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شماره پیمان: ۰۵۳ - ۰۷۳ - ۹۱۸۴	<table><tr><th colspan="8">PIPING WALL THICKNESS CALCULATION</th></tr><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>SSGRL</td><td>PEDCO</td><td>110</td><td>PI</td><td>CN</td><td>0001</td><td>D02</td></tr></table>	PIPING WALL THICKNESS CALCULATION								پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	SSGRL	PEDCO	110	PI	CN	0001	D02	شماره صفحه : ۱ از ۱۱
PIPING WALL THICKNESS CALCULATION																										
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	SSGRL	PEDCO	110	PI	CN	0001	D02																			

طرح نگهداشت و افزایش تولید ۲۷ مخزن

PIPING WALL THICKNESS CALCULATION

نگهداشت و افزایش تولید میدان نفتی بینک



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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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شماره پیمان:	PIPING WALL THICKNESS CALCULATION							شماره صفحه: ۲ از ۱۱	
۰۵۳ - ۰۷۳ - ۹۱۸۴	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	SSGRL	PEDCO	110	PI	CN	0001		D02

REVISION RECORD SHEET

PAGE	D00	D01	D02	D03	D04
1	X	X	X		
2	X	X	X		
3	X				
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PAGE	D00	D01	D02	D03	D04
66					
67					
68					
69					
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	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>فعالیت های رو زمینی در بسته های کاری تحت الارض</p> <p>عمومی و مشترک</p>																									
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PIPING WALL THICKNESS CALCULATION																										
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	SSGRL	PEDCO	110	PI	CN	0001	D02																			

TABLE OF CONTENTS

1.0 INTRODUCTION.....	4
2.0 SCOPE	5
3.0 NORMATIVE REFERENCES	5
4.0 ABBREVIATIONS	7
5.0 DESIGN.....	8
6.0 GENERAL TESTING REQUIRMENTS.....	10
7.0 APPENDIXES	10

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>فعالیت های روزمینی در بسته های کاری تحت الارض</p> <p>عمومی و مشترک</p>							
شماره پیمان: ۰۵۳ - ۰۷۳ - ۹۱۸۴	PIPING WALL THICKNESS CALCULATION							شماره صفحه : ۴ از ۱۱
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	SSGRL	PEDCO	110	PI	CN	0001	D02

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 CLIENT (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.

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شماره پیمان:	PIPING WALL THICKNESS CALCULATION							شماره صفحه : ۵ از ۱۱	
۰۵۳ - ۰۷۳ - ۹۱۸۴	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	SSGRL	PEDCO	110	PI	CN	0001		D02

2.0 SCOPE

This specification covers the wall thickness calculation for BINAK new wellhead facilities and manifold extension.



3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

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

3.2 INTERNATIONAL CODES AND STANDARDS

- ASME B16.5 Pipe Flanges and Flanged Fitting
- ASME B16.47 Large Diameter Steel Flanges
- ASME B31.3 Process Piping
- ASME B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
- ASME B31.8 Gas Transmission and Distribution Piping Systems
- ASME B36.10 Welded and Seamless Wrought Steel Pipe
- ASME B36.19 Stainless Steel Pipe
- ASTM A105/A105M Carbon Steel Forgings for Piping Applications
- ASTM A106/A106M Seamless Carbon Steel Pipe for High-Temperature Service
- ASTM A153/A153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A182/A182M Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- ASTM A216/A216M Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
- ASTM A234/A234M Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- ASTM A240/A240M Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- ASTM A312/A312M Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- ASTM A320/A320M Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
- ASTM A333/A333M Seamless and Welded Steel Pipe for Low-Temperature Service

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شماره پیمان:	PIPING WALL THICKNESS CALCULATION							شماره صفحه: ۶ از ۱۱	
۰۵۳ - ۰۷۳ - ۹۱۸۴	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	SSGRL	PEDCO	110	PI	CN	0001		D02



