PHOEBUS
ENERGY

Solution Description

Hydra Balance

1. General

Hotels, hospitals, sport centers, elderly houses and other corporative buildings consume large amounts of energy to heat and cool water for showers, swimming pools, enclosed spaces, air cooling and other general purposes. The Hydra Balance Solution reduces the cost of the energy for such corporative institutions by 60% to 75%.

The solution is available for sites with Air Conditioning systems operational most of the year.

Hydra Balance is a hybrid water system managed by smart cloud software.

The system is composed of the following:

- Hydra Balance units
- Hydra Monitoring & Control Module
- Hydra Monitoring & Control Cloud Software

Figure 1 shows the integration of the Hydra Balance solution into existing A/C and water heating systems.

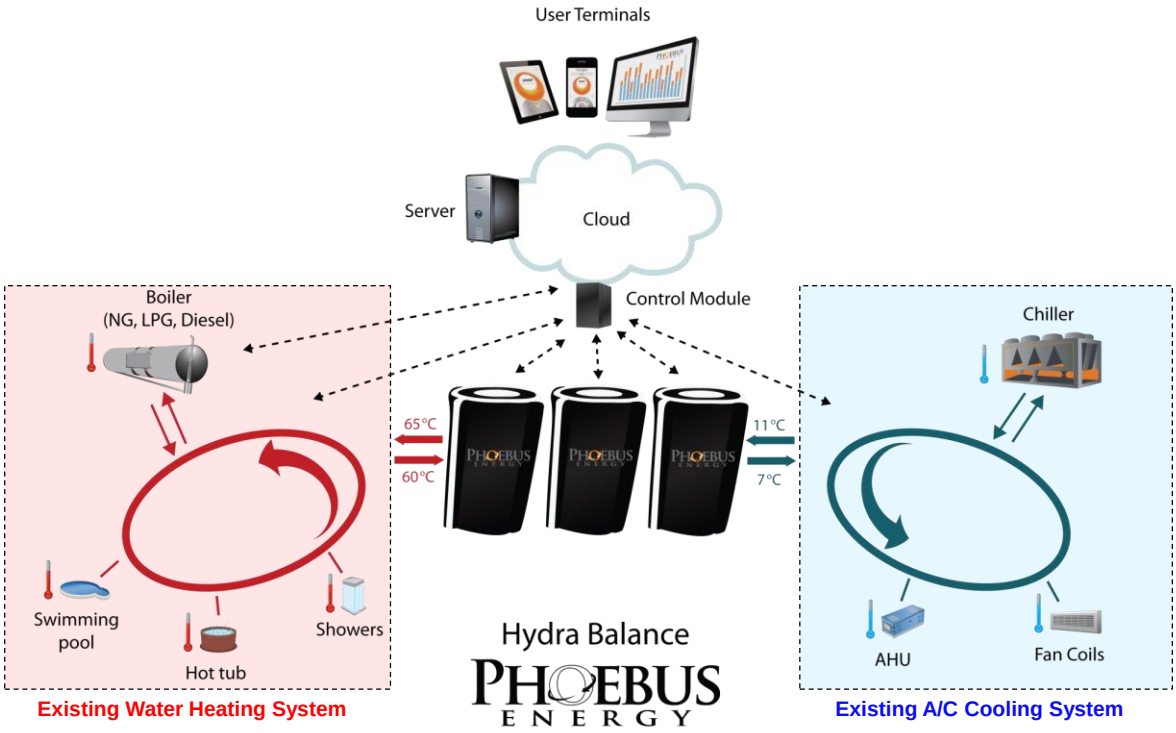


Figure 1: Hydra Balance Solution– Thermic grid

Hydra Balance Unit:

