Base Load Power Hub (BLPH)

HVAC SYSTEM DESCRIPTION
(MANAGEMENT LOGICS)
E&I SHELTERS

Document Number: 1724000049-HV-RE-00055

ROSETTI MARINO

1	NO COMMENTS - APPROVED - WORK MAY PROCEED
2	MINOR COMMENTS - REVISE AND RESUBMIT - WORK MAY PROCEED
3	MAJOR COMMENTS – REJECTED – DO NOT PROCEED
4	APPROVAL NOT REQUIRED

NOTE: Approval doesn't relieve the supplier from mandatory compliance with contractual documents and specifications. Comments made do not imply acceptance of any cost or delivery impact.

Sign	Date
L. Caviglia	07/02/2025

Document Class: 3

Rev.	Date	Description	Prepared	Reviewed	Approved
02	05/02/2025	Issue for Information (IFI)	FM	SKV	OA
01	04/11/2024	Issue for Information (IFI)	FM	SKV	OA
00	12/06/2024	Issue for Information (IFI)	FM	SKV	OA

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Revision / Change Log

Rev.	Description
00	Issue for Information (IFI)
01	Issue for Information (IFI)
02	Issue for Information (IFI)

HOLDS LIST

No.	Description
1	
2	
3	
4	

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

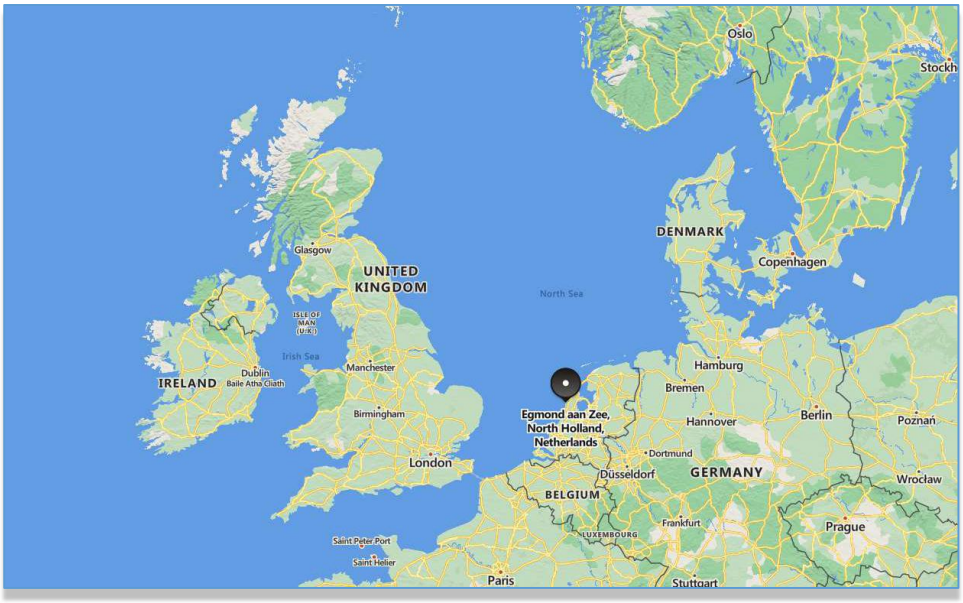


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map



Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

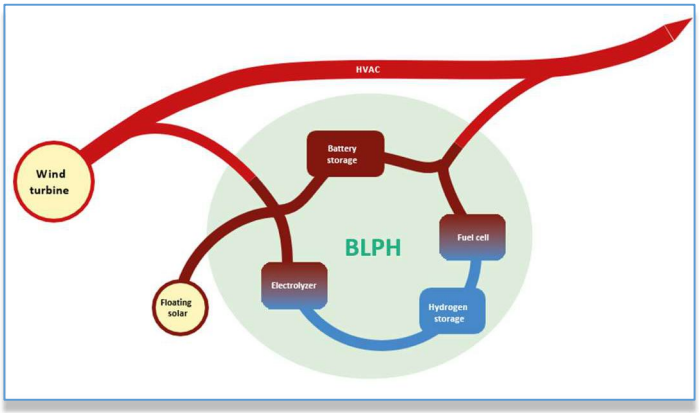


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 DOCUMENT SCOPE

The aim of this document is to describe the general configuration/operation mode of the HVAC system and provide a detailed description of HVAC control and interlocks implemented to manage the HVAC system.

