|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **طرح نگهداشت و افزایش تولید 27 مخزن** | | | | | | | |
| **HVAC CALCULATION NOTE FOR SWITCHGEAR BUILDING – BK14**  **نگهداشت و افزایش تولید میدان نفتی بینک** | | | | | | | |
|  | |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |
| D00 | | JAN. 2023 | IFC | H.Adineh | M.Fakharian | M.Mehrshad |  |
| **Rev.** | | **Date** | **Purpose of Issue/Status** | **Prepared by:** | **Checked by:** | **Approved by:** | **CLIENT Approval** |
| **Class: 2** | | | **CLIENT Doc. Number:** **F0Z-708190** | | | | |
| **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**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |  | **PAGE** | **D00** | **D01** | **D02** | **D03** | **D04** |
| **1** | X |  |  |  |  | **66** |  |  |  |  |  |
| **2** | X |  |  |  |  | **67** |  |  |  |  |  |
| **3** | X |  |  |  |  | **68** |  |  |  |  |  |
| **4** | X |  |  |  |  | **69** |  |  |  |  |  |
| **5** | X |  |  |  |  | **70** |  |  |  |  |  |
| **6** | X |  |  |  |  | **71** |  |  |  |  |  |
| **7** | X |  |  |  |  | **72** |  |  |  |  |  |
| **8** | X |  |  |  |  | **73** |  |  |  |  |  |
| **9** | X |  |  |  |  | **74** |  |  |  |  |  |
| **10** | X |  |  |  |  | **75** |  |  |  |  |  |
| **11** | X |  |  |  |  | **76** |  |  |  |  |  |
| **12** | X |  |  |  |  | **77** |  |  |  |  |  |
| **13** | X |  |  |  |  | **78** |  |  |  |  |  |
| **14** | X |  |  |  |  | **79** |  |  |  |  |  |
| **15** | X |  |  |  |  | **80** |  |  |  |  |  |
| **16** | X |  |  |  |  | **81** |  |  |  |  |  |
| **17** | X |  |  |  |  | **82** |  |  |  |  |  |
| **18** | X |  |  |  |  | **83** |  |  |  |  |  |
| **19** | X |  |  |  |  | **84** |  |  |  |  |  |
| **20** | X |  |  |  |  | **85** |  |  |  |  |  |
| **21** | X |  |  |  |  | **86** |  |  |  |  |  |
| **22** | X |  |  |  |  | **87** |  |  |  |  |  |
| **23** |  |  |  |  |  | **88** |  |  |  |  |  |
| **24** | X |  |  |  |  | **89** |  |  |  |  |  |
| **25** | X |  |  |  |  | **90** |  |  |  |  |  |
| **26** | X |  |  |  |  | **91** |  |  |  |  |  |
| **27** | X |  |  |  |  | **92** |  |  |  |  |  |
| **28** | X |  |  |  |  | **93** |  |  |  |  |  |
| **29** | X |  |  |  |  | **94** |  |  |  |  |  |
| **30** | X |  |  |  |  | **95** |  |  |  |  |  |
| **31** | X |  |  |  |  | **96** |  |  |  |  |  |
| **32** | X |  |  |  |  | **97** |  |  |  |  |  |
| **33** |  |  |  |  |  | **98** |  |  |  |  |  |
| **34** |  |  |  |  |  | **99** |  |  |  |  |  |
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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.

**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. |

1. **Scope**

This document covers minimum necessary requirements for basis of design and main equipment’s to be used for the Heating, Ventilating, Air-Conditioning and pressurizing and plumbing system for buildings for project

1. **NORMATIVE REFERENCES**

## Local Codes and Standards

* IPS Iranian petroleum standards
* INBC Iranian National Building Code

## 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](http://www.awwa.org/)
* ASME [The American Society of Mechanical Engineers](https://www.asme.org/)

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

## ENVIRONMENTAL DATA

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

1. **HVAC CALCULATION**

## Design weather Parameters:

## Design Parameters:

City Name …………………………………………………………………………**bink**

Location **IRAN**

Latitude **30.3** Deg. Longitude **-50.2** 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 **6.0** °C Atmospheric Clearness Number **1.00** Average Ground Reflectance **0.20**

