طرح نگهداشت و افزایش تولید 27 مخزن

HVAC CALCULATION NOTE FOR EXTENSION OF EXISTING ELECT. BUILDING

نگهداشت و افزایش تولید میدان نفتی بینک

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Rev.	**Date**	**Purpose of Issue/Status**	**Prepared by:**	**Checked by:**	**Approved by:**	**CLIENT Approval**
Class: 2		**CLIENT Doc. Number: F0Z-708866**				

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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2	X	X	X	X	
3	X	X		X	
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6	X	X		X	
7	X	X		X	
8	X	X		X	
9	X	X		X	
10	X	X		X	
11	X	X		X	
12	X	X		X	
13	X	X		X	
14	X	X		X	
15	X	X		X	
16	X	X		X	
17	X	X		X	
18	X	X		X	
19	X	X		X	
20	X	X		X	
21	X	X		X	
22	X	X		X	
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CONTENTS

GENERAL COMMENT: all revised parts shall be highlighted and marked.

HE Reply:
The details of the external wall were modified.(Page 10)
Corrected results of calculations were presented.(Page 18~26)
Split air conditioner selection tables were updated based on corrected result.(Page 27~28)
Component pressure drop (external p.d.) of the fan filter unit and exhaust fan were corrected.(Page 29~30)

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.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
GENERAL 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 main purpose of this document is to define the HVAC system load calculation has been carried out by computer program (HAP software) as per ASHRAE method in order to evaluate cooling load (summer) and heating load (winter) and also to select HVAC equipment for the calculated cooling and heating load.

3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

- IPS — Iranian petroleum standards
- INBC — Iranian National Building Code

3.2 INTERNATIONAL CODES AND STANDARDS

- ASTM — American Society for Testing Materials Relevant Parts
- API 610 — Centrifugal Pumps for General Refinery Service, 10th Edition
- ISO 15156 — Petroleum and Natural Gas Industries. Materials for use in H2S Containing Environments in Oil and Gas Production
- AMCA — Air Movement and Control Association
- ANSI — American National Standards Institute.
- ASHRAE — American Society of Heating, Refrigeration and Air-conditioning Engineer
- ASTM — American Society for Testing and Material
- BOCA — Building Officials and Code Administrators international
- BS — British Standards
- CIBSE — Chartered Institute of Building Services Engineers.
- NFPA — National fire protection association
- SBCCI — Southern Building Code Congress International
- SMACNA — Sheet Metal and Air Conditioning Contractors' National Association
- AWWA — American Water Works Association
- ASME — The American Society of Mechanical Engineers

Note: The latest issued or revised edition of all above mentioned codes and standards shall be considered as reference.

3.3 ENVIRONMENTAL DATA

- Latitude 29° 73’ N
- Longitude 50° 35’ E
- Elevation 10 m
- Summer dry bulb temperature : 41° C
- Summer wet bulb temperature : 30.5° C
- Summer daily range temperature : 15.0° C
- Winter dry bulb temperature : 6° C
- Winter relative humidity : 78%

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

4.0 HVAC CALCULATION

4.1 DESIGN WEATHER PARAMETERS:

Design Parameters:

City Name	**Binak**	
Location	**IRAN**	
Latitude	**29.7**	Deg.
Longitude	**-50.4**	Deg.
Elevation	**10.0**	m
Summer Design Dry-Bulb	**41.0**	°C
Summer Coincident Wet-Bulb	**30.5**	°C
Summer Daily Range	**15.0**	°K
Winter Design Dry-Bulb	**6.0**	°C
Winter Design Wet-Bulb	**4.4**	°C
Atmospheric Clearness Number	**1.00**	
Average Ground Reflectance	**0.20**	
Soil Conductivity	**1.385**	W/(m-°K)
Local Time Zone (GMT +/- N hours)	**-3.5**	hours
Consider Daylight Savings Time	**No**	
Simulation Weather Data	**noneN/A**	
Current Data is	**User Modified**	
Design Cooling Months	**January to December**	

Design Day Maximum Solar Heat Gains

(The MSHG values are expressed in W/m²)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S
January	77.5	77.5	95.1	360.4	561.2	730.9	794.1	786.3	762.3
February	89.1	89.1	206.7	484.1	668.9	760.8	782.0	718.9	671.9
March	101.4	120.5	367.4	576.2	723.5	759.6	702.5	590.8	520.1
April	113.0	252.7	487.2	636.6	705.1	688.3	568.6	408.7	322.0
May	124.3	351.1	551.9	666.3	679.9	619.4	469.6	279.8	199.5
June	161.0	389.1	570.0	664.8	662.8	586.8	421.4	228.9	165.7
July	128.9	355.9	541.6	644.7	671.3	606.9	452.1	270.2	196.1
August	118.3	256.1	470.7	606.2	686.0	663.8	546.8	395.4	311.9
September	104.3	109.2	354.3	538.8	681.8	728.9	670.0	569.4	503.5
October	91.2	91.2	226.5	441.2	642.7	746.9	748.8	692.4	650.8
November	78.1	78.1	103.7	341.8	572.3	707.9	785.7	774.1	747.8
December	71.9	71.9	71.9	306.4	524.4	699.0	788.1	799.2	780.7
Month	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**HOR**	**Mult**
January	779.8	791.7	733.2	577.4	337.4	108.2	77.5	591.4	1.00
February	716.3	777.2	772.2	650.4	482.8	225.6	89.1	714.5	1.00
March	590.5	703.8	755.6	713.7	589.1	369.6	114.3	816.8	1.00
April	413.5	574.6	682.6	707.6	645.8	485.9	241.4	863.3	1.00
May	282.1	471.6	614.4	688.4	669.7	550.4	343.5	875.1	1.00
June	233.1	424.2	577.0	674.2	670.6	567.0	376.4	872.9	1.00
July	274.2	458.7	596.0	677.5	657.5	539.9	345.0	865.3	1.00
August	398.9	554.0	657.3	682.8	624.7	473.1	240.3	846.4	1.00
September	569.0	669.3	728.9	681.0	540.4	354.6	108.6	783.8	1.00
October	697.0	755.4	737.2	647.9	457.7	216.5	91.2	696.8	1.00
November	775.6	786.0	708.0	568.2	351.0	91.0	78.1	582.8	1.00
December	798.2	790.7	685.6	536.9	295.2	71.9	71.9	533.5	1.00

Mult. = User-defined solar multiplier factor.