2.1 REFERENCES

Doc. No.	Description
1724000049-HV-PID-00039	B-100 PID - E&I Shelters
1724000049-HV-PID-00040	B-200 PID - E&I Shelters
1724000049-HV-PID-00041	B-300 PID - E&I Shelters
1724000049-HV-PID-00042	B-400 PID - E&I Shelters
1724000049-HV-CA-00035	B-100 HVAC Calculation Report
1724000049-HV-CA-00036	B-200 HVAC Calculation Report
1724000049-HV-CA-00037	B-300 HVAC Calculation Report
1724000049-HV-CA-00038	B-400 HVAC Calculation Report
1724000049-HV-LIS-00051	B-100 HVAC IO List - E&I Shelters
1724000049-HV-LIS-00052	B-200 HVAC IO List - E&I Shelters
1724000049-HV-LIS-00053	B-300 HVAC IO List - E&I Shelters
1724000049-HV-LIS-00054	B-400 HVAC IO List - E&I Shelters
1724000049-HV-DA-00026	B-100 HVAC and Lighting Panel Wiring Drawings and General Arrangement (Incl Interconnecting) - E&I Shelters
1724000049-HV-DA-00027	B-200 HVAC and Lighting Panel Wiring Drawings and General Arrangement (Incl Interconnecting) - E&I Shelters
1724000049-HV-DA-00028	B-300 HVAC and Lighting Panel Wiring Drawings and General Arrangement (Incl Interconnecting) - E&I Shelters
1724000049-HV-DA-00029	B-400 HVAC and Lighting Panel Wiring Drawings and General Arrangement (Incl Interconnecting) - E&I Shelters

Table 1 - Reference Documents

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2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
RH	Relative Humidity
D.B.	Dry Bulb Temperature
Pa	Pascal
ACH Min.	Minimum Air Changes per Hours
AHU	Air Handling Unit
HVAC	Heating Ventilation and Air Conditioning
HMI	Human Machine Interface
PCS	Process Control System
F&G	Fire and Gas System
SIS	Safety Instrumented System
PLC	Programmable Logic Controller
SIS	Safety Instrumented System
HLCP	HVAC & Lighting Control Panel

Table 2 - Definitions and Abbreviations

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2.3 DESIGN INPUT DATA

FOR B-100 SHELTER:

Outdoor design conditions:

Summer temperature:	+25°C D.B. (Dry Bulb) with RH 90 %
Winter temperature:	-8,4°C D.B. (Dry Bulb) with RH 100 %
Shelter U-Value:	0,450 W/(m² K).
Safe Area	

Indoor design conditions:

Room Pressurization:	+50 Pa
Summer temperature:	+35°C ±2 D.B. (Dry Bulb) with RH 30÷70%
Winter temperature:	+5°C ±2 D.B. (Dry Bulb) with RH 30÷70%
Internal Load Equipment:	5 kW
ACH Min.:	6
Safe Area	

FOR B-200 SHELTER:

Outdoor design conditions:

Summer temperature:	+25°C D.B. (Dry Bulb) with RH 90 %
Winter temperature:	-8,4°C D.B. (Dry Bulb) with RH 100 %
Shelter U-Value:	0,450 W/(m² K).
Safe Area	

Indoor design conditions:

Room Pressurization:	+50 Pa
Summer temperature:	+35°C ±2 D.B. (Dry Bulb) with RH 30÷70%
Winter temperature:	+5°C ±2 D.B. (Dry Bulb) with RH 30÷70%
Internal Load Equipment:	4,5 kW
ACH Min.:	6
Safe Area	

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FOR B-300 SHELTER:

Outdoor design conditions:

Summer temperature:	+25°C D.B. (Dry Bulb) with RH 90 %
Winter temperature:	-8,4°C D.B. (Dry Bulb) with RH 100 %
Shelter U-Value:	0,450 W/(m^2 K).
Safe Area	

Indoor design conditions

Room Pressurization:	+50 Pa
Summer temperature:	+35°C ±2 D.B. (Dry Bulb) with RH 30÷70%
Winter temperature:	+5°C ±2 D.B. (Dry Bulb) with RH 30÷70%
Internal Load Equipment:	10 kW
ACH Min.:	6
Safe Area	

FOR B-400 SHELTER:

Outdoor design conditions:

Summer temperature:	+25°C D.B. (Dry Bulb) with RH 90 %
Winter temperature:	-8,4°C D.B. (Dry Bulb) with RH 100 %
Shelter U-Value:	0,450 W/(m^2 K).
Safe Area	

Indoor design conditions:

Room Pressurization:	+50 Pa
Summer temperature:	+25°C D.B. (Dry Bulb) with RH 30÷70%
Winter temperature:	+15°C D.B. (Dry Bulb) with RH 30÷70%
Internal Load Equipment:	12 kW
ACH Min.:	6
Safe Area	

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3 HVAC SYSTEM DESCRIPTION

The HVAC system ensures that the internal design conditions within each shelter are maintained, considering external design conditions and the intended purpose of the shelter.
Designed for continuous operation, the HVAC system functions 24 hours a day, 365 days a year, with all equipment capable of sustaining uninterrupted performance. HVAC system controls ambient temperature to create an environment where systems can operate efficiently. Additionally, the HVAC system prevents gas ingress by maintaining positive pressurization of shelters relative to the external area.
The internal design temperature and overpressure inside each shelter, relative to the outdoor environment, are maintained through an Air Handling Unit (AHU). This system consists of the outdoor-installed AHU, a ductwork system, and the necessary in-line equipment to deliver the required service.

For heating purposes, space heaters are installed inside the shelters. Their function is to maintain the minimum temperature during maintenance activities and to supplement heating in case the AHU alone is insufficient to sustain the minimum design temperature.

Each HVAC system is managed by the HVAC & Lighting Panel Board (HVAC Panel), installed inside the corresponding shelter (e.g., panel B100-HSB-001 for shelter B-100). The panel is equipped with an HMI for system monitoring and parameter adjustment. It also communicates via both hardwired and serial signals with the Fire & Gas (F&G) system, Process Control System (PCS), and Safety Instrumented System (SIS), as detailed in Chapter 5.

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3.1 B-100 & B-200 HVAC SYSTEM

The main system serving the B-100 and B-200 shelters consists of two redundant AHU units (2x100%), one duty and one stand-by. Each AHU works with constant air flow and elaborate 100% fresh air coming from fresh air intake provided with Coalescer Assembly to eliminate moisture and guarantee the first filtration stage for moisture. After the coalescent filter, all fresh air passes in a G4 filter and then in a F7 filter. A pressure switch is mounted across the G4 and F7 filters to monitor the status of the filter and to give a visual warning of filter clogged on the HMI.
A motorized shut-off damper is provided at inlet for maintenance and changeover purposes.

The pressurization fan is powered by an inverter (VSD) to precisely regulate the overpressure within the shelter. The overpressure is monitored by a differential pressure transducer (PDIT-77-101 for B100, PDIT-77-201 for B200), whose signal is processed by the PLC to control the fan speed.
A pressure relief damper is provided to guarantee the overpressure requested inside the module, as previously specified. An outlet duct piece with bird screen wire mesh shall be installed on the external side of the sleeve, designed to avoid rain from entering the module.

Each unit is equipped with an electric heating coil to ensure that the air introduced into the cabinet has a temperature above 5°C. A temperature sensor is installed in the supply duct, and its signal is processed by the PLC, which regulates the heating element's power via triacs. This control mechanism ensures the design temperature is maintained while minimizing energy consumption.
Inside each shelter, two temperature sensors are installed (77-TT-101/102 for B100 and 77-TT-201/202 for B200). The average of these two measurements is used to verify that the internal temperature remains within the design limits.

