

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک								
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	BK	GCS	PEDCO	120	EL	CN	0007		D01

طرح نگهداشت و افزایش تولید 27 مخزن

CALCULATION NOTE FOR DIESEL GENERATOR SIZING

نگهداشت و افزایش تولید میدان نفتی بینک

D01	Aug. 2022	IFA	H.Shakiba	M.Fakharian	M.Mehrshad	
D00	Nov. 2021	IFC	H.Shakiba	M.Fakharian	M.Mehrshad	
Rev.	Date	Purpose of Issue/Status	Prepared by:	Checked by:	Approved by:	CLIENT Approval

Class: 2

CLIENT Doc. Number: F0Z-709013

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 Company Review
 AB-A: As-Built -Approved

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REVISION RECORD SHEET

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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 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.

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2.0 SCOPE

This document covers minimum necessary requirements for the design, selection, manufacture, inspection, testing and delivery of diesel generator. The diesel generator set under consideration, will provide emergency power to essential loads in the case of loss of power.

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

3.0 NORMATIVE REFERENCES

3.1 Local Codes & Standards

- IPS-E-EL-100 Engineering Standard for Electrical System Design

3.2 The Project Documents

- BK-GCS-PEDCO-120-EL-LI-0001 Electrical Load List
- BK-GNRAL-PEDCO-000-EL-SP-0009 Specification for Diesel Generator
- BK-GCS-PEDCO-120-EL-DT-0003 Data Sheets for Diesel Generator
- BK-GCS-PEDCO-120-EL-SL-0002 LV Switchgear/MCC Single Line Diagram

3.3 Environmental Data

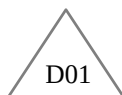
Refer to "Process Basis of Design; Doc. No. BK-GNRAL-PEDCO-000-PR-DB-0001-D07"

3.4 Order of Precedence

In case of conflict between requirements specified herein & the requirements of any other referenced document, the most approved stringent requirements of below listed items shall be considered based on the approval given by the owner's representative:

- Purchase order
- Material Requisition
- MTO & Data Sheet
- This Specification
- Drawing & Other Specification
- Reference Project Specification
- Iranian Petroleum Standard (IPS)
- Reference international Code & Standards

When the term "Authorized", Authorization", "Approval", or "Approved" are used in this specification, it shall mean authorization or Approval from OWNER.



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In case of any conflict between the project documents, the most stringent one shall be considered.

4.0 DIESEL SIZING

4.1 Continuous Operation

D01

According to Electrical Load List "BK-GCS-PEDCO-120-EL-LI-0001-D04", total Peak Active Power is equal to 343 kW. (Refer to end page)

Considering 20% spare capacity diesel generator load will be equal to:

$P_{de} = 343 \times 1.2 = 412 \text{ kW}$ (This will be used for diesel engine sizing)

According to Electrical Load List, total Apparent Peak Power is equal to 404 kVA. Considering 20% spare capacity, diesel generator load will be equal to:

$S_{de} = 404 \times 1.2 = 485 \text{ kVA}$ (This will be used for generator sizing).

For calculation of mechanical shaft power, electrical demand shall be divided by diesel efficiency. Diesel efficiency according to attached typical efficiency curves (Appendix 1) is about 0.946 @ 80% of rated kVA, so $P_{dm} = P / 0.946 = 412 / 0.946 = 435 \text{ kWm}$ (net engine power)

10kW cooling fan power requirement (typical value) shall be added to this power:

$P_d = 435 + 10 \text{ (fan)} = 445 \text{ Kw}$ (gross engine power)

Derating factor for site conditions shall be foreseen for diesel engine.

- For humidity no derating factor is recommended by manufacturers.
- For altitudes below 1000m no derating factor is required ($d_a = 1$)
- Typical derating factor for ambient temperature is 1.0% per each 5°C over 40°C

So, derating factor for 52°C ambient temperature is $d_t = (52 - 40) / 5 \times 1.0 = 2.4\%$

Derating factor for site conditions will be $d_a \times d_t = 0.976$

$P = P_{dm} / (d_a \times d_t) = 435 / 0.976 = 445 \text{ kWm}$ (net engine power)

$P = P_d / (d_a \times d_t) = 445 / 0.976 = 455 \text{ kWm}$ (gross engine power)

Diesel engine prime power shall be 445 kWm (net) / 455 kWm (gross)

According to client letter 1401-2294-156941 dated on 1401-05-06, the coefficient of continuous diesel is 1.15, and therefore diesel sizing will be:

Diesel engine prime power shall be $445 \times 1.15 = 511 \text{ kWm}$ (net) / $455 \times 1.15 = 523 \text{ kWm}$ (gross)

4.2 Diesel Sizing - Standby Operation (The Biggest Motor Starting)

D01

Starting of the biggest motor in the system shall be studied as follow:

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In this project, the largest motor in the system is related to the HVAC compressor of control room with direct on line starting motor 85 KW.