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|-------------------------|--|
| • ASTM A350/A350M | Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components |
| • ASTM A351/A351M | Castings, Austenitic, for Pressure-Containing Parts |
| • ASTM A352/A352M | Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts, Suitable for Low-Temperature Service |
| • ASTM A358/A358M | Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications |
| • ASTM A403/A403M | Wrought Austenitic Stainless Steel Piping Fittings |
| • ASTM A420/A420M | Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service |
| • ASTM A516/A516M | Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| • ASTM A671/A671M | Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures |
| • ASTM A694/A694M | Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service |
| • ASTM A860/A860M | Wrought High-Strength Ferritic Steel Butt-Welding Fittings |
| • ASTM B148 | Aluminum-Bronze Sand Castings |
| • API 5L | Specification for Line Pipe |
| • MSS SP-6 | Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings |
| • NACE MR0175-ISO 15156 | Petroleum and Natural Gas Industries-Materials for Use in H2S-Containing Environments in Oil and Gas Production |

3.3 THE PROJECT DOCUMENTS

- BK-SSGRL-PEDCO-110-PI-RT-0001 Piping Corrosion Study & Material Selection Report
- BK-SSGRL-PEDCO-110-PI-SP-0001 Piping Material Specification

3.4 ENVIRONMENTAL DATA

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



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شماره پیمان: ۰۵۳ - ۰۷۳ - ۹۱۸۴	PIPING WALL THICKNESS CALCULATION								شماره صفحه: ۷ از ۱۱
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	
	BK	SSGRL	PEDCO	110	PI	CN	0001	D02	

3.5 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.

4.0 ABBREVIATIONS

AFC	Approved For Construction
AFD	Approved For Design
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Material
CL	Class
Cr	Chromium
C.S.	Carbon Steel
EFW	Electric Fusion Welded
FF	Flat Faced
Gr.	Grade
HIC	Hydrogen-Induced Cracking
L.T.C.S.	Low Temperature Carbon Steel
MSS	Manufacturers Standardization Society
NPS	Nominal Pipe Size
PWHT	Post Weld Heat Treatment
RF	Raised Face
RTJ	Ring Type Joint
SAW	Submerged Arc Welding
SCH.	Schedule
SMLS	Seamless
SMYS	Specified Minimum Yield Strength
S.S.	Stainless Steel
STD	Standard
THK	Thickness

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شماره پیمان: ۰۵۳ - ۰۷۳ - ۹۱۸۴	PIPING WALL THICKNESS CALCULATION							شماره صفحه : ۸ از ۱۱	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	SSGRL	PEDCO	110	PI	CN	0001	D02	

5.0 DESIGN

5.1 DEFINITION AND TERMINOLOGY

5.1.1 CA

Corrosion Allowance (based on Piping Material Specification and Corrosion Study)

5.1.2 DESIGN LIMITS

Design Pressure / Design Temperature limits given in piping classes (based on Piping Material Specification) and are applied in Wall Thickness Calculation Table

5.2 PIPING WALL THICKNESS CALCULATIONS

5.2.1 GENERAL

Based on ASME Codes for Pressure Piping Systems B31, there are three main different codes which are applicable in this project regard to Wall Thickness Calculation as follow.

5.2.2 PIPES WHICH ARE SUBJECTED TO REQUIREMENTS OF ASME B31.3

This codes deals with the pipes that are typically found in Petrochemical, Oil refineries, Gas Plants, Cryogenic Plants and related terminals.

Pressure Design of Pipes

Piping wall thickness calculation process follows the following formula:

$$t_{mil} = t_m / ((100-M)/100) = t_m / 0.875$$

$$t_m = t + c$$

Where:

t_{mil} = Calculated wall thickness considering Mill Tolerance



M= Mill Tolerance=12.5

t_m = Minimum required thickness including mechanical, corrosion, and erosion allowances.

C = Sum of mechanical allowances (groove and thread depth) plus corrosion and erosion allowances.