Soil Conductivity **1.385** W/(m-°K) Local Time Zone (GMT +/- N hours) **-1.0** hours Consider Daylight Savings Time **No** Simulation Weather Data **none N/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 | 76.4 | 76.4 | 104.1 | 335.1 | 577.4 | 722.3 | 796.4 | 786.7 | 764.0 |
| February | 88.0 | 88.0 | 230.9 | 458.1 | 662.9 | 773.4 | 774.9 | 717.7 | 674.9 |
| March | 100.7 | 108.6 | 368.7 | 585.3 | 707.6 | 758.3 | 705.1 | 595.4 | 528.1 |
| April | 113.1 | 256.3 | 472.2 | 642.7 | 716.0 | 679.9 | 580.0 | 422.9 | 334.5 |
| May | 124.2 | 353.9 | 534.8 | 663.8 | 694.2 | 620.4 | 475.0 | 290.9 | 209.6 |
| June | 157.8 | 384.6 | 558.6 | 667.1 | 676.8 | 585.8 | 428.0 | 240.6 | 172.3 |
| July | 127.6 | 344.7 | 537.1 | 656.3 | 678.1 | 598.4 | 463.4 | 281.6 | 203.3 |
| August | 118.2 | 248.3 | 466.5 | 623.6 | 687.8 | 654.3 | 558.9 | 407.2 | 322.5 |
| September | 104.5 | 113.3 | 336.6 | 555.0 | 683.3 | 716.4 | 681.4 | 580.5 | 517.4 |
| October | 90.9 | 90.9 | 201.8 | 462.7 | 636.7 | 736.7 | 756.5 | 701.7 | 660.0 |
| November | 77.8 | 77.8 | 98.3 | 345.3 | 551.3 | 718.6 | 773.6 | 774.1 | 756.1 |
| December | 71.4 | 71.4 | 71.4 | 269.7 | 530.8 | 696.4 | 785.4 | 795.0 | 786.8 |
| **Month** | **SSW** | **SW** | **WSW** | **W** | **WNW** | **NW** | **NNW** | **HOR** | **Mult** |
| January | 789.5 | 796.9 | 721.1 | 569.2 | 354.1 | 83.2 | 76.4 | 579.3 | 1.00 |
| February | 722.0 | 781.4 | 766.3 | 669.5 | 467.5 | 224.5 | 88.0 | 702.0 | 1.00 |
| March | 596.6 | 704.4 | 761.1 | 720.6 | 569.4 | 368.1 | 116.6 | 809.9 | 1.00 |
| April | 421.4 | 576.3 | 689.2 | 714.5 | 631.4 | 476.0 | 257.9 | 863.7 | 1.00 |
| May | 289.5 | 470.8 | 624.0 | 691.1 | 655.0 | 542.6 | 355.7 | 877.6 | 1.00 |
| June | 238.3 | 421.9 | 590.9 | 670.1 | 656.4 | 565.4 | 389.3 | 873.7 | 1.00 |
| July | 278.1 | 456.2 | 609.2 | 671.7 | 644.3 | 540.2 | 353.4 | 863.9 | 1.00 |
| August | 405.5 | 554.8 | 664.2 | 689.2 | 610.9 | 463.3 | 256.0 | 845.0 | 1.00 |
| September | 580.7 | 681.6 | 714.0 | 684.8 | 554.4 | 333.4 | 114.2 | 785.9 | 1.00 |
| October | 698.5 | 750.4 | 744.7 | 624.3 | 458.7 | 216.5 | 90.9 | 693.3 | 1.00 |
| November | 770.3 | 775.6 | 718.6 | 559.7 | 335.4 | 103.0 | 77.8 | 579.1 | 1.00 |
| December | 796.5 | 774.3 | 701.4 | 517.9 | 296.9 | 71.4 | 71.4 | 527.6 | 1.00 |

