pump pressure based on PIPENET hydraulic calculation results (see attached Appendices).

Table 2: Firewater ring main size and fire water pumps discharge header pressure based on PIPENET calculation with a strategic blocked pipe

D01

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fire Scenario Description** | **Required****Flow Rate (lpm)****Note 1** | **Minimum Required Pressure at users (barg)- Note 2** | **Strategic Blocked Pipe Label** | **Calculated Pressure at Fire Water Pump Discharge Header (barg)** |
| Fire in Most Remote Point of Fire Water Network, with a strategic blocked pipe section in fire water network | 2000 | 10 | 23 | 10.29 |

1. Based on firewater demand
2. At the inlet flange of firefighting equipment (hydrant valve) – based on IPS-E-SF-220

D01

As per result, discharge pressure of firewater pump in case of maximum firewater demand at farthest point will be 10.29 barg.

## Scenario 3 – Calculate the size of each deluge line based on calculated Most remote nozzle calculation

The following table reflects the sizes of deluge valve spray lines and required pressure in downstream of each deluge valve based on PIPENET hydraulic calculation results (see attached Appendices).

Table 3: Deluge line sizes and pressure based on PIPENET calculation

D01

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Deluge Name** | **Pressure in inlet of DV (barg) Note 1** | **DV Size****Note 2** | **Size of DV****Lines (inch)** | **Required Pressure in DV down stream** | **Spray Nozzles K-factor** |
| **DV-2301** | 10.4 - 11.4 | 4 | 4 | 5.7 | 183551 |
| **DV-2302** | 10.4 - 11.4 | 6 | 4 | 5.6 | 643530 |
| **DV-2303** | 10.4 - 11.4 | 6 | 4 | 5.6 | 643530 |
| **DV-2304** | 10.4 - 11.4 | 6 | 4 | 5 | 643526 |

1. Based on Hydraulic calculation report
2. Based on Calculation Note For Fire Water Demand, BK-GCS-PEDCO-120-SA-CN-0002
3. **CONCLUSION**

Based on the result, firewater pumps should deliver flow of 6496 LPM @ 10.33 barg at the discharge tie-in of pumps to cater maximum firewater demand on the plant.

With considering of 10 barg pressure on farthest hydrant, minimum required pressure will be 10.33 barg at the firewater pump discharge to cater required firewater demand on the plant.

As per NFPA-20, the suction and discharge size of firewater pumps with capacity of 454.2 m3/hr is 10”. In addition, based on standard and considering of the above calculation results, pump discharge header and ring main sizes will be considered 10”.

Table 3 shows the Deluge Valve size and also Deluge line sizes and pressure. Deluge sprays should be provided with K factors according to table 3. (Data should be confirmed by deluge valve vendor)

Hydrant is 4” and hydrant/monitor is 6” based on standards and also NISOC recommendations.

1. **ATTACHMENTS**

**Att.1: FIRE WATER NETWORK HYDRAULIC CALCULATION**

## Att. 1.1:

* FWHC-Most Remote Point-Normal, Calculation Report

## Att. 1.2:

* FWHC-Most Remote Point-Block, Calculation Report

**Att.2: DELUGE SYSTEMS HYDRAULIC CALCULATION**

D01

**Att.2.1:**

* DV-2301, Calculation Report

**Att.2.2:**

* DV-2302, Calculation Report

**Att.2.3:**

* DV-2303, Calculation Report

**Att.2.4:**

* DV-2304, Calculation Report