طرح نگهداشت و افزایش تولید 27 مخزن

CALCULATION NOTE FOR PSV SIZING

نگهداشت و افزایش تولید میدان نفتی بینک

Rev.	Date	Purpose of Issue/Status	Prepared by:	Checked by:	Approved by:	CLIENT Approval
D08	FEB.2024	AFD	M.Aryafar	M.Fakharian	S.Faramarzpour	
D07	JUL.2023	AFD	M.Aryafar	M.Fakharian	A.M.Mohseni	
D06	MAY.2023	IFA	M.Aryafar	M.Fakharian	A.M.Mohseni	
D05	APR.2023	IFA	M.Aryafar	M.Fakharian	M.Mehrshad	
D04	DEC.2022	IFA	M.Aryafar	M.Fakharian	M.Mehrshad	
D03	OCT.2022	IFA	M.Aryafar	M.Fakharian	M.Mehrshad	
D02	APR.2022	IFA	M.Aryafar	M.Fakharian	M.Mehrshad	
D01	JAN.2022	IFA	M.Aryafar	M.Fakharian	M.Mehrshad	
D00	SEP.2021	IFC	M.Aryafar	M.Fakharian	Sh.Ghalikar	

Class: 2 **CLIENT Doc. Number:** F0Z-708742

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

NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک	شرکت توسعه پتروایران HIRGAN ENERGY

شماره پیمان:	CALCULATION NOTE FOR PSV SIZING								شماره صفحه : 2 از 14
053 – 073 – 9184	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	
	BK	GCS	PEDCO	120	PR	CN	0004	D08	

REVISION RECORD SHEET

PAGE	D00	D01	D02	D03	D04	D05	D06	D07	D08
1	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X
3	X								
4	X								
5	X	X	X						
6	X	X	X						
7	X	X	X						
8	X	X							
9	X		X						
10	X								
11	X								
12	X		X	X	X	X	X		X
13	X		X	X	X	X			
14	X		X	X	X	X			
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									
63									
64									
65									

PAGE	D00	D01	D02	D03	D04	D05	D06	D07	D08
66									
67									
68									
69									
70									
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									
95									
96									
97									
98									
99									
100									
101									
102									
103									
104									
105									
106									
107									
108									
109									
110									
111									
112									
113									
114									
115									
116									
117									
118									
119									
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									

CONTENTS

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.

2.0 SCOPE

The scope of this document is to provide sizing calculation of Pressure Safety Valves's of BINAK New GCS unit.

3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

- IPS-E-PR-450 — Process Design Of Pressure Relieving systems inclusive safety relief valves
- IPS-E-PR-460 — Process Design Of Flare And Blowdown Systems

3.2 INTERNATIONAL CODES AND STANDARDS

- API-STD-520 — Sizing, Selection and Installation of Pressure Relieving Devices in Refineries, Part 1-Sizing and Selection
- API-STD-521 — Pressure Relieving and Depressuring Systems
- API-STD-526 — Flanged Steel Pressure Relief Valves

3.3 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 — Process Flow Diagram (PFD)
- BK-GCS-PEDCO-120-PR-PI-0002~25 — Piping & Instrumentation Diagram

3.4 ENVIRONMENTAL DATA

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

4.0 PSV SIZING

Following two over pressure scenarios are recognized for Kashan gas compressor station, which PSV's are considered to protect relevant equipments & pipings against pressure increasing.

- FIRE (UNWETTED)
- FIRE (WETTED)
- BLOCKED OUTLET

4.1 FIRE; EXTERNAL FIRE ON THE UNWETTED SURFACE OF VESSEL

According to API 521 2007, The discharge areas for pressure-relief devices on vessels containing super-critical fluids, gases or vapors exposed to open fires can be estimated using Equation 1.

$$A = \frac{F' \cdot A'}{\sqrt{p_1}} \qquad (1)$$

Where

A is the effective discharge area of the valve, expressed in SI units (square inches);

A′ is the exposed surface area of the vessel, expressed in SI units (square feet);

P1 is the upstream relieving absolute pressure, expressed in SI units (psi);

NOTE: p1 is the set pressure plus the allowable overpressure plus the atmospheric pressure.

F′ can be determined using Equation (2). If calculated using Equation (2) and the result is less than 0,01, then use a recommended minimum value of F′ =0,01. If insufficient information is available to use Equation (2), then use F′ =0,045.

$$F' = \frac{0{,}1406}{C \cdot K_D}\left[\frac{(T_w - T_1)^{1{,}25}}{T_1^{0{,}6506}}\right] \qquad (2)$$

Where

KD is the coefficient of discharge (obtainable from the valve manufacturer);

NOTE: A KD value of 0.975 is typically used for preliminary sizing of pressure-relief valves (see API RP 520-1 or ISO 4126).

Tw is the recommended maximum wall temperature of vessel material

T1 is the gas absolute temperature, at the upstream relieving pressure, determined from Equation (4), expressed in °R.

