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| **طرح نگهداشت و افزایش تولید 27 مخزن** | | | | | | |
| **PIPELINE WALL THICKNESS CALCULATION**  **نگهداشت و افزایش تولید میدان نفتی بینک** | | | | | | |
| D04 | SEP. 2023 | AFD | M.NOORI | M.Fakharian | S.Faramarzpour |  |
| D03 | OCT. 2022 | AFD | M.NOORI | M.Fakharian | M.Mehrshad |  |
| D02 | AUG. 2022 | AFD | F.Mosayebnejad | M.Fakharian | M.Mehrshad |  |
| D01 | DEC. 2021 | IFA | H.Shahrokhi | M.Fakharian | M.Mehrshad |  |
| D00 | OCT. 2021 | IFC | H.Shahrokhi | M.Fakharian | M.Mehrshad |  |
| **Rev.** | **Date** | **Purpose of Issue/Status** | **Prepared by:** | **Checked by:** | **Approved by:** | **CLIENT Approval** |
| **Class: 2** | | **CLIENT Doc. Number: F0Z-707363** | | | | |
| **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** |  | **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |
| **1** | **x** | **x** | **x** | **x** | **x** | **66** |  |  |  |  |  |
| **2** | **x** | **x** | **x** | **x** | **x** | **67** |  |  |  |  |  |
| **3** | **x** |  |  |  |  | **68** |  |  |  |  |  |
| **4** | **x** |  |  |  |  | **69** |  |  |  |  |  |
| **5** | **x** | **x** |  |  |  | **70** |  |  |  |  |  |
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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, construction of well location, access roads, wellhead facilities for 6 new wells (with electric power supply for 2 of them) and required modifications on 4 workover wells (with electric power supply) shall be done. In addition, construction of 6 new flowlines from new wells 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 New Well Locations, Modifications on Workover Wells, Wellhead Facilities, Electrification Facilities, Flowlines 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. |

1. **Scope**

This document covers the wall thickness calculation for Binak 6 new wellheads and flow lines based on IPS standard (IPS-E-PI-140), ASME B 31.4 and ASME B 31.8.

1. **NORMATIVE REFERENCES**

The latest edition of following codes & standards are applicable in this project (unless otherwise):

## Local Codes and Standards

* IPS-E-PI-140 Engineering Standard for Onshore Transportation

Pipelines

* IPS-M-PI-190 Material and Equipment Standard for Line Pipe
* NOSIC-S4L8001-001D 3000 API Rating Production Wellhead Fittings-6”
* NOSIC-S4L8004-001C 3000 Bangestan Production Wellhead Fittings-6”
* NOSIC-S5L-9002-0010 5000API/3000 API Oil Well Production Wellhead Fittings 6”

## International Codes and Standards

* ASTM American Society for Testing Materials Relevant Parts
* API 5L Specification for Line Pipe
* ASME B31.8 Gas Transmission and Distribution Piping Systems
* ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids Unified screw threads
* ASME B 36.10 Welded and Seamless Wrought Steel Pipe
* NACE MR 0175-ISO 15156 Petroleum and Natural Gas Industries. Materials for use in H2S Containing Environments in Oil and Gas Production

## The Project Documents

* BK-SSGRL-PEDCO-110-PL-RT-0001 Pipeline Corrosion Study & Material Selection Report
* BK-GNRAL-PEDCO-000-PR-DB-0001 Process Basis of Design
* BK-GNRAL-PEDCO-000-PL-DC-0001 Pipeline Design Criteria
* BK-SSGRL-PEDCO-110-PL-SP-0001 Pipeline Material Specification

## 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 requirements specified herein & the requirements of any other referenced document, this subject shall be reflected to CLIENT and the final decision will be made by CLIENT.