The AHUs operate in automatic mode (AUTO mode), with a scheduled changeover between the duty and standby units every seven days. This alternating operation ensures equal aging of both AHUs.

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3.2 B-300 & B-400 HVAC SYSTEM

The main system serving the B-300 and B-400 shelters consists of two redundant AHU units (2x100%), one duty and one stand-by. Each AHU recirculate the shelter air with an addition of the fresh air coming from fresh air intake provided with Coalescer Assembly in order to eliminate moisture and guarantee the first filtration stage for moisture. After the coalescent filter, all fresh air passes in a G4 filter and then in a F7 filter. A pressure switch is mounted across the G4 and F7 filters to monitor the status of the filter and to give a visual warning of filter clogged on the HMI. The airflow rate supplied into the shelter will be constant.
These packaged units of DX type, so called rooftop unit, consist of a pressurization fan, supply fan, refrigeration circuit, and electric heating coil.
Motorized shut-off dampers are provided at inlet, return and outlet connections for maintenance and changeover purposes.
Cooling won't be provided if the external air temperature during winter season will be sufficient to maintain the internal design temperature (free cooling).
During normal functioning, the supply air will have a constant airflow rate, and the pressurization fan will be managed by VSD in order to set and maintain the overpressure required.

The pressurization fan is powered by an inverter (VSD) to precisely regulate the overpressure within the shelter. The overpressure is monitored by a differential pressure transducer (PDIT-77-301 for B300, PDIT-77-401 for B400), whose signal is processed by the PLC to control the fan speed.
A pressure relief damper is provided to guarantee the overpressure requested inside the module, as previously specified. An outlet duct piece with bird screen wire mesh shall be installed on the external side of the sleeve, designed to avoid rain from entering the module.

Each unit is equipped with an electric heating coil to ensure that the air introduced into the cabinet has a temperature above 5°C. A temperature sensor is installed in the supply duct, and its signal is processed by the PLC, which regulates the heating element's power via triacs. This control mechanism ensures the design temperature is maintained while minimizing energy consumption.
Two temperature sensors are installed inside the shelter (77-TT-301/302 for B300 and 77-TT-401/402 for B400). The average of these two measurements is used to verify that the internal temperature remains within the design limits.

The AHUs operate in automatic mode (AUTO mode), with a scheduled changeover between the duty and standby units every seven days. This alternating operation ensures equal aging of both AHUs.

4 HVAC PANEL AND PLC ARCHITECTURE

HVAC panel is microprocessor based and will monitor and control temperature, pressure, equipment operating status, alarm conditions of the HVAC system and guarantee all safety requirements. Control set point adjustments, equipment override commands and software modifications will be accessible from the local HMI.

Manual selector switches, alarm indicator lights and a local display terminal will be installed on board the control panel.

The HVAC panel is powered by the normal feeder, while the PLC is powered by an UPS power supply to ensure continuity in operation.

Furthermore, the HVAC Panel feeds the power to all field equipment, instruments, sockets, lighting system and switches. For detailed information please refer to the shelter's wiring diagrams.

During normal operation mode, the HVAC system is designed to supply the airflow rate to maintain the correct air quality and to maintain the internal design conditions inside the shelters.

HVAC panel manages the duty/standby of the units as follows:

- in case of failure of the duty unit the system automatically switches on the standby unit;
- changeover of the units: after a design time of operation (7 days), the duty unit automatically switch on the standby unit to guarantee equal wear and tear of units.

The PLC architecture is made with a redundant CPU and decentralized peripherals for the I/O.

All shelters HVAC panel have mounted a 12" HMI to keep the system under control and visualize temperature, differential pressure, warnings or alarms related to each shelter.

The PLC gives the client a hardwired signal of critical fault and MODBUS TCP/IP information about the system status, while it receives a hardwired signal of shutdown.

No redundant MODBUS communication is provided.

Refer to doc. Shelter's I/O List for all signal lists, both hardwired and via serial connection.