Cooling Design Temperature Profile

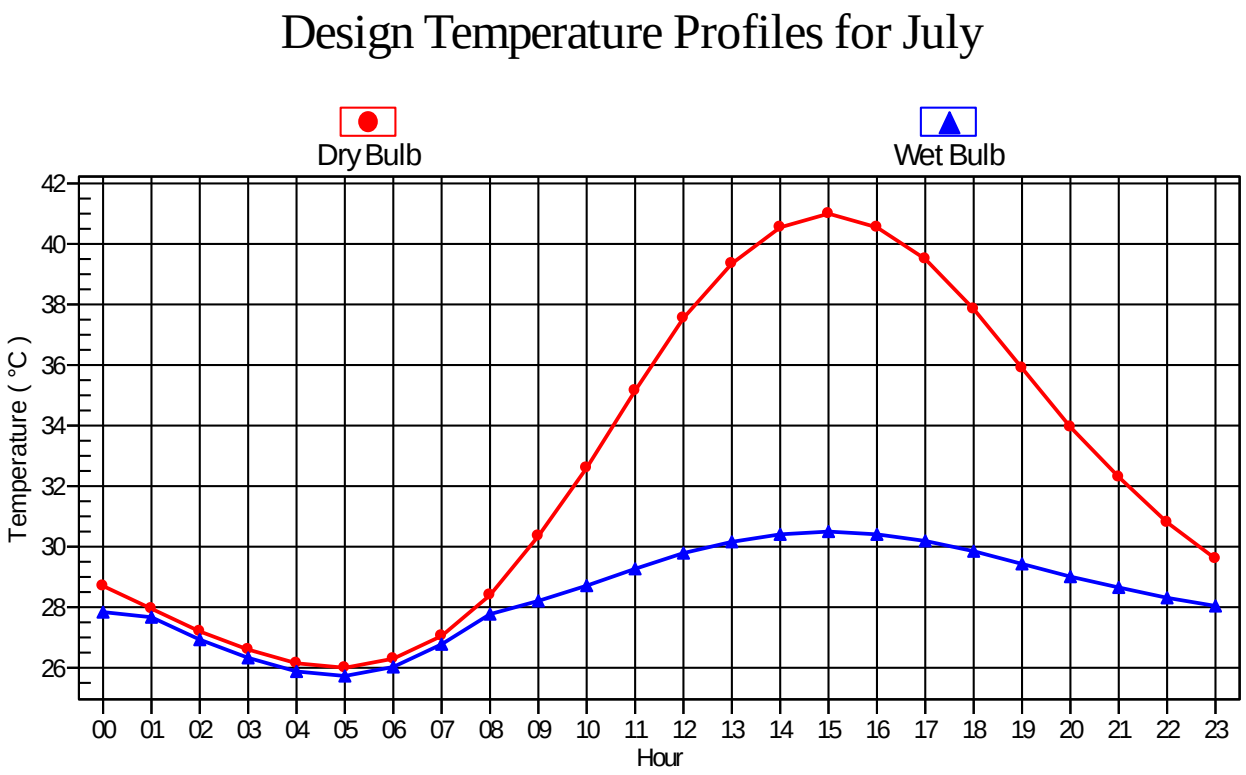
Location: Binak, IRAN

(Dry and Wet Bulb temperatures are expressed in °C)

Hr	January		February		March		April		May		June	
	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB
0000	19.4	19.1	20.5	20.2	23.0	22.8	24.5	24.2	26.7	26.4	28.1	27.8
0100	18.6	18.3	19.7	19.5	22.3	22.0	23.7	23.5	26.0	25.7	27.4	27.1
0200	17.9	17.6	19.0	18.7	21.5	21.3	23.0	22.7	25.2	24.9	26.6	26.4
0300	17.3	17.0	18.4	18.1	20.9	20.7	22.4	22.1	24.6	24.3	26.0	25.8
0400	16.8	16.5	17.9	17.7	20.5	20.2	21.9	21.7	24.2	23.9	25.6	25.3
0500	16.7	16.4	17.8	17.5	20.3	20.1	21.8	21.5	24.0	23.7	25.4	25.2
0600	17.0	16.7	18.1	17.8	20.6	20.4	22.1	21.8	24.3	24.0	25.7	25.5
0700	17.7	17.4	18.8	18.6	21.4	21.1	22.8	22.6	25.1	24.8	26.5	26.2
0800	19.1	18.8	20.2	19.9	22.7	22.5	24.2	23.9	26.4	26.1	27.8	27.6
0900	21.0	20.7	22.1	21.9	24.7	24.4	26.1	25.9	28.4	27.0	29.8	28.2
1000	23.3	22.2	24.4	23.2	26.9	25.6	28.4	26.6	30.6	27.5	32.0	28.7
1100	25.8	22.9	26.9	23.9	29.5	26.2	30.9	27.2	33.2	28.1	34.6	29.3
1200	28.2	23.6	29.3	24.5	31.9	26.8	33.3	27.7	35.6	28.6	37.0	29.8
1300	30.0	24.1	31.1	25.0	33.7	27.2	35.1	28.1	37.4	29.0	38.8	30.2
1400	31.2	24.4	32.3	25.3	34.9	27.5	36.3	28.4	38.6	29.3	40.0	30.4
1500	31.7	24.5	32.8	25.4	35.3	27.6	36.8	28.5	39.0	29.4	40.4	30.5
1600	31.2	24.4	32.3	25.3	34.9	27.5	36.3	28.4	38.6	29.3	40.0	30.4
1700	30.2	24.1	31.3	25.0	33.8	27.3	35.3	28.2	37.5	29.1	38.9	30.2
1800	28.5	23.7	29.6	24.6	32.2	26.9	33.6	27.8	35.9	28.7	37.3	29.8
1900	26.6	23.1	27.7	24.1	30.2	26.4	31.7	27.3	33.9	28.3	35.3	29.4
2000	24.6	22.6	25.7	23.5	28.3	25.9	29.7	26.9	32.0	27.8	33.4	29.0
2100	23.0	22.1	24.1	23.1	26.6	25.5	28.1	26.5	30.3	27.4	31.7	28.6
2200	21.5	21.2	22.6	22.3	25.1	24.9	26.6	26.1	28.8	27.1	30.2	28.3
2300	20.3	20.0	21.4	21.1	23.9	23.7	25.4	25.1	27.6	26.8	29.0	28.0