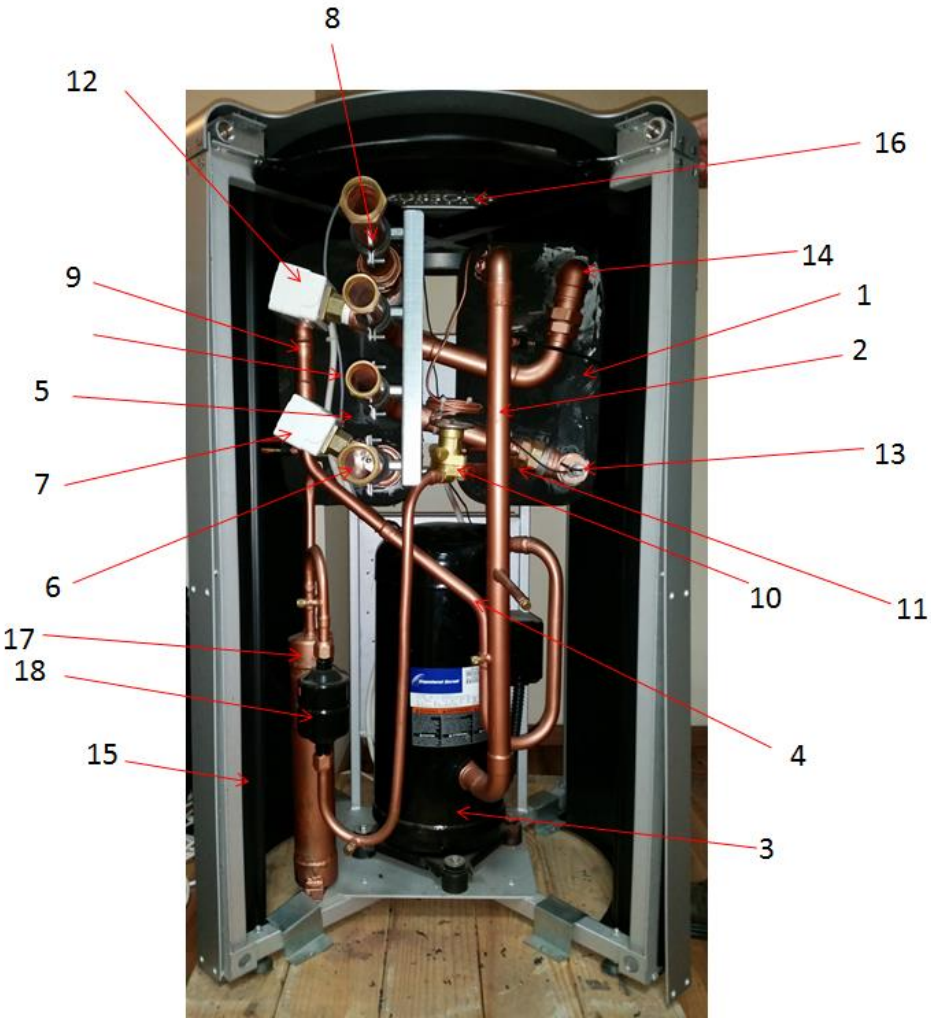
A Hydra Balance unit is a designated water source heat pump, which pumps the thermal energy from the cold water A/C loop, and uses it in order to heat the water in a hot sanitary water loop.
An Hydra Balance unit has a heating capacity of 25kW and a cooling supply capacity of 17kW.
The Hydra Balance reduces energy costs not only by producing heat energy but also by reducing the Air Conditioning electricity consumption.

Figure 2: Hydra Balance Unit

Hydra Balance Unit operating cycle principle:

A low pressure liquid refrigerant (R134a) enters an **evaporator,** in which the fluid absorbs thermal energy (latent heat) from an A/C water cooling loop, and evaporates. The fluid now in its gaseous phase is pressurized by a **compressor** and circulated through the unit. On the discharge side of the compressor, now hot and highly pressurized vapor is cooled in a **condenser** until it condenses into a high pressure, moderate temperature liquid. The thermal energy (latent heat) absorbed in the evaporation phase is now released into a hot sanitary water loop. The condensed refrigerant then passes

through an **expansion valve** lowering its pressure to the starting level. The low pressure liquid refrigerant then returns to the evaporator and the cycle is repeated.