## CONSTRUCTIONS U-VALUE:

**External Wall**

**Wall Details**

    Outside Surface Color   **Medium**

    Absorptivity   **0.675**

    Overall U-Value   **0.589** W/(m²-°K)

**Wall Layers Details (Inside to Outside)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Thickness** | **Density** | **Specific Ht.** | **R-Value** | **Weight** |
| **Layers** | **mm** | **kg/m³** | **kJ / (kg - °K)** | **(m²-°K)/W** | **kg/m²** |
| Inside surface resistance | 0.000 | 0.0 | 0.00 | 0.12064 | 0.0 |
| concrete block | 250.000 | 2000.0 | 0.84 | 0.23750 | 500.0 |
| insulation | 50.000 | 40.0 | 0.92 | 1.19000 | 2.0 |
| 100mm face brick | 100.000 | 2002.3 | 0.92 | 0.09000 | 200.2 |
| Outside surface resistance | 0.000 | 0.0 | 0.00 | 0.05864 | 0.0 |
| **Totals** | **400.000** | **-** |  | **1.69678** | **702.2** |

**External Roof**

**Roof Details**

    Outside Surface Color   **Dark**

    Absorptivity   **0.900**

    Overall U-Value   **0.642** W/(m²-°K)

**Roof Layers Details (Inside to Outside)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Thickness** | **Density** | **Specific Ht.** | **R-Value** | **Weight** |
| **Layers** | **mm** | **kg/m³** | **kJ / (kg - °K)** | **(m²-°K)/W** | **kg/m²** |
| Inside surface resistance | 0.000 | 0.0 | 0.00 | 0.12064 | 0.0 |
| 50mm HW concrete | 50.000 | 2242.6 | 0.84 | 0.03000 | 112.1 |
| poly styrene block | 200.000 | 10.0 | 0.84 | 0.59000 | 2.0 |
| Built-up roofing | 100.000 | 1121.3 | 1.47 | 0.61467 | 112.1 |
| terrazzo | 25.000 | 0.0 | 0.84 | 0.14449 | 0.0 |
| Outside surface resistance | 0.000 | 0.0 | 0.00 | 0.05864 | 0.0 |
| **Totals** | **375.000** | **-** |  | **1.55844** | **226.3** |

**DOOR (1.0 x 2.5)**

**Door Details:**

    Gross Area   **2.5** m²

    Door U-Value   **5.8** 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**

**DOOR (2x2.5)**

**Door Details:**

    Gross Area   **5.0** m²

    Door U-Value   **5.8** 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**

## SPACE INPUT DATA:

**SWITCHGEAR ROOM**

**1. General Details:**

    Floor Area   **57.0** m²

    Avg. Ceiling Height   **5.5** m

    Building Weight   **341.8** kg/m²

**1.1. OA Ventilation Requirements:**

    Space Usage   **User-Defined**

    OA Requirement 1   **0.0** L/s

    OA Requirement 2   **0.00** L/(s-m²)

    Space Usage Defaults   **ASHRAE Standard 62.1-2007**

**2. Internals:**

**2.1. Overhead Lighting:**

    Fixture Type   **Free Hanging**

    Wattage   **368 watts**

    Ballast Multiplier   **1.20**

    Schedule   **Lighting**

**2.4. People:**

    Occupancy   **0.0** Person

    Activity Level   **Office Work**

    Sensible   **71.8** W/person

    Latent   **60.1** W/person

    Schedule   **None**

**2.2. Task Lighting:**

    Wattage   **0.00** W/m²

    Schedule   **None**

**2.5. Miscellaneous Loads:**

    Sensible   **0** W

    Schedule   **None**

    Latent   **0** W

    Schedule   **None**

**2.3. Electrical Equipment:**

    Wattage   **8000.0** Watts

    Schedule   **Equipment**

**3. Walls, Windows, Doors:**

| **Exp.** | **Wall Gross Area (m²)** | **Window 1 Qty.** | **Window 2 Qty.** | **Door 1 Qty.** |
| --- | --- | --- | --- | --- |
| WNW | 37.6 | 0 | 0 | 0 |
| ENE | 30.0 | 0 | 0 | 1 |
| ESE | 56.0 | 0 | 0 | 0 |
| SSW | 30.0 | 0 | 0 | 1 |