Hr	July		August		September		October		November		December	
	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB
0000	28.7	27.8	28.7	27.8	27.6	27.2	25.6	25.3	22.5	22.2	19.9	19.6
0100	28.0	27.7	28.0	27.7	26.8	26.6	24.8	24.6	21.7	21.5	19.2	18.9
0200	27.2	26.9	27.2	26.9	26.1	25.8	24.1	23.8	21.0	20.7	18.4	18.1
0300	26.6	26.3	26.6	26.3	25.5	25.2	23.5	23.2	20.4	20.1	17.8	17.5
0400	26.2	25.9	26.2	25.9	25.0	24.8	23.0	22.8	19.9	19.7	17.4	17.1
0500	26.0	25.7	26.0	25.7	24.9	24.6	22.9	22.6	19.8	19.5	17.2	16.9
0600	26.3	26.0	26.3	26.0	25.2	24.9	23.2	22.9	20.1	19.8	17.5	17.2
0700	27.1	26.8	27.1	26.8	25.9	25.7	23.9	23.7	20.8	20.6	18.3	18.0
0800	28.4	27.8	28.4	27.8	27.3	27.0	25.3	25.0	22.2	21.9	19.6	19.3
0900	30.4	28.2	30.4	28.2	29.2	27.6	27.2	26.4	24.1	23.9	21.6	21.3
1000	32.6	28.7	32.6	28.7	31.5	28.1	29.5	26.9	26.4	25.4	23.8	23.4
1100	35.2	29.3	35.2	29.3	34.0	28.7	32.0	27.5	28.9	26.0	26.4	24.1
1200	37.6	29.8	37.6	29.8	36.4	29.2	34.4	28.1	31.3	26.6	28.8	24.7
1300	39.4	30.2	39.4	30.2	38.2	29.6	36.2	28.5	33.1	27.0	30.6	25.2
1400	40.6	30.4	40.6	30.4	39.4	29.8	37.4	28.7	34.3	27.3	31.8	25.5
1500	41.0	30.5	41.0	30.5	39.9	29.9	37.9	28.8	34.8	27.4	32.2	25.6
1600	40.6	30.4	40.6	30.4	39.4	29.8	37.4	28.7	34.3	27.3	31.8	25.5
1700	39.5	30.2	39.5	30.2	38.4	29.6	36.4	28.5	33.3	27.0	30.7	25.2
1800	37.9	29.9	37.9	29.9	36.7	29.3	34.7	28.1	31.6	26.6	29.1	24.8
1900	35.9	29.4	35.9	29.4	34.8	28.9	32.8	27.7	29.7	26.2	27.1	24.3
2000	34.0	29.0	34.0	29.0	32.8	28.4	30.8	27.2	27.7	25.7	25.2	23.8
2100	32.3	28.7	32.3	28.7	31.2	28.0	29.2	26.8	26.1	25.3	23.5	23.2
2200	30.8	28.3	30.8	28.3	29.7	27.7	27.7	26.5	24.6	24.3	22.0	21.7
2300	29.6	28.0	29.6	28.0	28.5	27.4	26.5	26.2	23.4	23.1	20.8	20.5

Design Temperature Profile



4.2 CONSTRUCTIONS U-VALUE:

Wall

it is not correct

insulation layer shall be added

Wall Details

Outside Surface Color ..... **Medium**
Absorptivity **0.675**
Overall U-Value ..... **0.291** W/(m²-°K)

Wall Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m³	Specific Ht. kJ / (kg - °K)	R-Value (m²-°K)/W	Weight kg/m²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
Gypsum plaster	5.000	800.9	1.09	0.03106	4.0
Cement plaster	20.000	1600.0	0.80	0.02500	32.0
HW concrete	300.000	2242.6	0.84	0.17334	672.8
Cement plaster	30.000	1600.0	0.80	0.03750	48.0
Face brick	90.000	2000.0	0.03	2.99571	180.0
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	**445.000**	**-**		**3.44189**	**936.8**

R=0.03 For face brick

it is not correct

Roof

Roof Details

Outside Surface Color ..... **Medium**
Absorptivity **0.675**
Overall U-Value ..... **0.948** W/(m²-°K)

Roof Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m³	Specific Ht. kJ / (kg - °K)	R-Value (m²-°K)/W	Weight kg/m²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
HW concrete	300.000	2242.6	0.84	0.17334	672.8
Poly Urtan	50.000	25.0	0.84	0.20000	1.3
HW concrete	300.000	977.1	0.84	0.28889	293.1
Waterproofing/isogume or similar	4.000	1000.0	1.67	0.17390	4.0
Cement plaster	25.000	1600.0	0.80	0.03750	40.0
Terrazzo tile	25.000	2000.0	0.84	0.00185	50.0
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	**704.000**	**-**		**1.05476**	**1061.2**

it is not correct

$\lambda = 0.041$ for polyurethane

B.P.D./T-1

Door Details:

Gross Area ..... **2.6** m²
Door U-Value ..... **3.000** W/(m²-°K)

Glass Details:

Glass Area ..... **0.0** m²
Glass U-Value ..... **3.293** W/(m²-°K)
Glass Shade Coefficient **0.880**
Glass Shaded All Day? ..... **No**

HE Reply:
The details of the external wall were modified.(Page 10)

Ext. Dor W=1

Door Details:

Gross Area ..... **2.2** m²
Door U-Value ..... **3.000** W/(m²-°K)

Glass Details:

Glass Area ..... **0.0** m²
Glass U-Value ..... **3.293** W/(m²-°K)
Glass Shade Coefficient **0.880**
Glass Shaded All Day? ..... **No**

Ext. Dor W=2

Door Details:

Gross Area ..... **4.4** m²
Door U-Value ..... **3.000** W/(m²-°K)

Glass Details:

Glass Area ..... **0.0** m²
Glass U-Value ..... **3.293** W/(m²-°K)
Glass Shade Coefficient **0.880**
Glass Shaded All Day? ..... **No**

4.3 SPACE INPUT DATA:

01-Capacitor Bank

1. General Details:

Floor Area ..... **24.7** m²
Avg. Ceiling Height ..... **4.1** m
Building Weight ..... **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage ..... **User-Defined**
OA Requirement 1 ..... **0.0** L/s/person
OA Requirement 2 ..... **0.00** L/(s-m²)
Space Usage Defaults . **ASHRAE Standard 62.1-2010**

2. Internals:

2.1. Overhead Lighting:

Fixture Type ..... **Recessed (Unvented)**
Wattage ..... **20.00** W/m²
Ballast Multiplier **1.00**
Schedule ..... **Lighting**

2.2. Task Lighting:

Wattage ..... **0.00** W/m²
Schedule ..... **None**

2.3. Electrical Equipment:

Wattage ..... **4920.0** Watts
Schedule ..... **Electrical Eq.**

2.4. People:

Occupancy ..... **0.0** Person
Activity Level ..... **Office Work**
Sensible ..... **71.8** W/person
Latent ..... **60.1** W/person
Schedule ..... **None**

2.5. Miscellaneous Loads:

Sensible ..... **0** W
Schedule ..... **None**
Latent ..... **0** W
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
NNW	26.2	0	0	0
ENE	15.6	0	0	1

3.1. Construction Types for Exposure NNW

Wall Type ..... **Wall**

3.2. Construction Types for Exposure ENE

Wall Type ..... **Wall**
Door Type **B.P.D./T-1**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m²)	Roof Slope (deg.)	Skylight Qty.
H	24.7	0	0

4.1. Construction Types for Exposure H

Roof Type ..... **Roof**

5. Infiltration:

Design Cooling ..... **1.00** ACH
Design Heating ..... **1.00** ACH
Energy Analysis ..... **1.00** ACH
Infiltration occurs at all hours.