C is given by Equation (3):

$$C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}} \quad (3)$$

Where

k is the specific heat ratio (Cp/Cv) of gas or vapor at relieving conditions;

$$T_1 = \frac{p_1}{p_n} \cdot T_n \quad (4)$$

where

pn is the normal operating gas absolute pressure, expressed in SI units (psi);

Tn is the normal operating gas absolute temperature, expressed in SI units (°R).

The recommended maximum vessel wall temperature, Tw, for the usual carbon steel plate materials is 593 °C (1 100 °F).

The relief load, qm, relief, expressed in pounds per hour, can be calculated from equation (5)

$$q_{m,relief} = 0,1406\sqrt{M \cdot p_1}\left[\frac{A'(T_w - T_1)^{1,25}}{T_1^{1,1506}}\right] \quad (5)$$

Where M is the relative molecular mass of the gas.

4.2 FIRE; EXTERNAL FIRE ON THE WETTED SURFACE OF VESSEL

The amount of heat absorbed by a vessel exposed to an open fire is markedly affected by the type of fuel feeding the fire, the degree to which the vessel is envel-oped by the flames (a function of vessel size and shape), and fireproofing measures.

Adequate drainage is necessary to control the spread of major spills from one area to another and to control surface drainage and refinery waste water. This can be accomplished by the strategic

use of sewers and trenches with adequate capacity and/or by using the natural slope of the land.

Where adequate drainage and firefighting equipment do not exist, Equation 6 should be used

$$Q = 34{,}500FA^{0.82} \quad (6)$$

Qtotal: heat absorption (input) to the wetted surface (BTU/hr)

F: Environment factor. (Values for various types of installation are shown in Table 5 API 521)

A: Total wetted surface, in square feet (see 3.15.1.1 and Table 4 API 521.)

W required flow through the device from Equations (vessel containing liquid): (7)

$$W = Q\ (\mathrm{BTU/hr}) \div Latent\ Heat\ of\ Vaporisation\ (BTU/lb)$$

According to API 521 2007, The discharge areas for pressure-relief devices on vessels containing super-critical fluids, gases or vapours exposed to open fires can be estimated using Equation 8.

$$C = 520\sqrt{k\left(\frac{2}{k+1}\right)} \qquad A = \frac{W}{CK_dP_LK_bK_c}\sqrt{\frac{TZ}{M}} \quad (8)$$

Where

A required effective discharge area of the device, in2

W required flow through the device from Equations (7), lb/hr.

C coefficient determined from Equations (3).

Kd effective coefficient of discharge. For preliminary sizing, use the following values:

0.975 When a pressure relief valve is installed with or without a rupture disk in combination,

0.62 When a pressure relief valve is not installed and sizing is for a rupture disk

P1 upstream relieving pressure, psia. This is the set pressure plus the allowable overpressure plus atmospheric pressure.

Kb capacity correction factor due to back pressure. The back pressure correction factor applies to balanced bellows valves only. For conventional and pilot operated valves, use a value for Kb equal to 1.0

Kc combination correction factor for installations with a rupture disk upstream of the pressure relief valve

1.0 When a rupture disk is not installed,

0.9 When a rupture disk is installed in combination with a pressure relief valve and the combination does not have a published value.

T relieving temperature of the inlet gas or vapour, R (°F + 460)

Z compressibility factor

M molecular weight of the gas or vapour at inlet relieving conditions.

4.3 BLOCKED OUTLET

The absolute pressure ratio of the pressure at the nozzle exit at sonic velocity (Pcf) to the inlet pressure (P1) is called the critical pressure ratio. Pcf is known as critical flow pressure and can be estimated using the following equation (API 520):

$$\frac{P_{cf}}{P_1} = \left[\frac{2}{K+1}\right]^{K/(K-1)} \quad (9)$$

Where:

P_{cf}= critical flow nozzle pressure in psia

P_1=upstream relieving pressure in psia

K= ratio of specific heats

If the pressure downstream of the nozzle is less than or equal to the critical flow pressure Pcf, then critical flow will occur and following procedure will be used to determine the required effective

discharge area of the device.

According to API-520 2007, Pressure relief devices in gas or vapor service that operate at closed outlet conditions are sized using Equations (10). This equations is used to calculate the effective discharge area, A, required to achieve a required flow rate through a pressure relief device. A pressure relief valve that has an effective discharge area equal to or greater than the calculated value of A is then chosen for the application from API-526.

$$A = \frac{W}{CK_dP_1K_bK_c}\sqrt{\frac{TZ}{M}} \qquad (10)$$

Where

A required effective discharge area of the device, in2

W required flow through the device, lb/hr.

C coefficient determined from Equations (3).

Kd effective coefficient of discharge. For preliminary sizing, use the following values:

0.975 When a pressure relief valve is installed with or without a rupture disk in combination,

0.62 When a pressure relief valve is not installed and sizing is for a rupture disk

P1 upstream relieving pressure, psia. This is the set pressure plus the allowable overpressure plus atmospheric pressure.