P=85 kW	$\eta = 90\%$
$PF_{Nominal} = 0.85$	$PF_{Starting} = 0.4$

$$I_{Nominal} = \frac{85}{\sqrt{3} \times 0.4 \times 0.85 \times 0.9} = 160$$

$$I_{st} = 160 \times 6 = 962$$

$$P_{start} = \sqrt{3} \cdot V \cdot I_{st} \cdot \cos \phi_{st} = \sqrt{3} \times 0.4 \times 962 \times 0.4 = 266 \text{ kW}$$

$$\text{Total required Emergency Active Power} = 343 - 85 = 258 \text{ kW}$$

$$P_{de} = (266 + 258) \times 1.2 = 628 \text{ Kw}$$

$$P_{dm} = 628 / 0.946 = 663 \text{ kWm.}$$

$$P_d = 663 + 10 = 673$$

$$P = P_{dm} / 0.976 = 663 / 0.976 = 679 \text{ kWm (Net) \& } 673 / 0.976 = 689 \text{ kWm (Gross)}$$

Diesel engine prime power shall be:

$$679 \times 1.15 = 781 \text{ kWm (net)}$$

$$689 \times 1.15 = 792 \text{ kWm (gross) at ISO conditions}$$

*Noted: According to NEMA MG-1, Diesel shall be capable of withstanding a current equal to 1.5 times the rated current for not less than 30 seconds when the diesel is initially at normal operating temperature. So the size of Diesel can be selected 520KW (781KW/1.5).

4.3 Diesel Sizing – Conclusion

Diesel engine continuous power shall be > 445 kWm (net)

Diesel engine prime power shall be > 511 kWm (net)

Diesel engine standby power shall be > 490 kWm (net)

5.0 GENERATOR SIZING

5.1 Generator Sizing – Continuous Operation

According to clause 4.1, Sde = 485 kVA. So, generator shall have a power rating more than 485 kVA at site conditions. Since the site condition is 52°C, to consider effect of working in 40°C, a typical de-rating factor equals to 0.9 according to APPENDIX 2 is considered. So, the rated generator apparent power shall be about 485 / 0.9 = 539 kVA at 52°C. So, generator shall have power rating more than 539 kVA at 52°C. (Total Loads)

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5.2 Generator Sizing – Motor Starting Study

The biggest motor in the system is compressor of HVAC system of control room with Direct on Line starting:

P=85 kW	$PF_{Starting} = 0.4$
$PF_{Nominal} = 0.85$	S=100 kVA
$\eta = 90\%$	

Since the largest motor is compressor 85 kw, therefore

$$S_{Starting} = 6 \times S_{Nominal} = 600 \text{ KVA}$$

$$\text{Total required Emergency Apparent Power} = 404 - 100 = 304 \text{ KVA}$$

$$S_{de} = (600 + 304) = 904 \text{ KVA}$$

With considering derating factor 0.9, therefore:

$$S = 904 / 0.9 = 1004 \text{ KVA}$$

*Noted: According to NEMA MG-1, generator shall be capable of withstanding a current equal to 1.5 times the rated current for not less than 30 seconds when the diesel is initially at normal operating temperature. So the size of Generator can be selected 670KVA (1004KVA/1.5).

5.3 Generator Sizing – Conclusion

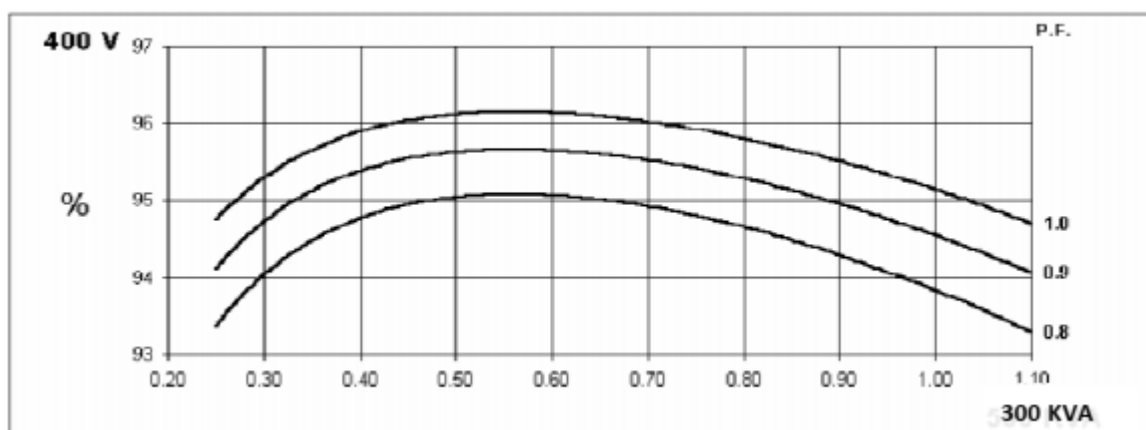
According to above calculation, the generator sizing will be 670 KVA.