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5 CONTROL AND MANAGEMENT LOGICS

5.1 OVERVIEW

Each shelter is equipped with two redundant HVAC systems to ensure that internal design conditions are consistently maintained.

HVAC equipment, including AHUs and space heaters, is powered and managed by the HVAC & Lighting Control Panel (HLCP), which also allows for remote monitoring. The HLCP automatically switches HVAC functions (e.g., from cooling to heating and vice versa) based on the temperature detected inside the shelters. Space heaters are directly controlled by the HLCP through temperature probes installed within the shelters.

All Fire & Gas (F&G) dampers are controlled by the F&G System.

The HVAC systems will be activated once the HLCP receives a START signal via Modbus from the Process Control System (PCS), provided that the SHUT-DOWN signal is not active. Activation is only possible if the fire dampers are open, preventing potential damage to HVAC units and ductwork. The HLCP will receive an open signal from each fire damper to confirm their status.

An HVAC system can be started only if the following conditions are met:

- The permissive START signal has been received from the PCS System.
- All fire dampers associated with the HVAC system are open.
- The shut-off dampers of the corresponding AHU are open.
- No faults are detected.

The duty system is switched off and the standby system is switched on if:

- One fire damper related to the duty system is closed
- The AHU is fault, which can occur if:
    - One shut-off damper is closed
    - The electrical heater is fault
    - The cooling circuit is fault
    - The fan is fault

All exchanged signals are reported in the following documents:

- 1724000049-HV-LIS-00051- B-100 HVAC IO LIST - E&I SHELTERS

- 1724000049-HV-LIS-00052- B-200 HVAC IO LIST - E&I SHELTERS
- 1724000049-HV-LIS-00053- B-300 HVAC IO LIST - E&I SHELTERS
- 1724000049-HV-LIS-00054- B-400 HVAC IO LIST - E&I SHELTERS

In case of an emergency, the Safety Instrumented System (SIS) will send a SHUT-DOWN signal, turning off the entire HVAC system. After an appropriate delay, all fire dampers will be closed by the F&G System.

In the event of a malfunction of the internal sensor in the duct connected to the operating unit, the duty unit will be shut down, a fault signal will be sent, and the standby unit will be activated.
If the internal temperature exceeds a user-defined setpoint (adjustable via HMI), the pressurization fan will be set to maximum speed to increase air changes and achieve the required temperature.
In case of differential pressure switch malfunction, the PLC will set the fan to a fixed speed (adjustable via HMI) to ensure a minimum overpressure and airflow are guaranteed.
In the event of accidental closure or malfunction of the fire damper on the discharge side of the operating unit, that unit will be shut down, and the standby unit will be switched on.

In the event of failure to open or close during operation of the exhaust fire damper (related to the pressure relief damper), the entire HVAC system will be shut down and the critical fault signal will be sent via cable (hardwired signal) to SIS.

Once this signal has been received, the HVAC panel monitors the opening of the fire dampers and will only start once they are all fully open. If one or more dampers fail to open within the specified time limit (60 seconds), a dedicated signal will be sent to the Process Control System (PCS) indicating a fire damper malfunction.

5.2 AHU SELECTORS

The HVAC panel (HLCP) will be equipped with two AUT-0-MAN selectors, one for each Air Handling Unit (AHU). If both AHUs are set to automatic (AUT), the system start will be initiated via Modbus from the PCS. Upon receiving the permissive to start signal, the HVAC system will operate automatically and will manage the logic of changeover between the units depending on the operating time or due to malfunctions.

In manual mode (MAN), the first of the two units set on this mode will start. While manual mode activates the selected unit, the PLC will still manage the overall operation to maintain the shelter's internal design conditions.

The MAN operation mode will be active until the operator maintains the selection on this mode.

To reestablish the START and STOP from remote, both selectors have to be set on AUT mode.

If a selector is set on OFF mode, the other AHU will be switched on.