6. Floors:

Type ..... **Slab Floor On Grade**
Floor Area ..... **24.7** m²
Total Floor U-Value ..... **0.568** W/(m²-°K)
Exposed Perimeter ..... **10.3** m
Edge Insulation R-Value ..... **0.00** (m²-°K)/W

7. Partitions:

7.1. 1st Partition Details:

Partition Type ..... **Wall Partition**
Area ..... **41.8** m²
U-Value ..... **1.260** W/(m²-°K)
Uncondit. Space Max Temp ..... **35.0** °C
Ambient at Space Max Temp ..... **41.0** °C
Uncondit. Space Min Temp ..... **12.8** °C
Ambient at Space Min Temp ..... **6.0** °C

7.2. 2nd Partition Details:

(No partition data).

02-High Voltage Room

1. General Details:

Floor Area ..... **129.8** m²
Avg. Ceiling Height ..... **4.1** m
Building Weight ..... **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage ..... **User-Defined**
OA Requirement 1 ..... **332.7** L/s
OA Requirement 2 ..... **0.00** L/(s-m²)
Space Usage Defaults . **ASHRAE Standard 62.1-2010**

2. Internals:

2.1. Overhead Lighting:

Fixture Type ..... **Recessed (Unvented)**
Wattage ..... **20.00** W/m²
Ballast Multiplier **1.00**
Schedule ..... **Lighting**

2.2. Task Lighting:

Wattage ..... **0.00** W/m²
Schedule ..... **None**

2.3. Electrical Equipment:

Wattage ..... **20960.0** Watts
Schedule ..... **Electrical Eq.**

2.4. People:

Occupancy ..... **0.0** Person
Activity Level ..... **Office Work**
Sensible ..... **71.8** W/person
Latent ..... **60.1** W/person
Schedule ..... **None**

2.5. Miscellaneous Loads:

Sensible ..... **0** W
Schedule ..... **None**
Latent ..... **0** W
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
NNW	51.1	0	0	0
ENE	21.4	0	0	1

3.1. Construction Types for Exposure NNW

Wall Type ..... **Wall**

3.2. Construction Types for Exposure ENE

Wall Type ..... **Wall**
Door Type ..... **Ext. Dor W=2**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m²)	Roof Slope (deg.)	Skylight Qty.
H	129.8	0	0

4.1. Construction Types for Exposure H

Roof Type ..... **Roof**

5. Infiltration:

Design Cooling ..... **0.00** ACH
Design Heating ..... **0.00** ACH
Energy Analysis ..... **0.00** ACH
Infiltration occurs at all hours.

6. Floors:

Type ..... **Floor Above Unconditioned Space**
Floor Area ..... **129.8** m²
Total Floor U-Value ..... **0.568** W/(m²-°K)
Unconditioned Space Max Temp. ..... **35.0** °C
Ambient at Space Max Temp. ..... **41.0** °C
Unconditioned Space Min Temp. ..... **12.8** °C
Ambient at Space Min Temp. ..... **6.0** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type ..... **Wall Partition**
Area ..... **43.4** m²
U-Value ..... **1.260** W/(m²-°K)
Uncondit. Space Max Temp ..... **35.0** °C
Ambient at Space Max Temp ..... **41.0** °C
Uncondit. Space Min Temp ..... **12.8** °C
Ambient at Space Min Temp ..... **6.0** °C

7.2. 2nd Partition Details:

(No partition data).

03-Low Voltage Room

1. General Details:

Floor Area ..... **156.6** m²
Avg. Ceiling Height ..... **4.1** m
Building Weight ..... **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage ..... **User-Defined**
OA Requirement 1 ..... **389.4** L/s
OA Requirement 2 ..... **0.00** L/(s-m²)
Space Usage Defaults . **ASHRAE Standard 62.1-2010**

2. Internals:

2.1. Overhead Lighting:

Fixture Type ..... **Recessed (Unvented)**
Wattage ..... **20.00** W/m²
Ballast Multiplier **1.00**
Schedule ..... **Lighting**

2.2. Task Lighting:

Wattage ..... **0.00** W/m²
Schedule ..... **None**

2.3. Electrical Equipment:

Wattage ..... **37361.0** Watts
Schedule ..... **Electrical Eq.**

2.4. People:

Occupancy ..... **0.0** Person
Activity Level ..... **Office Work**
Sensible ..... **71.8** W/person
Latent ..... **60.1** W/person
Schedule ..... **None**

2.5. Miscellaneous Loads:

Sensible ..... **0** W
Schedule ..... **None**
Latent ..... **0** W
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
WSW	21.4	0	0	1
SSE	13.6	0	0	0
ENE	21.4	0	0	1

3.1. Construction Types for Exposure WSW

Wall Type ..... **Wall**
Door Type ..... **Ext. Dor W=1**

3.2. Construction Types for Exposure SSE

Wall Type ..... **Wall**

3.3. Construction Types for Exposure ENE

Wall Type ..... **Wall**
Door Type ..... **Ext. Dor W=2**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m²)	Roof Slope (deg.)	Skylight Qty.
H	156.6	0	0

4.1. Construction Types for Exposure H

Roof Type ..... **Roof**

5. Infiltration:

Design Cooling ..... **0.00** ACH
Design Heating ..... **0.00** ACH
Energy Analysis ..... **0.00** ACH
Infiltration occurs at all hours.

6. Floors:

Type ..... **Floor Above Unconditioned Space**
Floor Area ..... **156.6** m²
Total Floor U-Value ..... **0.568** W/(m²-°K)
Unconditioned Space Max Temp. ..... **35.0** °C
Ambient at Space Max Temp. ..... **41.0** °C
Unconditioned Space Min Temp. ..... **12.8** °C
Ambient at Space Min Temp. ..... **6.0** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type ..... **Wall Partition**
Area ..... **128.4** m²
U-Value ..... **1.260** W/(m²-°K)
Uncondit. Space Max Temp ..... **35.0** °C
Ambient at Space Max Temp ..... **41.0** °C
Uncondit. Space Min Temp ..... **12.8** °C
Ambient at Space Min Temp ..... **6.0** °C

7.2. 2nd Partition Details:

(No partition data).