Note: Diesel Generator sizing calculation shall be checked by vendor based on manufacture standards.

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APPENDIX 1

GENERATOR EFFICIENCY

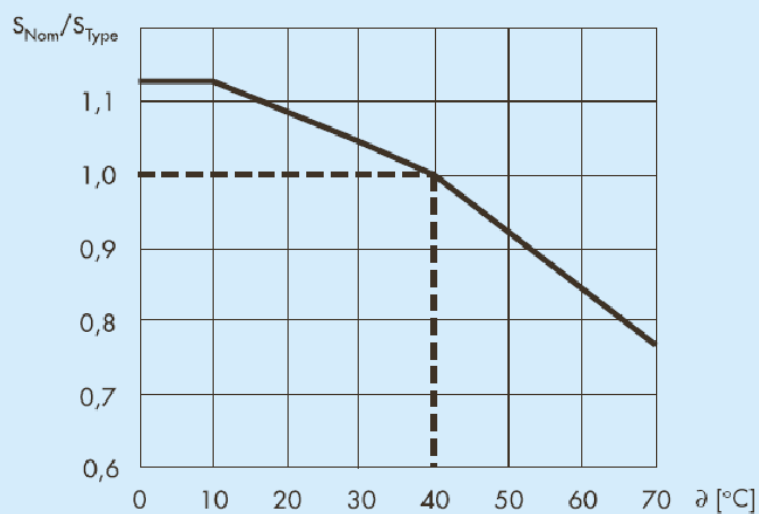


APPENDIX 2

AMBIENT TEMPERATURE DERATING FACTOR (GENERATOR)

Relation between power and coolant temperature

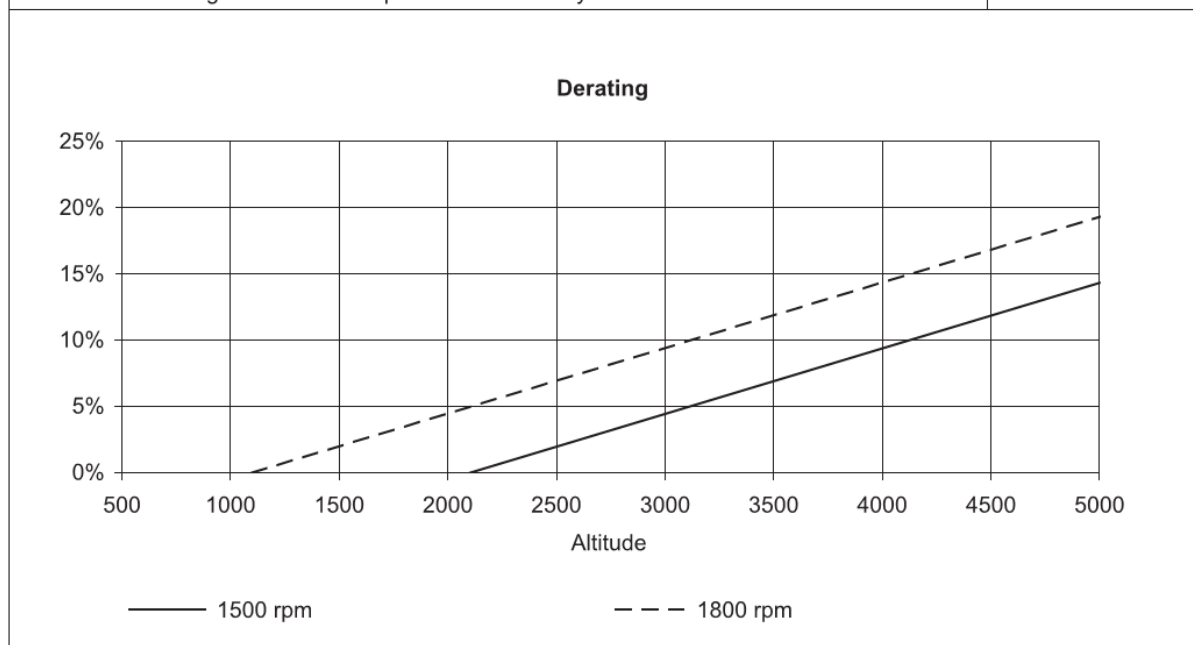
Characteristic curve 5.2



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Derating

The engine may be operated up to 2130 m altitude without derating at 1500rpm.
The engine may be operated up to 1130 m altitude without derating at 1800rpm.
For operation at higher altitudes the power will be derated according to the graph below.
There is no derating for ambient temperature or humidity.