T = The minimum thickness, for the pipe selected considering manufacturer's minus tolerance shall be not less than t_m

t = Pressure designed thickness calculated as following formula if $t < D/6$

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شماره پیمان: ۰۵۳ - ۰۷۳ - ۹۱۸۴	<table><tr><th colspan="8">PIPING WALL THICKNESS CALCULATION</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>SSGRL</td><td>PEDCO</td><td>110</td><td>PI</td><td>CN</td><td>0001</td><td>D02</td></tr></table>	PIPING WALL THICKNESS CALCULATION								پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	SSGRL	PEDCO	110	PI	CN	0001	D02	شماره صفحه : ۹ از ۱۱
PIPING WALL THICKNESS CALCULATION																										
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	SSGRL	PEDCO	110	PI	CN	0001	D02																			

$$t = \frac{PD}{2(SEW + PY)}$$

Where:

P = Internal Design Gauge Pressure. The design pressure of each component in a piping system shall be not less than the pressure at the most severe condition of coincident internal or external pressure and temperature (minimum or maximum) expected during service.

D = Outside Diameter of Pipe

S = Stress Value for Material from Table A-1 of ASME B31.3 code.

Stress value is indicated in that table as Basic Allowable Stress at metal Temperature. This value can easily be extracted with base of material and design metal temperature.



E = Quality Factor, A factor deals with the manufacturing (Cast, Welded, Seamless) of the components. The factors can be extracted from table A-1A for components manufactured by casting method and Table A-1B for the components manufactured by welding or seamless methods. According to the project specification casting method cannot be used for piping components except valves. So the factor E is extracted only from Table A-1B.

W = Weld Joint Strength Reduction Factor. That says welded joint strength may decrease during operation because of the temperature. This factor can be extracted from Table-302.3.5 of ASME B31.3.

Y = Coefficient Value deals with the effect of dimension on a component. That can be extracted from Table 304.1.1 of ASME B31.3 if $t < D/6$.

For $t \geq D/6$

$$Y = \frac{d+2c}{D+d+2c}$$

 NISOC	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>فعالیت های روزمینی در بسته های کاری تحت الارض</p> <p>عمومی و مشترک</p>								
شماره پیمان:	PIPING WALL THICKNESS CALCULATION							شماره صفحه : ۱۰ از ۱۱	
۰۵۳ - ۰۷۳ - ۹۱۸۴	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	SSGRL	PEDCO	110	PI	CN	0001		D02

5.2.3 PIPES WHICH ARE SUBJECTED TO REQUIREMENTS OF ASME B31.4 AND IPS-E-PI-140

This code deals with the Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids Unified screw threads.

The required thickness of straight sections of pipe shall be determined in accordance with $t_m = t + c$

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

$$t_m = [(P \times D) / (2SMYS \times FET)] + C3$$

where;

t_m = minimum required thickness (mm)

t = calculated thickness (mm)

C = corrosion allowance (mm)

P = design pressure (Psig)

D = outside diameter (mm)

S = specific minimum yield strength (Psi)

E = Weld Joint Factor

F = design factor



T = Temperature Derating Factor = 1

6.0 GENERAL TESTING REQUIRMENTS

6.1 Pressure testing of the following piping shall be in accordance with ASME B31.3 test procedures. The test pressure shall be held for a sufficient time to allow detection of any leaks and for a minimum time of 1 hour.

a) Metallic piping including carbon steel, lined carbon steel, stainless steel, corrosion resistant alloys and ductile iron but excluding copper shall normally be tested at 1.5 x the design pressure.

7.0 APPENDIXES

	<p>نگهداشت و افزایش تولید میدان نفتی بینک</p> <p>فعالیت های رو زمینی در بسته های کاری تحت الارض</p> <p>عمومی و مشترک</p>																									
شماره پیمان: ۰۵۳ - ۰۷۳ - ۹۱۸۴	<table><tr><th colspan="8">PIPING WALL THICKNESS CALCULATION</th></tr><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>D02</td><td>0001</td><td>CN</td><td>PI</td><td>110</td><td>PEDCO</td><td>SSGRL</td><td>BK</td></tr></table>	PIPING WALL THICKNESS CALCULATION								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	D02	0001	CN	PI	110	PEDCO	SSGRL	BK	شماره صفحه : ۱۱ از ۱۱
PIPING WALL THICKNESS CALCULATION																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
D02	0001	CN	PI	110	PEDCO	SSGRL	BK																			

APPENDIX 1

PIPING WALL THICKNESS CALCUALATION NOTE