4.4 SYSTEM INPUT DATA:

Capacitor Bank System

1. General Details:

Air System Name ..... **Capacitor Bank System**
Equipment Type ..... **Terminal Units**
Air System Type ..... **Split DX Fan Coil**
Number of zones **1**
Ventilation ..... **Direct Ventilation**

2. Ventilation System Components:

(Common Ventilation System not used: no inputs)

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
01-Capacitor Bank	x1

Thermostats and Zone Data:

Zone	Cooling T-Stat Occ. (°C)	Cooling T-Stat Unocc. (°C)	Heating T-Stat Occ. (°C)	Heating T-Stat Unocc. (°C)	T-Stat Throttling Range (°C)
1	30.0	31.0	10.0	8.0	0.83

Thermostat Schedule ..... **Fan**
Unoccupied Cooling is ..... **Available**

Common Terminal Unit Data:

Cooling Coil:

Design Supply Temperature ..... **18.0** °C
Coil Bypass Factor **0.100**
Cooling Source ..... **Air-Cooled DX**
Schedule ..... **JFMAMJJASOND**

Heating Coil:

Design Supply Temperature ..... **35.0** °C
Heating Source ..... **Electric Resistance**
Schedule ..... **JFMAMJJASOND**
Fan Control ..... **Fan On**
Ventilation Sizing Method ..... **ASHRAE Std 62.1-2010**

Terminal Units Data:

Zone ..... **All**
Terminal Type ..... **Fan Coil**
Minimum Airflow ..... **0.00** L/s/person
Fan Performance ..... **0** Pa
Fan Overall Efficiency ..... **50** %

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:

Hydronic Sizing Specifications:

Chilled Water Delta-T ..... **5.6** °K
Hot Water Delta-T ..... **11.1** °K

Safety Factors:

Cooling Sensible ..... **10** %
Cooling Latent ..... **10** %
Heating ..... **10** %

Elec. Building System

1. General Details:

Air System Name ..... **Elec. Building**
Equipment Type ..... **Packaged Rooftop Units**
Air System Type ..... **Single Zone CAV**
Number of zones **1**

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control ..... **Constant Ventilation Airflow**
Ventilation Sizing Method ..... **Sum of Space OA Airflows**
Unocc. Damper Position ..... **Closed**
Damper Leak Rate ..... **0** %
Outdoor Air CO2 Level ..... **400** ppm

Central Cooling Data:

Supply Air Temperature ..... **14.4** °C
Coil Bypass Factor **0.100**
Cooling Source ..... **Air-Cooled DX**
Schedule ..... **JFMAMJJASOND**
Capacity Control ..... **Cycled or Staged Capacity - Fan On**

Central Heating Data:

Supply Temperature ..... **35.0** °C
Heating Source ..... **Electric Resistance**
Schedule ..... **JFMAMJJASOND**
Capacity Control ..... **Cycled or Staged Capacity - Fan On**

Supply Fan Data:

Fan Type ..... **Forward Curved**
Configuration ..... **Draw-thru**
Fan Performance ..... **0** Pa
Overall Efficiency ..... **54** %
Fan Control ..... **1-speed fan, cooling and heating**

Duct System Data:

Supply Duct Data:

Duct Heat Gain ..... **0** %
Duct Leakage ..... **0** %

Return Duct or Plenum Data:

Return Air Via ..... **Ducted Return**

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
02-High Voltage Room	x1
03-Low Voltage Room	x1

Thermostats and Zone Data:

Zone ..... **All**
Cooling T-stat: Occ. ..... **30.0** °C
Cooling T-stat: Unocc. ..... **31.0** °C
Heating T-stat: Occ. ..... **10.0** °C
Heating T-stat: Unocc. ..... **8.0** °C
T-stat Throttling Range ..... **0.83** °K
Diversity Factor ..... **100** %
Direct Exhaust Airflow ..... **0.0** L/s
Direct Exhaust Fan kW ..... **0.0** kW
Thermostat Schedule ..... **Fan**
Unoccupied Cooling is ..... **Available**

Supply Terminals Data:

Zone ..... **All**
Terminal Type ..... **Diffuser**
Minimum Airflow ..... **0.00** L/s/person

Zone Heating Units:

Zone ..... **All**
Zone Heating Unit Type ..... **None**
Zone Unit Heat Source ..... **Electric Resistance**
Zone Heating Unit Schedule ..... **JFMAMJJASOND**

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:

Hydronic Sizing Specifications:

Chilled Water Delta-T ..... **5.6** °K
Hot Water Delta-T ..... **11.1** °K

Safety Factors:

Cooling Sensible ..... **10** %
Cooling Latent ..... **10** %
Heating ..... **10** %

4.5 AIR SYSTEM SIZING SUMMARAIR

Capacitor Bank System

Air System Information

Air System Name ..... **Capacitor Bank System**
Equipment Class ..... **TERM**
Air System Type ..... **SPLT-FC**
Number of zones **1**
Floor Area ..... **24.7** m²
Location ..... **Binak, IRAN**

Sizing Calculation Information

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**
Zone L/s Sizing ..... **Sum of space airflow rates**
Space L/s Sizing ..... **Individual peak space loads**

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (kW)	Design Airflow (L/s)	Minimum Airflow (L/s)	Time of Peak Load	Maximum Heating Load (kW)	Zone Floor Area (m²)	Zone L/(s-m²)
Zone 1	6.5	448	448	Jul 1500	0.4	24.7	18.15

Terminal Unit Sizing Data - Cooling

Zone Name	Total Coil Load (kW)	Sens Coil Load (kW)	Coil Entering DB / WB (°C)	Coil Leaving DB / WB (°C)	Water Flow @ 5.6 °K (L/s)	Time of Peak Load
Zone 1	7.4	6.4	30.6 / 22.1	18.7 / 17.9	-	Jul 1600

Terminal Unit Sizing Data - Heating, Fan, Ventilation

Zone Name	Heating Coil Load (kW)	Heating Coil Ent/Lvg DB (°C)	Htg Coil Water Flow @11.1 °K (L/s)	Fan Design Airflow (L/s)	Fan Motor (BHP)	Fan Motor (kW)	OA Vent Design Airflow (L/s)
Zone 1	0.4	10.1 / 10.7	-	448	0.000	0.000	0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m²)	Space L/(s-m²)
Zone 1							
01-Capacitor Bank	1	6.5	Jul 1500	448	0.4	24.7	18.15

Elec. Building System

Air System Information

Air System Name ..... **Elec. Building**
Equipment Class ..... **PKG ROOF**
Air System Type ..... **SZCAV**
Number of zones **1**
Floor Area ..... **286.4** m²
Location ..... **Binak, IRAN**

Sizing Calculation Information

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**
Zone L/s Sizing ..... **Sum of space airflow rates**
Space L/s Sizing ..... **Individual peak space loads**