Following above description, the selector positions function as follows:

1. AUT (Automatic) Position:
    - The HVAC PLC manages the HVAC system according to its internal control logic.
    - The onshore operator can remotely START or STOP the HVAC system.
    - When the onshore operator issues a START command, the HVAC system operates under the PLC's internal logic.
2. 0 (Off) Position:
    - The AHU is switched off, typically for maintenance purposes.
3. MAN (Manual) Position:
    - The HVAC PLC continues to manage the HVAC system based on its internal control logic.
    - The onshore operator is unable to remotely START or STOP the system.

When the selector is on AUT (Automatic) position the operators (from remote) shall have the ability to start/stop the HVAC package, also having the ability to initiate remote shutdown.

Although control is by the package HLCP, all necessary data shall be transmitted to the PCS so that the PCS shall act as the operator interface for both visualization and supervisory command from remote. This communication shall be done via a serial link (Modbus TCP/IP).

5.3 AHU AUTOMATIC OPERATION MODE (AUT)

HLCP Logic permits single AHU to start if all the following conditions are satisfied:

- Permissive to START signal from PCS;
- All F&G dampers open;
- No fan fault alarm;
- No Fan Discordance alarm;
- AHU shut-off dampers open;
- No AHU shut-off dampers limit switch discordance alarm;
- No general alarm;
- No filter alarm;
- No heaters fault alarm;
- HVAC set on automatic mode (AUT).

In case of one of the AHUs is UNAVAILABLE (duty unit), HLCP Logic permits single AHU to start if the above essential conditions are satisfied for the other AHU (stand-by unit).

5.4 PRESSURE DIFFERENTIAL TRANSMITTER

For differential pressure transmitters checking ambient pressurization, the Low Differential Pressure Alarm (PDAL) is foreseen and set in the PLC.

If the low pressure (less than 25 Pa) inside the shelter is detected for more than 90 seconds, then:

- The duty AHU is switched off.
- The AHU fault signal is sent to PCS via Modbus.
- The standby AHU is switched on.

After the changeover, if the low pressure (less than 25 Pa) inside the shelter is detected for more than 120 seconds, then:

- Also the standby AHU is switched off.
- The CRITICAL FAULT signal is sent to SIS.
- The HVAC system keeps running.

HLCP will generate these alarms if they will be constantly active for a settable period of time in order to avoid false alarm notifications.

A fault for broken transmitter shall be generated for each instrument.

5.5 HEATING COIL

Each stage of heating coil is provided with two safety temperature switches:

- High temperature safety switch with automatic rearm (TSH) giving high alarm. When the alarm is generated, it cuts off power supply until the supply temperature decreases under pre-determined temperature threshold value.
- High high temperature safety switch with manual rearm (TSHH) generating trip. When the trip signal is generated, it cuts off power supply and sends heating system alarm to HLCP.

The activation of a safety temperature switch results on cutting off the relevant heating coil power supply, at the same time an alarm shall be generated by HLCP.

A fault for broken transmitter shall be generated for each instrument.

Availability of heating coils are interlocked with:

- AHU running status.
- Safety Temperature Alarm of one or more stages.
- Heater Alarm (TSH, TSHH).

In case of HLCP gives a ON command to a heater stage and if it doesn't receive back a running status feedback, a discordance alarm shall be generated for the relevant stage after a settable time delay, then the duty AHU will be switched off and the standby one switched on.

5.6 FILTRATION STAGE

Filter status shall be monitored by Pressure Differential Transmitter, which communicate filter condition to the HLCP. In case of clogged filter, PDT shall generate an alarm (PDAH) to HLCP, which in turn will generate an alarm of high-level pressure.

A fault for broken transmitter shall be generated for each instrument.

5.7 AHU SHUT-OFF DAMPERS

The shut-off dampers shall be equipped with electric actuators and limit switches to provide indication of the damper open/closed status to the HLCP. The shut-off dampers shall be controlled by the HLCP. Suitable delays in damper opening/closing will be defined respect to fan start/shutdown in order to avoid any possible damages on AHUs/Fans.