**3.1. Construction Types for Exposure WNW**

    Wall Type   **External Wall**

**3.2. Construction Types for Exposure ENE**

    Wall Type   **External Wall**

    Door Type   **2\*2.5**

**3.3. Construction Types for Exposure ESE**

    Wall Type   **External Wall**

**3.4. Construction Types for Exposure SSW**

    Wall Type   **External Wall**

    Door Type   **1\*2.5**

**4. Roofs, Skylights:**

| **Exp.** | **Roof Gross Area (m²)** | **Roof Slope (deg.)** | **Skylight Qty.** |
| --- | --- | --- | --- |
| H | 57.0 | 0 | 0 |

**4.1. Construction Types for Exposure H**

    Roof Type   **External Roof**

**5. Infiltration:**

 Design Cooling   **0.00** ACH

    Design Heating   **0.00** ACH

    Energy Analysis   **0.00** L/s

    Infiltration occurs at all hours.

**6. Floors:**

    Type   **Slab Floor On Grade**

    Floor Area   **57.0** m²

    Total Floor U-Value   **2.000** W/(m²-°K)

    Exposed Perimeter   **22** m

    Edge Insulation R-Value   **0.00** (m²-°K)/W

**7. Partitions:**

**7.1. 1st Partition Details:**

Partition Type   **Wall Partition**

    Area   **15.0** m²

    U-Value   **2.839** W/(m²-°K)

    Uncondit. Space Max Temp   **25.0** °C

    Ambient at Space Max Temp   **41.0** °C

    Uncondit. Space Min Temp   **10.0** °C

    Ambient at Space Min Temp   **6.0** °C**7.2. 2nd Partition Details:**

**(No partition data)**

## SYSTEM INPUT DATA:

**1. General Details:**

    Air System Name   **SWITCHGEAR BUILDING OF WELL PADS**

    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** |  |
| SWITCHGEAR ROOM | x1 |

**Thermostats and Zone Data:**

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

    Thermostat Schedule   **Fan**

    Unoccupied Cooling is   **Available**

**Common Terminal Unit Data:**

**Cooling Coil:**

    Design Supply Temperature   **14.5** °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   **Sum of Space OA Airflows**

**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:**

    Cooling Supply Temperature   **14.5** °C

    Heating Supply Temperature   **35.0** °C

**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** %

**Zone Sizing Data:**

    Zone Airflow Sizing Method   **Sum of space airflow rates**

    Space Airflow Sizing Method   **Individual peak space loads**

| **Zone** | **Supply Airflow** | **Zone Htg Unit** | **Reheat Coil** | **Ventilation** |
| --- | --- | --- | --- | --- |
|  | **(L/s)** | **(kW)** | **(kW)** | **(L/s)** |
| **1** | 577.4 | - | - | 0.0 |

**5. Equipment Data**

**Terminal Cooling Units - Air-Cooled DX**

| **Zone** | **Estimated Maximum Load  (kW)** | **Design OAT  (°C)** | **Equipment Sizing** | **Gross Cooling Capacity  (kW)** | **Capacity Oversizing Factor  (%)** | **Compressor + OD Fan Power  (kW)** | **ARI Performance Rating** | **Units** | **Conventional Cutoff OAT  (°C)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | 10.7 | 35.0 | Auto-Sized | - | 0 | - | 3.224 | EER | -17.8 |

## AIR SYSTEM SIZING SUMMARY:

**Air System Information**

    Air System Name   **SWITCHGEAR BUILDING OF WELL PADS**

    Equipment Class   **TERM**

    Air System Type   **SPLT-FC**

Number of zones   **1**

Floor Area   **57.0** 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**

|  | **Maximum** |  |  |  | **Maximum** | **Zone** |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Cooling** | **Design** | **Minimum** |  | **Heating** | **Floor** |  |
|  | **Sensible** | **Airflow** | **Airflow** | **Time of** | **Load** | **Area** | **Zone** |
| **Zone Name** | **(kW)** | **(L/s)** | **(L/s)** | **Peak Load** | **(kW)** | **(m²)** | **L/(s-m²)** |
| Zone 1 | 10.8 | 577 | 577 | Jul 1800 | 0.8 | 57.0 | 10.13 |

**Terminal Unit Sizing Data - Cooling**

|  | **Total** | **Sens** | **Coil** | **Coil** | **Water** | **Time** |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Coil** | **Coil** | **Entering** | **Leaving** | **Flow** | **of** |
|  | **Load** | **Load** | **DB / WB** | **DB / WB** | **@ 5.6 °K** | **Peak** |
| **Zone Name** | **(kW)** | **(kW)** | **(°C)** | **(°C)** | **(L/s)** | **Load** |
| Zone 1 | 10.7 | 10.7 | 30.7 / 10.8 | 15.4 / 3.4 | - | Jul 1700 |

**Terminal Unit Sizing Data - Heating, Fan, Ventilation**

|  |  | **Heating** | **Htg Coil** |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Heating** | **Coil** | **Water** | **Fan** |  |  | **OA Vent** |
|  | **Coil** | **Ent/Lvg** | **Flow** | **Design** | **Fan** | **Fan** | **Design** |
|  | **Load** | **DB** | **@11.1 °K** | **Airflow** | **Motor** | **Motor** | **Airflow** |
| **Zone Name** | **(kW)** | **(°C)** | **(L/s)** | **(L/s)** | **(BHP)** | **(kW)** | **(L/s)** |
| Zone 1 | 0.8 | 10.0 / 11.1 | - | 577 | 0.000 | 0.000 | 0 |

**Space Loads and Airflows**

|  |  | **Cooling** | **Time** | **Air** | **Heating** | **Floor** |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Zone Name /** |  | **Sensible** | **of** | **Flow** | **Load** | **Area** | **Space** |
| **Space Name** | **Mult.** | **(kW)** | **Load** | **(L/s)** | **(kW)** | **(m²)** | **L/(s-m²)** |
| ***Zone 1*** |  |  |  |  |  |  |  |
| SWITCHGEAR ROOM | 1 | 10.8 | Jul 1800 | 577 | 0.8 | 57.0 | 10.13 |

**Ventilation Sizing Summary for Switchgear Building of WELL PADS**

**1. Summary**

    Ventilation Sizing Method   **Sum of Space OA Airflows**

**2. Space Ventilation Analysis Table**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Floor** |  | **Maximum** | **Required** | **Required** | **Required** | **Required** | **Uncorrected** |
|  |  | **Area** | **Maximum** | **Supply Air** | **Outdoor Air** | **Outdoor Air** | **Outdoor Air** | **Outdoor Air** | **Outdoor Air** |
| **Zone Name / Space Name** | **Mult.** | **(m²)** | **Occupants** | **(L/s)** | **(L/s/person)** | **(L/(s-m²))** | **(L/s)** | **(% of supply)** | **(L/s)** |
| **Zone 1** |  |  |  |  |  |  |  |  |  |
| SWITCHGEAR ROOM | 1 | 57.0 | 0.0 | 577.4 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 |
| **Totals (incl. Space Multipliers)** |  |  |  | **577.4** |  |  |  |  | **0.0** |

## AIR SYSTEM DESIGN LOAD SAMMARY:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **DESIGN COOLING** | | | **DESIGN HEATING** | | |
|  | **COOLING DATA AT Jul 1700** | | | **HEATING DATA AT DES HTG** | | |
|  | **COOLING OA DB / WB 39.5 °C / 30.2 °C** | | | **HEATING OA DB / WB 6.0 °C / 6.0 °C** | | |
|  |  | **Sensible** | **Latent** |  | **Sensible** | **Latent** |
| **ZONE LOADS** | **Details** | **(W)** | **(W)** | **Details** | **(W)** | **(W)** |
| Window & Skylight Solar Loads | 0 m² | 0 | - | 0 m² | - | - |
| Wall Transmission | 146 m² | 735 | - | 146 m² | 344 | - |
| Roof Transmission | 57 m² | 679 | - | 57 m² | 146 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 8 m² | 229 | - | 8 m² | 120 | - |
| Floor Transmission | 57 m² | 0 | - | 57 m² | 82 | - |
| Partitions | 15 m² | -275 | - | 15 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 442 W | 442 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 8000 W | 8000 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 0 | 0 | - | 0 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 981 | 0 | 10% | 69 | 0 |
| **>> Total Zone Loads** | **-** | **10790** | **0** | **-** | **761** | **0** |
| Zone Conditioning | - | 10654 | 0 | - | 768 | 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** | **-** | **10654** | **0** | **-** | **768** | **0** |
| Terminal Unit Cooling | - | 10654 | 0 | - | 0 | 0 |
| Terminal Unit Heating | - | 0 | - | - | 768 | - |
| **>> Total Conditioning** | **-** | **10654** | **0** | **-** | **768** | **0** |
| **Key:** | **Positive values are clg loads** | | | **Positive values are htg loads** | | |
|  | **Negative values are htg loads** | | | **Negative values are clg loads** | | |

## ZONE DESIGN LOAD SAMMARY:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Zone 1** | **DESIGN COOLING** | | | **DESIGN HEATING** | | |
|  | **COOLING DATA AT Jul 1800** | | | **HEATING DATA AT DES HTG** | | |
|  | **COOLING OA DB / WB 37.9 °C / 29.9 °C** | | | **HEATING OA DB / WB 6.0 °C / 6.0 °C** | | |
|  | **OCCUPIED T-STAT 30.0 °C** | | | **OCCUPIED T-STAT 10.0 °C** | | |
|  |  | **Sensible** | **Latent** |  | **Sensible** | **Latent** |
| **ZONE LOADS** | **Details** | **(W)** | **(W)** | **Details** | **(W)** | **(W)** |
| Window & Skylight Solar Loads | 0 m² | 0 | - | 0 m² | - | - |
| Wall Transmission | 146 m² | 749 | - | 146 m² | 344 | - |
| Roof Transmission | 57 m² | 714 | - | 57 m² | 146 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 8 m² | 199 | - | 8 m² | 120 | - |
| Floor Transmission | 57 m² | 0 | - | 57 m² | 82 | - |
| Partitions | 15 m² | -293 | - | 15 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 442 W | 442 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 8000 W | 8000 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 0 | 0 | - | 0 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 981 | 0 | 10% | 69 | 0 |
| **>> Total Zone Loads** | **-** | **10791** | **0** | **-** | **761** | **0** |

## SPACE DESIGN LOAD SAMMARY:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **TABLE 1.1.A. COMPONENT LOADS FOR SPACE '' SWITCHGEAR ROOM '' IN ZONE '' Zone 1 ''** | | | | | | |
|  | **DESIGN COOLING** | | | **DESIGN HEATING** | | |
|  | **COOLING DATA AT Jul 1800** | | | **HEATING DATA AT DES HTG** | | |
|  | **COOLING OA DB / WB 37.9 °C / 29.9 °C** | | | **HEATING OA DB / WB 6.0 °C / 6.0 °C** | | |
|  | **OCCUPIED T-STAT 30.0 °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 | 146 m² | 749 | - | 146 m² | 344 | - |
| Roof Transmission | 57 m² | 714 | - | 57 m² | 146 | - |
| Window Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Skylight Transmission | 0 m² | 0 | - | 0 m² | 0 | - |
| Door Loads | 8 m² | 199 | - | 8 m² | 120 | - |
| Floor Transmission | 57 m² | 0 | - | 57 m² | 82 | - |
| Partitions | 15 m² | -293 | - | 15 m² | 0 | - |
| Ceiling | 0 m² | 0 | - | 0 m² | 0 | - |
| Overhead Lighting | 442 W | 442 | - | 0 | 0 | - |
| Task Lighting | 0 W | 0 | - | 0 | 0 | - |
| Electric Equipment | 8000 W | 8000 | - | 0 | 0 | - |
| People | 0 | 0 | 0 | 0 | 0 | 0 |
| Infiltration | - | 0 | 0 | - | 0 | 0 |
| Miscellaneous | - | 0 | 0 | - | 0 | 0 |
| Safety Factor | 10% / 10% | 981 | 0 | 10% | 69 | 0 |
| **>> Total Zone Loads** | **-** | **10791** | **0** | **-** | **761** | **0** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **TABLE 1.1.B. ENVELOPE LOADS FOR SPACE '' SWITCHGEAR ROOM '' IN ZONE '' Zone 1 ''** | | | | | | |
|  |  |  |  | **COOLING** | **COOLING** | **HEATING** |
|  | **Area** | **U-Value** | **Shade** | **TRANS** | **SOLAR** | **TRANS** |
|  | **(m²)** | **(W/(m²-°K))** | **Coeff.** | **(W)** | **(W)** | **(W)** |
| **WNW EXPOSURE** |  |  |  |  |  |  |
| WALL | 38 | 0.589 | - | 187 | - | 89 |
| **ENE EXPOSURE** |  |  |  |  |  |  |
| WALL | 25 | 0.589 | - | 140 | - | 59 |
| DOOR | 5 | 4.000 | - | 132 | - | 80 |
| **ESE EXPOSURE** |  |  |  |  |  |  |
| WALL | 56 | 0.589 | - | 316 | - | 132 |
| **SSW EXPOSURE** |  |  |  |  |  |  |
| WALL | 28 | 0.589 | - | 106 | - | 65 |
| DOOR | 3 | 4.000 | - | 66 | - | 40 |
| **H EXPOSURE** |  |  |  |  |  |  |
| ROOF | 57 | 0.642 | - | 714 | - | 146 |

## SYSTEM PSYCHROMETRICS:

**July DESIGN COOLING DAY, 1700**

**TABLE 1: SYSTEM DATA**

|  |  | **Dry-Bulb** | **Specific** |  |  | **Sensible** | **Latent** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Temp** | **Humidity** | **Airflow** | **CO2 Level** | **Heat** | **Heat** |
| **Component** | **Location** | **(°C)** | **(kg/kg)** | **(L/s)** | **(ppm)** | **(W)** | **(W)** |
| Ventilation Air | Inlet | 39.5 | 0.02351 | 0 | 400 | 0 | 0 |
| Vent - Return Mixing | Outlet | -17.8 | 0.00000 | 0 | 0 | - | - |
| Ventilation Fan | Outlet | -17.8 | 0.00000 | 0 | 0 | 0 | - |
| Zone Air | - | 30.7 | 0.00000 | 577 | 0 | 10654 | 0 |
| Return Plenum | Outlet | -17.8 | 0.00000 | 577 | 0 | 0 | - |

*Air Density x Heat Capacity x Conversion Factor: At sea level = 1.207; At site altitude = 1.206 W/(L/s-K)*

*Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947.6; At site altitude = 2944.1 W/(L/s)*

*Site Altitude = 10.0 m*

**TABLE 2: ZONE DATA**

|  |  | **Dry-Bulb** | **Specific** |  |  | **Sensible** | **Latent** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Temp** | **Humidity** | **Airflow** | **CO2 Level** | **Heat** | **Heat** |
| **Component** | **Location** | **(°C)** | **(kg/kg)** | **(L/s)** | **(ppm)** | **(W)** | **(W)** |
| **Zone 1 ( Cooling )** |  |  |  |  |  |  |  |
| Ventilation Air | - | - | - | 0 | - | - | - |
| Cooling Coil Inlet | - | 30.7 | 0.00002 | 577 | 0 | - | - |
| Cooling Coil Outlet | - | 15.4 | 0.00002 | 577 | 0 | 10654 | 0 |
| Heating Coil Inlet | - | 15.4 | 0.00002 | 577 | 0 | - | - |
| Heating Coil Outlet | - | 15.4 | 0.00002 | 577 | 0 | 0 | - |
| Zone Air | - | 30.7 | 0.00002 | 577 | 0 | 10654 | - |

**WINTER DESIGN HEATING**

**TABLE 1: SYSTEM DATA**

|  |  | **Dry-Bulb** | **Specific** |  |  | **Sensible** | **Latent** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Temp** | **Humidity** | **Airflow** | **CO2 Level** | **Heat** | **Heat** |
| **Component** | **Location** | **(°C)** | **(kg/kg)** | **(L/s)** | **(ppm)** | **(W)** | **(W)** |
| Ventilation Air | Inlet | 6.0 | 0.00580 | 0 | 400 | 0 | 0 |
| Vent - Return Mixing | Outlet | -17.8 | 0.00000 | 0 | 0 | - | - |
| Ventilation Fan | Outlet | -17.8 | 0.00000 | 0 | 0 | 0 | - |
| Zone Air | - | 10.0 | 0.00000 | 577 | 0 | -768 | 0 |
| Return Plenum | Outlet | -17.8 | 0.00000 | 577 | 0 | 0 | - |

*Air Density x Heat Capacity x Conversion Factor: At sea level = 1.207; At site altitude = 1.206 W/(L/s-K)*

*Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947.6; At site altitude = 2944.1 W/(L/s)*

*Site Altitude = 10.0 m*

**TABLE 2: ZONE DATA**

|  |  | **Dry-Bulb** | **Specific** |  |  | **Sensible** | **Latent** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Temp** | **Humidity** | **Airflow** | **CO2 Level** | **Heat** | **Heat** |
| **Component** | **Location** | **(°C)** | **(kg/kg)** | **(L/s)** | **(ppm)** | **(W)** | **(W)** |
| **Zone 1 ( Deadband )** |  |  |  |  |  |  |  |
| Ventilation Air | - | - | - | 0 | - | - | - |
| Cooling Coil Inlet | - | 10.0 | 0.00002 | 577 | 0 | - | - |
| Cooling Coil Outlet | - | 10.0 | 0.00002 | 577 | 0 | 0 | 0 |
| Heating Coil Inlet | - | 10.0 | 0.00002 | 577 | 0 | - | - |
| Heating Coil Outlet | - | 11.1 | 0.00002 | 577 | 0 | 768 | - |
| Zone Air | - | 10.0 | 0.00002 | 577 | 0 | -768 | - |

1. **Equipment Selection**

## Air Conditioning Unit

Switchgear Room Total Cooling Load= 10800 w ≈ 36850 btu/hr

Actual Total Cooling Load with considering 10% over capacity = 40534 btu/hr

Actual Total heating Load with considering 10% over capacity = 800 \* 1.1 \*3.412=3000 btu/hr

Split Unit Actual Cooling / Heating Capacity= 40534 / 3000 btu/hr

Switchgear Room load ÷ Quantity = 40534 btu/hr ÷ 2 = 20267 btu/hr→ 2\*split unit 24000 nominal load-wall mounted (Tropical-heat pump type)

Indoor Unit Equipment No: 1201-BK14-SUI-01 A/B

Quantity: 2

Type : wall mounted

Outdoor Unit Equipment No: 1201-BK14-SUO-01 A/B

## Exhaust fan selection

|  |  |
| --- | --- |
| Equipment No: | 1201-BK14-EF-01 |
| Quantity | 1 |
| Type | WALL MOUNTED |
| Flow Rate(L/S) | 190 ≈ (ACH-10) |
| Static Pressure | Sand trap louver:  44pa  Exhaust Air Louver:  38 pa  Total pr. Drop With 10% over design→90 pa |
| Service Area | Battery Room |
| Remarks |  |

## SAND TRAP LOUVER SELECTION

**Battery Room Sand Trap Louver (STL-01):**

Pressure Drop = 44 pa ≈ 0.174 inwg

Air Flow Rate: 190 l/s

from “**Shahrokhi Manufacturing co.**“ catalogue for Sand Trap Louver:

0.174 inwg Pressure Drop (from the SH.SAL.L table)→ =300 FPM

Air Flow Rate: l/s ≈ 403 CFM →

=403/300=1.34 → W=36” , H=18”