1. **GENERAL**

Candidate material for pipeline as per Corrosion Study & Material Selection Report (with Doc. No. BK-SSGRL-PEDCO-110-PL-RT-0001) is carbon steel with 3 mm corrosion allowance. This document presents the calculation procedure of carbon steel pipeline wall thickness.

The types, size, length, operating & design pressure and temperature and service condition of pipelines (according to process documents such as Process Basis of Design with Doc. No. BK-GNRAL-PEDCO-000-PR-DB-0001, Pipeline Design Criteria with Doc. No. BK-GNRAL-PEDCO-000-PL-DC-0001) are as following tables.

1. **CALCULATION NOTE & design data**

## General

The required thickness of straight sections of pipe shall be determined in accordance with Eq. (2) tm = t + c

## Nomenclature

**tm:** Minimum required thickness, including mechanical, corrosion, and erosion allowances

* **t** Calculated Wall Thickness (in)
* **ts** Selected Wall Thickness (in)
* **P** Design Pressure (psig)
* **D** Nominal Pipe Diameter (in)
* **SMYS** Specified Minimum Yield Strength (psi) (as per appendix D)
* **F** Design Factor (as per Table 841.1.6-2)
* **E** Longitudinal Joint Efficiency (as per Table 841.1.7-1)
* **T** Temperature Derating Factor (as per Table 841.1.8-1)
* **C** Corrosion & Erosion Allowance (in)

## Calculation Formula

Calculation of pres. design THK. for straight pipe requires special consideration of factors such as theory of failure, effects of fatigue, and thermal stress.

Tm = [(P x D) / (2SMYS x FET)] + C

1. **Line SERVICE INDEX**

| **Class** | **Rating** | **Base**  **Material** | **C.A**  **(mm)** | **Design**  **Code** | **Design Temp. (°C)** | **Design Pressure (psig)** | **Fluid** | **Symbol** | **State** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Face** | **Max.** | **Max.** |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Flowline** | | | | | | | | | |
| LN15 | API 3000 | C.S | 3 | ASME B31.4 | 85 | 1035 | Crude Oil | CRD | Liquid |
| RTJ |

1. **thickness calculation**

* **For Pipeline**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Piping Class** | **Material** | **Design**  **PRESS.**  **<P> (Psig)** | | **Design**  **TEMP.**  **(deg. C)** | | | **Corrosion**  **Allowance**  **<C>(mm)** | | | **Specific Min. Yield**  **<S> (Psi)** | | **Design Factor**  **<F>** | **Welding Factor**  **<E>** |
| **LN15** | **API 5L-B**  **PSL 2 for <2”** | **1035** | | **85** | | | **3** | | | **35000** | | **0.72** | **1.00** |
| **API 5L-X52 PSL 2 for ≥2”** | **52000** | |
| CALCULATING PROCEDURE BY ASME B31.4 | | | | | | | | | |  |  |  |  |
|  |  | | |  | |  | | where ; | | | | | |
|  | P ×D | |  | |  | | | | tm = minimum required thickness (mm) | | | | |
| t = | ---------------------- | |  | |  | | | | t = calculated thickness (mm) | | | | |
|  | 2 ×S ×0.72 ×E ×T | |  | |  | | | | C = corrosion allowance (mm) | | | | |
|  |  | |  | |  | | | | P = design pressure (Psig) | | | | |
| tm = | t + C | | |  | |  | | D = outside diameter (mm) | | | | | |
|  |  | | |  | |  | | S = specific minimum yield strength (Psi) | | | | | |
|  |  | | |  | |  | | E = Weld Joint Factor | | | | | |
|  |  | | |  | |  | | F = design factor  T = Temperature Derating Factor = 1 | | | | | |
| NPS | PIPE O.D. | | | CALCULATED THICKNESS | | | | | | | | SELECTED  WALL THICK. (mm) | |
| Inch | <D> (mm) | | | t (mm) | | | | | | tm (mm) | |
| 1/2 | 21.3 | | | 0.43 | | | | | | 3.43 | | Sch. 80 | |
| 3/4 | 26.7 | | | 0.55 | | | | | | 3.55 | | Sch. 80 | |
| 1 | 33.4 | | | 0.68 | | | | | | 3.68 | | Sch. 80 | |
| 1 1/2 | 48.3 | | | 0.99 | | | | | | 3.99 | | Sch. 80 | |
| 2 | 60.3 | | | 0.83 | | | | | | 3.83 | | Sch. 40 | |
| 3 | 88.9 | | | 1.22 | | | | | | 4.22 | | Sch. 40 | |
| 4 | 114.3 | | | 1.57 | | | | | | 4.57 | | Sch. 40 | |
| 6 | 168.3 | | | 2.33 | | | | | | 5.33 | | 7.9 mm **(Note 1)** | |