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D01	0007	CN	EL	120	PEDCO	GCS	BK																			

Item	Equipment Number	Load Description	Service Type	Load Duty	Rated Voltage (V)	Rated Power (Kw)	Absorbed Peak Active Power (Kw)	Absorbed Peak Reactive Power (Kvar)
1	PK-C-2203A	Instrument & Plant Air Package A	E	C	0.4	50	50.00	30.99
2	PK-C-2203B	Instrument & Plant Air Package B	E	S	0.4	50	5.00	3.10
3	IG-2201	LP Flare Ignition Package	E	I	0.4	2	1.50	0.49
4	P-2203A	Sump Pump A	E	I	0.4	2.2	0.86	0.72
5	P-2203B	Sump Pump B	E	I	0.4	2.2	0.86	0.72
6	P-2202A	Closed Drain Pump A	E	I	0.4	1.1	2.59	1.94
7	P-2202B	Closed Drain Pump B	E	I	0.4	1.1	2.59	1.94
8	P-2201A	LP Flare K.O. Drum Pump A	E	I	0.4	1.1	0.54	0.40
9	P-2201B	LP Flare K.O. Drum Pump B	E	I	0.4	1.1	0.54	0.40
10	GCS-400-EDP-01	Process Area Emergency Distribution Panel	E	C	0.4	10	10.00	6.20
11	GCS-400-EDP-02	Utility Area Emergency Distribution Panel	E	C	0.4	5	5.00	3.10
12	CTRL- HVAC	HVAC Panel for Control Room	E	C	0.4	150	150.00	92.96
14	GCS-110-CHG-002	110VDC Charger 2	E	C	0.4	20	22.22	13.77
15	GCS-24-CHG-002	24VDC Charger 2	E	C	0.4	18.5	20.56	12.74
16	GCS-110-UPS-002	110VAC UPS 2	E	C	0.4	36	40.00	24.79

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض احداث ردیف تراکم گاز در ایستگاه جمع آوری بینک																	
شماره پیمان: 053 - 073 - 9184	CALCULATION NOTE FOR DIESEL GENERATOR SIZING	شماره صفحه : 12 از 12																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادرکننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>D01</td><td>0007</td><td>CN</td><td>EL</td><td>120</td><td>PEDCO</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	D01	0007	CN	EL	120	PEDCO	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه									
D01	0007	CN	EL	120	PEDCO	GCS	BK											

Item	Equipment Number	Load Description	Service Type	Load Duty	Rated Voltage (V)	Rated Power (Kw)	Absorbed Peak Active Power (Kw)	Absorbed Peak Reactive Power (Kvar)
17	GCS-110-UPS-Bypass	110VAC UPS By Pass	E	S	0.4	20	2.22	1.38
18	GCS-230-FDP 01	Fire Diesel Panel 01 (Electrical Main Motor)	E	C	0.23	1	1.00	0.62
19	GCS-230-FDP 02	Fire Diesel Panel 02 (Diesel Engine)	E	C	0.23	1	1.00	0.62
20	SPH-01	Space Heater & Lighting for New LV Switchgear	E	C	0.23	2	2.00	1.24
21	SPH-02	Space Heater & Lighting for MV Switchgear	E	C	0.23	2	2.00	1.24
22	GCS-400-EDP-CRM	Control Room Emergency Distribution Panel	E	C	0.4	23	23.00	14.25

GCS-400-NSWG-001E					
Continuous		Intermittent		Standby	
Active Power (Kw)	Reactive Power (Kvar)	Active Power (Kw)	Reactive Power (Kvar)	Active Power (Kw)	Reactive Power (Kvar)
326.78	202.52	9.49	6.62	7.22	4.48
Power Calculation		Active Power (Kw)	Reactive Power (Kvar)	Apparent power (KVA)	Power Factor
Maximum Normal Running Load		336.26	209.14	395.99	0.85
Peak Load		343.49	213.61	404.49	0.85
Peak Load With 20% Spare (KVA)				485.389	