Kb capacity correction factor due to back pressure. The back pressure correction factor applies to balanced bellows valves only. For conventional and pilot operated valves, use a value for Kb equal to 1.0

Kc combination correction factor for installations with a rupture disk upstream of the pressure relief valve

1.0 When a rupture disk is not installed,

0.9 When a rupture disk is installed in combination with a pressure relief valve and the combination does not have a published value.

T relieving temperature of the inlet gas or vapour, R (°F + 460)

Z compressibility factor

M molecular weight of the gas or vapor at inlet relieving conditions.

PSV SIZING CALCULATION REPORT

software

The software using for sizing Pressure safety valve is valve star. Pressure safety valve sizing report have been reported as following attachment.

5.0 RELIEF LOAD SUMMARY TABLE

D08

PSV No.	PSV-2111/2112	PSV-2113/2114	PSV-2121A/B/C	PSV-2122,2123A/B/C	PSV-2131 A/B/C
Service	V-2104	V-2105	V-2101 A/B/C	C-2101A/B/C	V-2102A/B/C
Fire	YES	-	-	-	YES
Other	-	Blocked Outlet	Control Valve Failiure	Blocked Outlet	-
Fluid & State	HC	HC	HC	HC	HC
Operating Pressure (Barg)	5.3	5.1	4.9	19.0	18.1
Normal Temperature (°C)	32.0	36.92	36.78	124.8	60
Relief Temperature (°C)	284	36.92	60	124.8	208.3
P set, Barg	9.00	9.00	20.00	22.00	22.00
Required massflow (kg/hr)	37247.28	17833.11	2166.00	8664.0	982.27
Specific Heat Ratio (Cp/Cv)	1.223	1.246	1.457	1.225	1.278
Molecular Weight (kg/Kmol)	48.1	24.52	24.55	24.52	24.52
Compressibility Factor	0.954	0.954	0.822	0.964	0.936
Total Back Pressure (Barg)	3.4	1.2	0.2	0.9	3.4
Allowable Over Pressure (%)	21	10	10	10	21
Calculated Discharge Area (mm^2)	4134	2240.6	117.51	539.85	59.62
Required Discharge Area (mm^2)	8742	3421.19	153.938	1017	153.93
Orifice Designation	Q	N	E	J	D
Body size	6" × 8"	4" × 6"	1" × 2"	2" × 3"	1" × 2"
Capacity exceed %	66	25	7.6	54.9	20.49
P&ID Number	BK-GCS-PEDCO-120-PR-PI-0004 (3/1)	BK-GCS-PEDCO-120-PR-PI-0005 (1/1)	BK-GCS-PEDCO-120-PR-PI-0006 (1~3)	BK-GCS-PEDCO-120-PR-PI-0007 (3~1)	BK-GCS-PEDCO-120-PR-PI-0009 (1~3)

PSV No.	PSV-2132,2133A/B/C	PSV-2141/2142	PSV-2201 (NOTE)	PSV-2211	PSV-2271	PSV-2293
Service	C-2102A/B/C	V-2103	V-2203	V-2204	V-2205	V-2107
Fire	-	-	YES	YES	YES	YES
Other	Blocked Outlet	Blocked Outlet	-	-	-	-
Fluid & State	HC	HC	Air	N2	HC	TEG
Operating Pressure (Barg)	54.80	53.9	8.0	8.0	4.9	0.1
Normal Temperature (°C)	142.3	60	65	60	36.78	AMB
Relief Temperature (°C)	142.3	60	201.7	323.4	182.6	335.9
P set, Barg	62.0	62.0	12.5	12.5	9.0	3.5
Required massflow (kg/hr)	8664	17252.5	1071.8	500.39	174.5	2098.01
Specific Heat Ratio (Cp/Cv)	1.278	1.461	1.416	1.4	1.245	1.083
Molecular Weight (kg/Kmol)	24.52	24.56	28.95	28.00	18.02	143.6
Compressibility Factor	0.923	0.823	0.99	1.00	0.975	0.646
Total Back Pressure (Barg)	1.0	1.0	0.0	0.5	3.2	0.1
Allowable Over Pressure (%)	10	10	21	21	21	21
Calculated Discharge Area (mm^2)	193.67	311	113.24	54.241	28.75	275
Required Discharge Area (mm^2)	397.60	629.01	153.95	153.9	153.9	397.6
Orifice Designation	G	H	E	D	D	G
Body size	1 1/2" × 3”	2 " × 3”	1" × 2”	1” × 2”	1” × 2”	1 1/2" × 3”
Capacity exceed %	68.66	66.12	11.67	32.44	136	18.8
P&ID Number	BK-GCS-PEDCO-120-PR-PI-0010 (1~3)	BK-GCS-PEDCO-120-PR-PI-0012 (1/1)	BK-GCS-PEDCO-120-PR-PI-0015 (2/2)	BK-GCS-PEDCO-120-PR-PI-0016	BK-GCS-PEDCO-120-PR-	BK-GCS-PEDCO-120-PR-PI-0025

NOTE: 2 X 100 PSVs, ONE Duty ONE Standby

ATTACHMENT: SOFTWARE REPORT