Shut-off damper command and signals:

- Open command (damper powered)
- Open status
- Close Status

5.8 AHU CHANGEOVER

Duty and standby AHUs shall be provided with automatic changeover within the HLCP. If a duty AHU fails or is unavailable, the standby unit shall start automatically. AHU status shall be displayed at the HMI.

HLCP shall preform the changeover actions in order to reduce the "dead time" and limit the loss of pressurization. Time delays shall be appropriately set-up during the commissioning phase and the following sequence shall be followed:

1- HLCP gives STOP command to the relevant fan of the duty AHU (eg. Unit "1") waiting for the NO Running status.

2- HLCP gives OFF command to the relevant electric heating coils (if running) waiting for the NO Running status.
3- With a time delay of 5 second (useful to avoid critical pressure hummer on the AHU dampers), HLCP gives close command to the AHU shut-off dampers and monitors the relative limit switches close status ensuring the absence of Shut-off damper Discordance Alarm.
4- When the "1" running status is lost, at the same time, the HLCP change the priority to the AHU unit "2".
5- At the same time (without waiting the closure feedback of the Dampers), HLCP gives the OPEN command to the shut-off dampers relating the "2" unit and monitors the relative limit switches open status ensuring the absence of Shut-off damper Discordance Alarm.
6- HLCP gives the START command to the "2" unit, and thus the fan related, waiting for the Running status.
7- HLCP gives the ON command to the relevant electric heating coils (if any) waiting for the Running status.
8- If one of the AHUs fails the start procedure the HLCP will switch to the other; the HVAC general alarm will be set from HLCP and HMI, and communicated by serial link to PCS system (Modbus TCP/IP).
9- If both the AHUs fail the start procedure, the "HVAC System Critical Fault" will be set from HLCP and HMI and communicated by hardwired link to PCS system.

5.9 FAN FLOW ALARM

When HLCP receives (after a suitable settable delay of time to avoid false alarm during fans switchover) a flow alarm from the pressure differential transmitter (PDSL) mounted on fan module, it shall shut off currently operating fan and assign a fault status alarm to it; then it shall switch duty operational condition to the other unit.

5.10 FAN DISCORDANCE ALARM

When HLCP gives a start command to duty fan and, after a suitable delay of time, it doesn't receive running status feedback, a discordance alarm shall be generated for duty fan and (for duty/stand-by fans) stand-by fan shall be switched on.

Vice versa, when HLCP toggles the stop command to duty fan but, after a suitable delay of time, running status feedback is still on (i.e. contactor opening problem) a discordance alarm shall be generated for duty fan and (for duty/stand-by fans) stand-by fan shall be switched on.

5.11 AHU SHUT-OFF DAMPER DISCORDANCE ALARM

HLCP shall generate damper OPEN POSITION alarm when after 45 seconds (settable), damper open command has been given, it shall not receive relevant limit switch signal of damper opened.

HLCP shall generate damper CLOSE POSITION alarm when after 45 second (settable), damper close command has toggled, it shall not receive relevant limit switch signal of damper closed.

5.12 EMERGENCY PUSH BUTTON

In case of emergency, the AHU can be stopped manually pushing the Emergency Push Button located on the equipment and directly connected to the HLCP.

- Supply fan of the AHU is switched off and is out of the HLCP Logic.
- Motor UNAVAILABLE signal is generated by HLCP.
- Heater UNAVAILABLE signal is generated by HLCP.

Motor UNAVAILABLE signal must be reset on HLCP to restart the unit.