Central Cooling Coil Sizing Data

Total coil load ..... **107.7** kW
Sensible coil load ..... **78.6** kW
Coil L/s at Aug 1500 ..... **3768** L/s
Max block L/s ..... **3768** L/s
Sum of peak zone L/s ..... **3768** L/s
Sensible heat ratio **0.730**
m²/kW **2.7**
W/m² **375.9**
Water flow @ 5.6 °K rise ..... **N/A**
Load occurs at ..... **Aug 1500**
OA DB / WB ..... **41.0 / 30.5** °C
Entering DB / WB ..... **32.6 / 22.2** °C
Leaving DB / WB ..... **15.3 / 14.4** °C
Coil ADP ..... **13.3** °C
Bypass Factor **0.100**
Resulting RH ..... **36** %
Design supply temp. ..... **14.4** °C
Zone T-stat Check ..... **1 of 1** OK
Max zone temperature deviation ..... **0.0** °K

Central Heating Coil Sizing Data

Max coil load ..... **4.5** kW
Coil L/s at Des Htg ..... **3768** L/s
Max coil L/s ..... **3768** L/s
Water flow @ 11.1 °K drop ..... **N/A**
Load occurs at ..... **Des Htg**
W/m² **15.9**
Ent. DB / Lvg DB ..... **9.1 / 10.1** °C

Supply Fan Sizing Data

Actual max L/s ..... **3768** L/s
Standard L/s ..... **3764** L/s
Actual max L/(s-m²) ..... **13.16** L/(s-m²)
Fan motor BHP ..... **0.00** BHP
Fan motor kW ..... **0.00** kW
Fan static ..... **0** Pa

Outdoor Ventilation Air Data

Design airflow L/s ..... **722** L/s
L/(s-m²) ..... **2.52** L/(s-m²)
L/s/person ..... **0.00** L/s/person

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (kW)	Design Airflow (L/s)	Minimum Airflow (L/s)	Time of Peak Load	Maximum Heating Load (kW)	Zone Floor Area (m²)	Zone L/(s-m²)
Zone 1	70.7	3768	3768	Jul 0800	1.5	286.4	13.16

Zone Terminal Sizing Data

No Zone Terminal Sizing Data required for this system.

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m²)	Space L/(s-m²)
Zone 1							
02-High Voltage Room	1	26.2	Jul 0800	1395	0.7	129.8	10.75
03-Low Voltage Room	1	44.5	Jul 0800	2374	0.8	156.6	15.16

4.6 VENTILATION SIZING SUMMARY

Capacitor Bank System

1. Summary

Ventilation Sizing Method ..... **ASHRAE Std 62.1-2010**
Design Condition ..... **Cooling operation**

2. Space Ventilation Analysis Table

Zone Name / Space Name	Mult.	Supply Air (L/s) (Vpz)	Space Floor Area (m²) (Az)	Area Outdoor Air Rate (L/(s-m²)) (Ra)	Time Averaged Occupancy (Occupants) (Pz)	People Outdoor Air Rate (L/s/person) (Rp)	Air Distribution Effectiveness (Ez)	Space Outdoor Air (L/s) (Voz)	Breathing Zone Outdoor Air (L/s) (Vbz)	Space Ventilation Efficiency (Evz)
Zone 1										
01-Capacitor Bank	1	448	24.7	0.00	0.0	0.00	1.00	**0**	*0*	1.000
Totals (incl. Space Multipliers)		**448**							**0**	**1.000**

Elec. Building System

1. Summary

Ventilation Sizing Method ..... **Sum of Space OA Airflows**
Design Ventilation Airflow Rate ..... **722** L/s

2. Space Ventilation Analysis Table

Zone Name / Space Name	Mult.	Floor Area (m²)	Maximum Occupants	Maximum Supply Air (L/s)	Required Outdoor Air (L/s/person)	Required Outdoor Air (L/(s-m²))	Required Outdoor Air (L/s)	Required Outdoor Air (% of supply)	Uncorrected Outdoor Air (L/s)
Zone 1									
02-High Voltage Room	1	129.8	0.0	1394.9	0.00	0.00	332.7	0.0	332.7
03-Low Voltage Room	1	156.6	0.0	2373.5	0.00	0.00	389.4	0.0	389.4
Totals (incl. Space Multipliers)				**3768.4**					**722.1**

4.7 AIR SYSTEM DESIGN LOAD SUMMARY:

Capacitor Bank System

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 40.6 °C / 30.4 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 6.0 °C / 4.4 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	39 m²	82	-	39 m²	46	-
Roof Transmission	25 m²	268	-	25 m²	94	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	3 m²	64	-	3 m²	31	-
Floor Transmission	25 m²	0	-	25 m²	23	-
Partitions	42 m²	169	-	42 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	11	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4920 W	4920	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	358	853	-	136	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	587	85	10%	33	0
>> Total Zone Loads	**-**	**6459**	**938**	**-**	**362**	**0**
Zone Conditioning	-	6417	938	-	371	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 L/s	0	-	0 L/s	0	-
Ventilation Load	0 L/s	0	0	0 L/s	0	0
Ventilation Fan Load	0 L/s	0	-	0 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**6417**	**938**	**-**	**371**	**0**
Terminal Unit Cooling	-	6417	950	-	0	0
Terminal Unit Heating	-	0	-	-	371	-
>> Total Conditioning	**-**	**6417**	**950**	**-**	**371**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Elec. Building System

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 41.0 °C / 30.5 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 6.0 °C / 4.4 °C		
ZONE LOADS	**Details**	**Sensible (W)**	**Latent (W)**	**Details**	**Sensible (W)**	**Latent (W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	118 m²	236	-	118 m²	137	-
Roof Transmission	286 m²	2907	-	286 m²	1086	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	11 m²	274	-	11 m²	132	-
Floor Transmission	286 m²	536	-	286 m²	0	-
Partitions	172 m²	713	-	172 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	140	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	58321 W	58318	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	6312	0	10%	136	0
>> Total Zone Loads	**-**	**69437**	**0**	**-**	**1491**	**0**
Zone Conditioning	-	69529	0	-	1189	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	3768 L/s	0	-	3768 L/s	0	-
Ventilation Load	722 L/s	9079	29054	722 L/s	3360	0
Supply Fan Load	3768 L/s	0	-	3768 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**78608**	**29054**	**-**	**4548**	**0**
Central Cooling Coil	-	78608	29055	-	0	0
Central Heating Coil	-	0	-	-	4548	-
>> Total Conditioning	**-**	**78608**	**29055**	**-**	**4548**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

4.8 ZONE DESIGN LOAD SUMMARY:

Capacitor Bank System

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 41.0 °C / 30.5 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 6.0 °C / 4.4 °C		
	OCCUPIED T-STAT 30.0 °C			OCCUPIED T-STAT 10.0 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	39 m²	81	-	39 m²	46	-
Roof Transmission	25 m²	272	-	25 m²	94	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	3 m²	65	-	3 m²	31	-
Floor Transmission	25 m²	0	-	25 m²	23	-
Partitions	42 m²	174	-	42 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	12	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4920 W	4920	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	373	843	-	136	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	590	84	10%	33	0
>> Total Zone Loads	**-**	**6486**	**928**	**-**	**362**	**0**

Elec. Building System

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 0800 COOLING OA DB / WB 28.4 °C / 27.8 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 6.0 °C / 4.4 °C		
	OCCUPIED T-STAT 30.0 °C			OCCUPIED T-STAT 10.0 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	118 m²	270	-	118 m²	137	-
Roof Transmission	286 m²	3448	-	286 m²	1086	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	11 m²	-27	-	11 m²	132	-
Floor Transmission	286 m²	-406	-	286 m²	0	-
Partitions	172 m²	-541	-	172 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	5728 W	3194	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	58321 W	58318	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	6426	0	10%	136	0
>> Total Zone Loads	**-**	**70681**	**0**	**-**	**1491**	**0**

4.9 SPACE DESIGN LOAD SUMMARY:

Capacitor Bank System

TABLE 1.1.A. COMPONENT LOADS FOR SPACE " 01-Capacitor Bank " IN ZONE " Zone 1 "						
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 41.0 °C / 30.5 °C OCCUPIED T-STAT 30.0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 6.0 °C / 4.4 °C OCCUPIED T-STAT 10.0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	Details	(W)	(W)	Details	(W)	(W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	39 m²	81	-	39 m²	46	-
Roof Transmission	25 m²	272	-	25 m²	94	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	3 m²	65	-	3 m²	31	-
Floor Transmission	25 m²	0	-	25 m²	23	-
Partitions	42 m²	174	-	42 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	12	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4920 W	4920	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	373	843	-	136	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	590	84	10%	33	0
>> Total Zone Loads	**-**	**6486**	**928**	**-**	**362**	**0**

TABLE 1.1.B. ENVELOPE LOADS FOR SPACE " 01-Capacitor Bank " IN ZONE " Zone 1 "						
				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²-°K))	Coeff.	(W)	(W)	(W)
NNW EXPOSURE						
WALL	26	0.291	-	47	-	30
ENE EXPOSURE						
WALL	13	0.291	-	34	-	15
DOOR	3	3.000	-	65	-	31
H EXPOSURE						
ROOF	25	0.948	-	272	-	94

Elec. Building System

TABLE 1.1.A. COMPONENT LOADS FOR SPACE " 02-High Voltage Room " IN ZONE " Zone 1 "						
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 0800 COOLING OA DB / WB 28.4 °C / 27.8 °C OCCUPIED T-STAT 30.0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 6.0 °C / 4.4 °C OCCUPIED T-STAT 10.0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	68 m²	146	-	68 m²	79	-
Roof Transmission	130 m²	1562	-	130 m²	492	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	4 m²	-11	-	4 m²	53	-
Floor Transmission	130 m²	-184	-	130 m²	0	-
Partitions	43 m²	-137	-	43 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	2596 W	1448	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	20960 W	20959	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	2378	0	10%	62	0
>> Total Zone Loads	**-**	**26162**	**0**	**-**	**687**	**0**

TABLE 1.1.B. ENVELOPE LOADS FOR SPACE " 02-High Voltage Room " IN ZONE " Zone 1 "						
				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²-°K))	Coeff.	(W)	(W)	(W)
NNW EXPOSURE						
WALL	51	0.291	-	103	-	59
ENE EXPOSURE						
WALL	17	0.291	-	44	-	20
DOOR	4	3.000	-	-11	-	53
H EXPOSURE						
ROOF	130	0.948	-	1562	-	492

TABLE 1.2.A. COMPONENT LOADS FOR SPACE " 03-Low Voltage Room " IN ZONE " Zone 1 "

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 0800 COOLING OA DB / WB 28.4 °C / 27.8 °C OCCUPIED T-STAT 30.0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 6.0 °C / 4.4 °C OCCUPIED T-STAT 10.0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	50 m²	123	-	50 m²	58	-
Roof Transmission	157 m²	1885	-	157 m²	594	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	7 m²	-16	-	7 m²	79	-
Floor Transmission	157 m²	-222	-	157 m²	0	-
Partitions	128 m²	-404	-	128 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	3132 W	1747	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	37361 W	37359	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	4047	0	10%	73	0
>> Total Zone Loads	**-**	**44519**	**0**	**-**	**804**	**0**

TABLE 1.2.B. ENVELOPE LOADS FOR SPACE " 03-Low Voltage Room " IN ZONE " Zone 1 "

				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²-°K))	Coeff.	(W)	(W)	(W)
WSW EXPOSURE						
WALL	19	0.291	-	53	-	22
DOOR	2	3.000	-	-5	-	26
SSE EXPOSURE						
WALL	14	0.291	-	27	-	16
ENE EXPOSURE						
WALL	17	0.291	-	44	-	20
DOOR	4	3.000	-	-11	-	53
H EXPOSURE						
ROOF	157	0.948	-	1885	-	594

5.0 Equipment Selection

5.1 AIR CONDITIONING UNIT (SPLIT UNIT)

Capacitor Bank System

Item	Service Area Capacitor Bank
Calculated Sensible Cooling Load(w)	6486
Calculated Latent Cooling Load(w)	928
Calculated Total Cooling Load(w)	7414
Calculated Total Cooling Load (btu/hr)	25320
Calculated Sensible Heating Load(w)	362
Calculated Sensible Heating Load (btu/hr)	1236
Eq. ID (1202-SUI/SUO-GCSEB-XX)	01
Equipment QTY.	1 duty / 1 standby
Equipment Type	W.M.*
Eq. Calculated Cooling Load+ 10% Over Cap. (btu/hr)	27852
Eq. Calculated Heating Load+ 10% Over Cap. (btu/hr)	1360
Selected Eq. Nominal Cooling Cap. (btu/hr)	B.V.**
Selected Eq. Actual Cooling Cap. (btu/hr)	B.V.**
Selected Eq. Actual Heating Cap. (btu/hr)	B.V.**
Power Supply (V/PH/Hz)	230/1/50
Max. Power Consumption (w) Eq. (Cooling/Heating)	B.V.**
REMARKE ***	Cooling & Heating (Heat Pump)

*Wall Mounted Split unit

**By Vendor

***Indoor & Outdoor Unit-T3, With Thermostat and All Standard Accessory

Elec. Building System

Existing Package Unit:

PACKAGE UNIT SCHEDULE		
Performance	Tag No. : PU-02-01 , PU-02-02	
	Cooling Capacity: 53400 KCAL/HR	
	Nominal Tonnage: 25 TON	
	Supply Air:12000 CMH – Fresh Air :2550 CMH	
	SUMMER	Air Inlet Temp. :80.5/68.8 °F Leaving Temp. :57.7/56.6 °F
Elec. Data	400-3-50	
Physical Data	Dimensions:5200×2000×174 mm	
	Operating Weight=1970 kg	
Designation & Quantity	P.U-2 QTY=1	
	MAX. Ambient Temp.= 125 °F	
Com. Data	Elec. Power =25 HP 400-3-50	
	Thermal =75450 Kcal/Hr	
Condenser Data	QTY=2	
	HP=3 HP	
Fan Data	Elec.-400-3-50	
	RPM=1450	
Model	Similar to SARAN P.U. Model SPAR 25-1 Roof Top	
Quantity	QTY.=2 One as Standby	

High Voltage and Low Voltage Room:

Central Cooling Coil Sizing Data (From Hap 4.9)

Total coil load ..... **107.7** kW
Sensible coil load ..... **78.6** kW
Coil L/s at Aug 1500 ..... **3768** L/s
Max block L/s ..... **3768** L/s
Sum of peak zone L/s ..... **3768** L/s
Sensible heat ratio **0.730**
m²/kW **2.7**
W/m² **375.9**

Existing Package Unit Actual Total Cooling Capacity = 53400 kcal/hr = 17.8 ton = 62.6 kW

Total Cooling Load – Package Unit Cooling Capacity = 107.7 – 62.6 = 45.1 kW

LV & HV Rooms Split units new loads = 45.1 kW

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Cooling Latent (kW)	Heating (kW)
02-High Voltage Room	1	26.162	0	0.687
03-Low Voltage Room	1	44.519	0	0.804

Low Voltage Room load Ratio= $\frac{44.5}{44.5+26.2} = \frac{44.5}{70.7}$ = 0.63

Low Voltage Room load = 0.63 × 45.1 kW = 28.413 kW
High Voltage Room load = 0.37 × 45.1 kW = 16.687 kW

Item	Service Area	
	High Voltage Room	Low Voltage Room
Calculated Sensible Cooling Load(w)	16687	28413
Calculated Latent Cooling Load(w)	0	0
Calculated Total Cooling Load(w)	16687	28413
Calculated Total Cooling Load (btu/hr)	56989	97035
Calculated Sensible Heating Load(w)	687	804
Calculated Sensible Heating Load (btu/hr)	2346	2746
Eq. ID (1202-SUI/SUO-GCSEB-XX)	02	03
Equipment QTY.	2 duty / 2 standby	2 duty / 2 standby
Equipment Type	C.T.	C.T.
Eq. Calculated Cooling Load+ 10% Over Cap. (btu/hr)	31344	53369
Eq. Calculated Heating Load+ 10% Over Cap. (btu/hr)	1290	1510
Selected Eq. Nominal Cooling Cap. (btu/hr)	B.V.**	B.V.**
Selected Eq. Actual Cooling Cap. (btu/hr)	B.V.**	B.V.**
Selected Eq. Actual Heating Cap. (btu/hr)	B.V.**	B.V.**
Power Supply (V/PH/Hz)	400/3/50	400/3/50
Max. Power Consumption (w) Eq. (Cooling/Heating)	B.V.**	B.V.**
REMARKE ***	Cooling & Heating (Heat Pump)	Cooling & Heating (Heat Pump)

* Ceiling Mounted Cassette Split unit
**By Vendor
***Indoor & Outdoor Unit-T3, With Thermostat, Control and All Standard Accessory

5.2 FAN FILTER UNIT SELECTION

1202-FFU-GCSEB-01 (Capacitor Bank + CO2 Room)

Capacitor Bank

Air Flow = 24.73 (area, m²) × 4.07 (height, m) × 1 ACH ÷ 60 min = 1.68 m³/min = 28 L/S = 59.33 cfm

CO2 Room

Air Flow = 20.13 (area, m²) × 4.57 (height, m) × 6 ACH ÷ 60 min = 9.2 m³/min = 153.3 L/S = 324.9 cfm

Item		**1202-FFU-GCSEB-01**
Service Area		Capacitor Bank + CO2 Room
Equipment QTY.		1
Air Flow(L/S)		181.3
Air Flow(CFM)		384.23
Internal Pressure Drop (In.WG.)	Sand Tarp Louver	By Vendor
	V-Type Aluminium Filter	By Vendor
	Bag Filter (95% Efficiency)	By Vendor
Component Pressure Drop (External) (In.WG.)	Blast Proof Valve-01	0.200
	Fire Damper-01	0.150
	Intake Air Duct	0.050
	Intake Air Duct Volume Damper	0.040
	Intake Air Diffuser	0.026
Total External Pressure Drop * + 10% Over S.F.	(In.WG.)	0.466
	(Pa)	115.96
Fan type		Centrifugal
Power Supply (V/PH/Hz)		230/1/50
Power Consumption (w) Each Eq.		By Vendor
REMARKE		Equipped With Bird Mesh, Sand Tarp Louver, V-Type Aluminium Filter and Bag Filter (95% Efficiency).

* Total Pressure Drop (External + Internal) Shall Be Specified By Vendor.

5.3 EXHAUST FAN SELECTION

1202-EF-GCSEB-01 (Capacitor Bank + CO2 Room)

Capacitor Bank

Air Flow = 24.73 (area, m²) × 4.07 (height, m) × 1 ACH ÷ 60 min = 1.68 m³/min = 28 L/S = 59.33 cfm

CO2 Room

Air Flow = 20.13 (area, m²) × 4.57 (height, m) × 6 ACH ÷ 60 min = 9.2 m³/min = 153.3 L/S = 324.9 cfm

Item		1202-EF-GCSEB-01
Service Area		Capacitor Bank + CO2 Room
Equipment QTY.		1
Air Flow(L/S)		181.3
Air Flow(CFM)		384.23
Component Pressure Drop (External) (In.WG.)	Exhaust Air Diffuser/Register	0.028
	Exhaust Air Duct Volume Damper	0.050
	Exhaust Air Duct	0.031
	Blast Proof Valve-02	0.200
	Fire Damper-02	0.150
Total Pressure Drop * + 10% Over S.F.	(In.WG.)	0.459
	(Pa)	114.22
Exhaust Fan type		Utility Ex. Fan (Centrifugal)
Power Supply (V/PH/Hz)		230/1/50
Power Consumption (w) Each Eq.		By Vendor
REMARKE		Equipped With Bird Mesh and Gravity Damper

* Total Pressure Drop (External + Internal) Shall Be Specified By Vendor.

Battery Room Exhaust Fan:

Air Flow = 25.64 (area, m²) × 4.07 (height, m) × 10 ACH ÷ 60 min = 17.39 m³/min = 289.83 L/S = 614.12 cfm = 1043 m³/hr

Wall Mounted Exhaust Fan Pressure Drop: 15 Pa

"This Fan is Existing and Battery Room Air Exhaust Directly from Inside Battery Room"