**Note 1:**

Final thickness of flowlines will be 7.9mm. So considering design pressure of 1035 psi (Approved by NISOC), the actual corrosion allowance would be 5~5.5 mm which is sufficient for the corrosion calculations.

* **For Crossings**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Piping Class** | **Material** | **Design**  **PRESS.**  **<P> (Psig)** | | **Design**  **TEMP.**  **(deg. C)** | | | **Corrosion**  **Allowance**  **<C>(mm)** | | | **Specific Min. Yield**  **<S> (Psi)** | | **Design Factor**  **<F>** | **Welding Factor**  **<E>** |
| **LN15** | **API 5L-B**  **PSL 2 for <2”** | **1035** | | **85** | | | **3** | | | **35000** | | **0.6** | **1.00** |
| **API 5L-X52 PSL 2 for ≥2”** | **52000** | |
| CALCULATING PROCEDURE BY ASME B31.4 | | | | | | | | | |  |  |  |  |
|  |  | | |  | |  | | where ; | | | | | |
|  | P ×D | |  | |  | | | | tm = minimum required thickness (mm) | | | | |
| t = | ---------------------- | |  | |  | | | | t = calculated thickness (mm) | | | | |
|  | 2 ×S ×0.6 ×E ×T | |  | |  | | | | C = corrosion allowance (mm) | | | | |
|  |  | |  | |  | | | | P = design pressure (Psig) | | | | |
| tm = | t + C | | |  | |  | | D = outside diameter (mm) | | | | | |
|  |  | | |  | |  | | S = specific minimum yield strength (Psi) | | | | | |
|  |  | | |  | |  | | E = Weld Joint Factor | | | | | |
|  |  | | |  | |  | | F = design factor  T = Temperature Derating Factor = 1 | | | | | |
| NPS | PIPE O.D. | | | CALCULATED THICKNESS | | | | | | | | SELECTED  WALL THICK. (mm) | |
| Inch | <D> (mm) | | | t (mm) | | | | | | tm (mm) | |
| 1/2 | 21.3 | | | 0.52 | | | | | | 3.52 | | Sch. 80 | |
| 3/4 | 26.7 | | | 0.66 | | | | | | 3.66 | | Sch. 80 | |
| 1 | 33.4 | | | 0.82 | | | | | | 3.82 | | Sch. 80 | |
| 1 1/2 | 48.3 | | | 1.19 | | | | | | 4.19 | | Sch. 80 | |
| 2 | 60.3 | | | 1.00 | | | | | | 4.00 | | Sch. 80 | |
| 3 | 88.9 | | | 1.47 | | | | | | 4.47 | | Sch. 40 | |
| 4 | 114.3 | | | 1.90 | | | | | | 4.90 | | Sch. 40 | |
| 6 | 168.3 | | | 2.79 | | | | | | 5.79 | | 7.9 mm **(Note 1)** | |

**Note 1:**

Final thickness of flowlines will be 7.9mm. So considering design pressure of 1035 psi (Approved by NISOC), the actual corrosion allowance would be 5~5.5 mm which is sufficient for the corrosion calculations.