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6 CAUSES AND EFFECTS MATRIX

CROSSWIND

ROSETTI MARINO

BASE LOAD POWER HUB: HVAC CONTROL PANEL

CAUSE

Signal From	Description	–	EFFECT	Description	Shutdown stop all equipment	Start in automatic mode	Start	Start	Start	Start	ALLARM SIGNAL	MODBUS TCP/IP		Shutdown stop all equipment	Start in automatic mode	Start	Start	Start	Start	ALLARM SIGNAL	MODBUS TCP/IP		Shutdown stop all equipment	Start in automatic mode	Start	Start	Start	Start	ALLARM SIGNAL	MODBUS TCP/IP		Shutdown stop all equipment	Start in automatic mode	Start	Start	Start	Start	ALLARM SIGNAL	MODBUS TCP/IP
				Equipment	B100-HSB-001	B100-HSB-001	HHU-77001	HHU-77002	HHS-77-00112	HHS-77003	SIS	PCS		B200-HSB-001	B200-HSB-001	HHU-77003	HHU-77004	HHS-77-00445	HHS-77004	SIS	PCS		B300-HSB-001	B300-HSB-001	HHU-77005	HHU-77006	HHS-77-00178	HHS-77-009	SIS	PCS		B400-HSB-001	B400-HSB-001	HHU-77007	HHU-77008	HHS-77-01011	HHS-77-012	SIS	PCS
				System	HVAC	HVAC	HVAC	HVAC	HVAC	HVAC				HVAC	HVAC	HVAC	HVAC	HVAC	HVAC				HVAC	HVAC	HVAC	HVAC	HVAC	HVAC				HVAC	HVAC	HVAC	HVAC	HVAC	HVAC		
SIS	HVAC System Shutdown Actuation B100				S																																	
SIS	HVAC System Shutdown Deactivation B100					A	DUTY	STB	A	A																													
PCS	Hhvac System Stop From Modbus					S	S	S	S	S																													
B100-HSB-001	HVAC HHU-77001 malfunction					A	F	DUTY	A	A		X																											
B100-HSB-001	HVAC HHU-77002 malfunction					A	DUTY	F	A	A		X																											
B100-HSB-001	HVAC HHU-77001/2 malfunction					A	F	F			X																												
B100-HSB-001	HVAC HHU-77001 filter dogged																																					
B100-HSB-001	HVAC HHU-77002 filter dogged											X																											
SIS	HVAC System Shutdown Actuation B200													S																									
SIS	HVAC System Shutdown Deactivation B200														A	DUTY	STB	A	A																				
PCS	Hhvac System Stop From Modbus														S	S	S	S	S																				
B200-HSB-001	HVAC HHU-77003 malfunction														A	F	DUTY	A	A		X																		
B200-HSB-001	HVAC HHU-77004 malfunction														A	DUTY	F	A	A		X																		
B200-HSB-001	HVAC HHU-77003/4 malfunction														A	F	F			X																			
B200-HSB-001	HVAC HHU-77003 filter dogged																																						
B200-HSB-001	HVAC HHU-77004 filter dogged																				X																		
SIS	HVAC System Shutdown Actuation B300																					S																	
SIS	HVAC System Shutdown Deactivation B300																						A	DUTY	STB	A	A												
PCS	Hhvac System Stop From Modbus																						S	S	S	S	S												
B300-HSB-001	HVAC HHU-77005 malfunction																						A	F	DUTY	A	A		X										
B300-HSB-001	HVAC HHU-77006 malfunction																						A	DUTY	F	A	A		X										
B300-HSB-001	HVAC HHU-77005/6 malfunction																						A	F	F			X										
B300-HSB-001	HVAC HHU-77005 filter dogged																																					
B300-HSB-001	HVAC HHU-77006 filter dogged																												X									
SIS	HVAC System Shutdown Actuation B400																															S						
SIS	HVAC System Shutdown Deactivation B400																																A	DUTY	STB	A	A		
PCS	Hhvac System Stop From Modbus																																S	S	S	S	S		
B400-HSB-001	HVAC HHU-77007 malfunction																																A	F	DUTY	A	A		X
B400-HSB-001	HVAC HHU-77008 malfunction																																A	DUTY	F	A	A		X
B400-HSB-001	HVAC HHU-77007/8 malfunction																																A	F	F			X	
B400-HSB-001	HVAC HHU-77007 filter dogged																																						
B400-HSB-001	HVAC HHU-77008 filter dogged																																						X

S : SHUTDOWN
A: AUTOMATIC
DUTY : UNIT START
STD: UNIT STAND BY
F: UNIT FAULT
X: SIGNAL TO

NOTES: