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| **طرح نگهداشت و افزایش تولید 27 مخزن** |
| **CALCULATION NOTE FOR LINE SIZING** **نگهداشت و افزایش تولید میدان نفتی بینک** |
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**REVISION RECORD SHEET**

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| **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |  | **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |
| **1** | X | X | X | X |  | **66** |  |  |  |  |  |
| **2** | X | X | X | X |  | **67** |  |  |  |  |  |
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| **10** |  |  |  |  |  | **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** |  |  |  |  |  |
| **65** |  |  |  |  |  | **130** |  |  |  |  |  |

**CONTENTS**

[1.0 INTRODUCTION 4](#_Toc92194862)

[2.0 Scope 5](#_Toc92194863)

[3.0 NORMATIVE REFERENCES 5](#_Toc92194864)

[3.1 Local Codes and Standards 5](#_Toc92194865)

[3.2 International Codes and Standards 5](#_Toc92194866)

[3.3 The Project Documents 5](#_Toc92194867)

[3.4 ENVIRONMENTAL DATA 5](#_Toc92194868)

[3.5 Order of Precedence 5](#_Toc92194869)

[4.0 Line sizing criteria 6](#_Toc92194870)

[4.1 LIQUID LINES design crieria 6](#_Toc92194871)

[5.0 Basic Formulae Used for Line Sizing 7](#_Toc92194872)

[6.0 Gas Line Design Criteria 8](#_Toc92194873)

[7.0 Two Phase Line Design Criteria 8](#_Toc92194874)

[8.0 Line Sizing Results 9](#_Toc92194875)

[9.0 Software 9](#_Toc92194876)

[10.0 RESULT 9](#_Toc92194877)

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.

|  |  |
| --- | --- |
| COMPANY:  | National Iranian South Oilfields Company (NISOC)  |
| PROJECT: | Binak Oilfield Development – Surface Facilities; New Gas Compressor Station |
| EPD/EPC CONTRACTOR:  | 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 COMPANY (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 COMPANY rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR. |
| MAY:  | Is used where a provision is completely discretionary. |

1. **Scope**

This document covers minimum necessary requirements for the design, selection, manufacture,
inspection, testing and delivery of BINAK.

It shall be used in conjunction with data/requisition sheets for present document subject.

1. **NORMATIVE REFERENCES**

## Local Codes and Standards

* IPS-E-PR-440 Engineering Standard for Process Design of piping system

## International Codes and Standards

* ASTM American Society for Testing Materials Relevant Parts

## The Project Documents

* BK-GNRAL-PEDCO-000-PR-DB-0001 Process Basis of Design
* BK-GNRAL-PEDCO-000-PR-DC-0001 Process Design Criteria
* BK-GCS-PEDCO-120-PR-PF-0001 PFD
* BK-GCS-PEDCO-120-PR-PI-0002~0014 P&IDs

## ENVIRONMENTAL DATA

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

## Order of Precedence

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

1. **Line sizing criteria**

## LIQUID LINES design crieria

For liquid single phase the pressure drop and velocity limitation is as following table:

|  | **DP(bar/km)** | **Max. Velocity (m/s)** |
| --- | --- | --- |
| **Norm.** | **Max.** | **To 2”** | **3” to 6”** | **8”to18”** | **From 20”** |
| Pump suction |  |  |
| Liquid at bubble point/ with dissolved gas | 0.6 | 0.9 | 0.6 | 0.9 | 1.2 | 1.5 |
| Non boiling liquid | 2.3 | 3.5 | 0.9 | 1.2 | 1.5 | 1.8 |
| Unit lines |  |  |  |
| - Liquid at bubble point/ with dissolved gas | 0.6 | 1.0 | 0.6 | 1.0 | 1.4 | 1.8 |
| - Non boiling liquid | 2.3 | 3.5 | 0.9 | 1.2 | 1.8 | 2.4 |
| Pump discharge (1) |  |  |  |
| - Disch. Pres.<=50 barg | 3.5 | 4.5 | 1.5 to 4.5 | 6.0 |
| - Disch. Pres.> 50 barg | 7.0 | 9.0 | 1.5 to 4.5 | 6.0 |
| Gravity flow |  |  | 0.25 | 0.45 | 0.6 | 0.6 |
| Cooling & service water |  |  |  |
| - Large feeders between pumps and units | 1.5 |  | 1.5 to 3.0 m/s |
| - Unit lines (long)- Unit lines (short) |  | 1.53.5 | 1.51.5 | 2.52.5 | 3.03.0 | 3.03.0 |

Note 1: 3.0 m/s maximum (2 m/s average) at storage tank inlet or in loading.

1. **Basic Formulae Used for Line Sizing**
* **Friction Factor**





* **Pressure Drop**

Darcy-Weisbach Equation



1. **Gas Line Design Criteria**

For gas single phase the pressure drop and velocity limitation is as following table:

| **SERVICE** | ρv2 Maxi(Pa) | **ΔP****(Norm./Max)****(bar/km)** |
| --- | --- | --- |
| - Single phase |  | Max=3.5 |
|  |  | p≤20barg | 6000 |  |
|  |  | 20<p<50barg | 7500 |
|  |  | 50<p<80barg | 10000 |
|  |  | p≥80barg | 15000 |
|  |  |  |  |
|  | - Compressor Suction | Same as Single Phase in Continuous Operation | 0.2/0.7 |
|  | - Compressor Discharge | 0.45/1.15 |

* Roughness factor for piping is assumed as commercial steel pipe which is 0.05 mm.
* Relief valve inlet and outlet lines shall be sized based on the requirements in API RP 520.
* Pressure drop in the PSV inlet line shall not exceed 3% of the set pressure based on the rated capacity of the valve
* V Max value shall be consistent with the ρv2 criteria used for general gas lines design.
* Velocity shall be limited in the range given in annex1 (identical to guide book 4.4.1 “piping”,chap.II,graph II.2)depending on compressor type
1. **Two Phase Line Design Criteria**

The following guidelines are recommended in sizing the lines with two phase lines:

High velocity in two phase lines can cause rapid wear by erosion, hence the calculated velocity shall not exceed the erosion velocity (the velocity at which erosion may occur).

The erosion velocity is calculated by the formula given in API RP 14E as:



Ve: erosional velocity in m/s

: Gas/liquid mixture density at flowing conditions in kg/m3

The multiphase mixture density  can be determined by the following equation:

$$ρ\_{m}=\frac{m\_{m}}{\frac{m\_{L}}{ρ\_{L}}+ \frac{m\_{G}}{ρ\_{G}}} $$

Where:

m m :total mass flow rate, kg/sec $(m\_{m}=m\_{L}+m\_{G} )$

m L :liquid mass flow rate, kg/sec

m G :Gas mass flow rate, kg/sec

C: empirical constant equal to 122.045 to 152.556 for continuous flow. “C” value up to 244 can be considered on peak flow rate only in case of absence of abrasive (solid) particles such as sand.

It is widely accepted in the industry that above simple criterion is inadequate, where it is for clean service (non-corrosive and sand free) and the limits should be reduced if sand and the limits should be reduced if sand or corrosive conditions are present.

Alternatively the mixture density can be determined from the HYSYS simulation program.

1. **Line Sizing Results**

All Two phase, gas and liquid line sizing was performed according to the above design criteria and the result is shown on Attachment 01.

1. **Software**

For the purpose of calculating line sizes and pressure drops the following software shall be used:

* Aspen Hysys 11
* In house Line Calculation Spreadsheet.

D03

1. **RESULT**

Please find Attachment-01