1	Evaporator
2	Low temp'/pressure refrigerant (GAS) goes to the compressor
3	Compressor
4	High temp'/pressure refrigerant (GAS) goes to the condenser
5	Condenser
6	Hot water supply
7	Flow switch, hot side
8	Hot water- return
9	High temp'/pressure refrigerant (LIQUID) goes to expansion valve
10	Expansion valve
11	Low temp'/pressure refrigerant (LIQUID) enters the evaporator
12	Flow switch, cold side
13	Cold water supply (comes from the AC loop)
14	Cold water return to the AC loop)
15	Fire retardants ABS cover
16	Designated aperture for wasted heat from the compressor
17	Receiver
18	Filter/dryer

Figure 3: Hydra Balance unit- components

The unit features extremely high energy efficiency (COP).

Hydra Balance 25 kW		
High Temperature Water Source Heat Pump		
General		
Refrigerant		R134a
CAS number		811-97-2
Formula		CH_2FCF_3
Mass flow	[g/s]	154.57
Volume flow (suction line)	[m³/h]	34.71
Volume Capacity	[kJ/[m³]	1,655
Number of refrigerant circuits		1
Capacity control		100-0%
Power Input	[kW]	7.5
Power Supply	V / Hz / Ph	400 / 50 / 3
Starting mode		Direct
Heating		
Heating Capacity	[kW]	25.0
COP (*)		3.33
Fluid		Water
Inlet/Outlet temperature	[°C]	60.0 / 65.0
Water Flow Rate (rated)	[m³/h]	4.3
Unit Water Connections	[ø"]	1.25, 1.5
Cooling		
Cooling capacity	[kW]	17.5
Fluid		Water
Inlet/Outlet temperature	[°C]	11.0 / 7.0
Water Flow Rate (rated)	[m³/h]	3.75
Unit Water Connections	[ø"]	1.25
Dimensions	**L / H / W [mm]**	**670 / 1180 / 670**
Weight (net)	**[Kg]**	**170**

(*) Chilled water 11°C / 7°C and hot water 40°C / 45°C

Figure 4: Hydra Balance – Spec.

Hydra Monitoring & Control Module

The Hydra Monitoring & Control Module gathers data from several points in the surrounding environment and in the heating and cooling system. This data is continuously processed and transmitted via the internet to specialized software, where it is analyzed using a unique algorithm

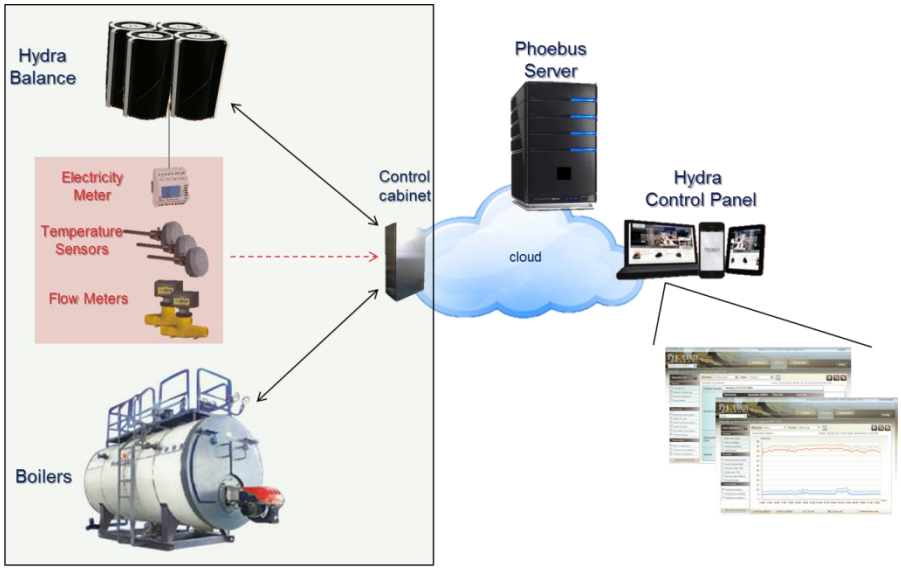


Figure 5: Hybrid Hydra Monitoring & Control Module

The Hydra control Module performs the following functions:

- Data collection, processing and transfer of onsite temperature, electrical consumption, water usage, heating oil/gas usage, electrical tariff, heating requests and more. The control system collects data every 60 seconds, processes it and sends it via the Internet cloud every 5 minutes to the Hydra Control software.
- Control of all heat sources located onsite. The system controls the heat sources, turning them on and off, according to the instructions received from the Hydra Control Software.

A typical Hydra Monitoring & Control Module includes the following components:

Component	Description	Quantity
industrial PC	Main PC of the end unit	1
ADAM 4015 PT100 input transducer	Transducer for the meters	3
ICP 7055 Digital I/O transducer	Transducer for the temperature sensors	2
Communication adapter RS-485		1
SITRANS F M MAG 5100W 7ME6520-3TC13-2AA1	Electromagnetic 6" hot water meter	1
ElNet LT Energy & Power Multimeter	Electricity meter	1
2" cold water meter	Cold water meter	1
NG meter	Natural gad meter	1
4" temperature sensor		4
Pocket for PT100 temp sensor		8
Radion sensor	Sensor for the main controller	4
Pocket for Radion sensor		4
6" temperature sensor	Temperature sensor	3
Pocket for 6" sensor		6
8" temperature sensor	Temperature sensor	4
Pocket for 8" sensor		8
Main Hydra Balance units Controller		1
Main monitor & control cabinet		1
Modem	ADSL or Cellular modem	1

Figure 6: Typical Hydra Monitoring & Control Module components

Hydra Monitoring & Control Cloud Software:

The Monitoring & Control Cloud Software has the following functionalities:

- Automatically enable / disable any heating source (Hydra Balance units, boiler) following the results obtained from the specific site upon processing the real time information sent via de cloud by the Hydra Monitoring & Control Module.
- On line and continuous selection of the most cost-effective way to produce the energy required at the site (considering the relevant electricity “time of use” tariffs and the gas/fuel updated prices).
- Providing a user interface (refer to figure 7) to allow any customer to follow the real-time activity of his heating systems constantly updating on the site water consumption, the energy used to heat and cool the site as well as showing the ongoing savings.

Figure 7: Examples of different user interface screens

The Software is adaptive and has four operative stages:

- Adaptation: The software builds, using a complex algorithm, a statistical model of forecasted heat and AC generation costs for each of the energy sources available onsite.
- Active Optimization: Every 5 minutes, the software receives via the Internet the data collected onsite from the Hydra Monitoring & Control Module. The data is processed according to the algorithms, resulting in a forecast of costs and a decision on how to produce the required heat at the lowest cost for the next 5 minutes. The software transforms the available energy sources at the site, into a Hybrid Water Heating and Cooling System capable of producing the required energy at the minimum cost.
- Activation/Deactivation Instructions: Instructions are dispatched to the onsite heat sources, via the local control system, according to the optimization decision.
- A database is generated, in addition to statistical data, in HTML or Excel format, providing complete information on energy, hot water usage, temperatures, electricity, fuel/gas usage and costs.

2. Installation Considerations

Piping & Instrumentation Design (P&ID)

The following figure describes the hydraulic integration of the Hydra Balance array into an existing Water Heating System.

The Hydra Balance array is connected in one side (blue) to the Cold Water Loop (chillers) to absorb thermal energy from the flowing A/C water and in the other side (red) it connects to the Hot Water Loop and delivers the thermal energy to it.

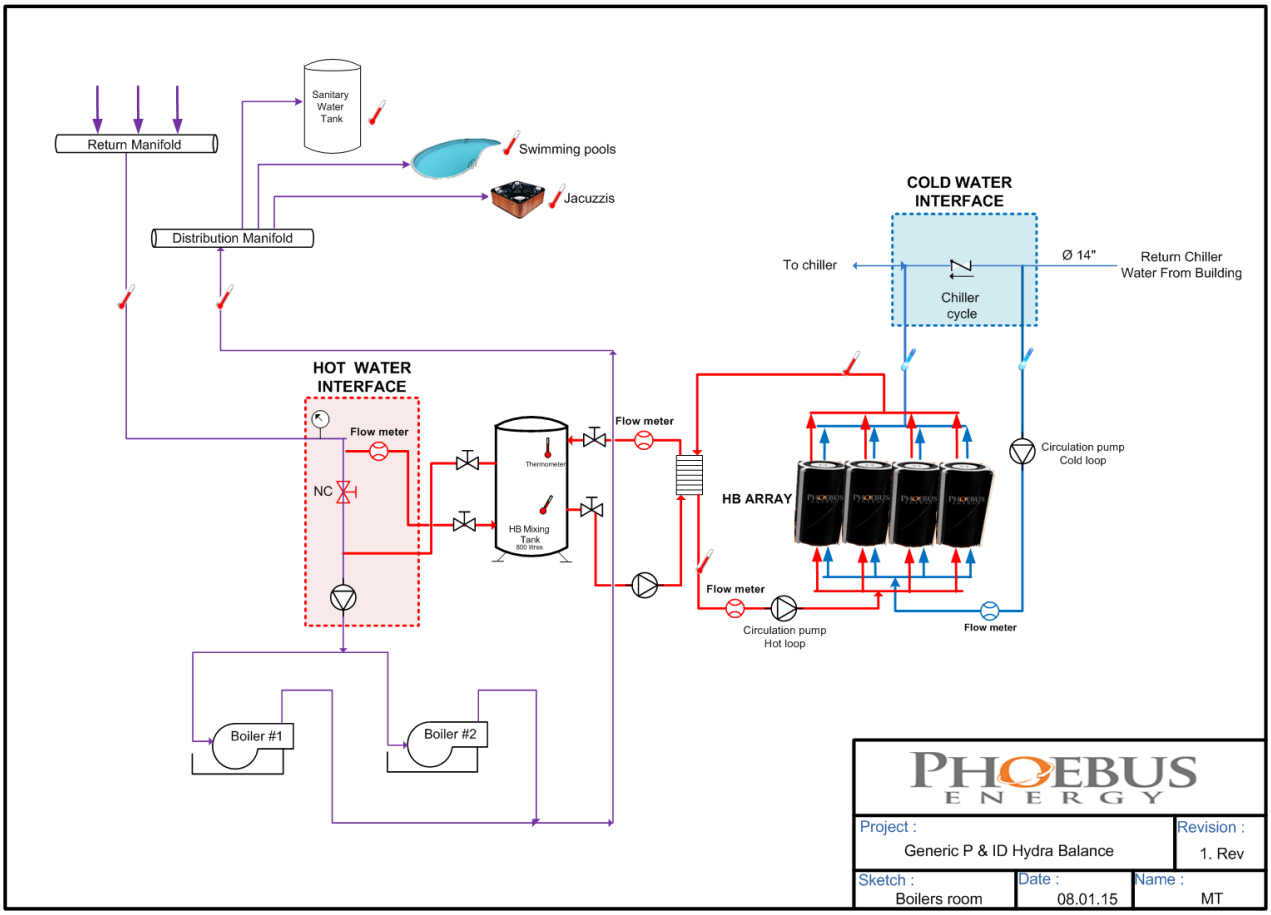


Figure 8 – General Layout (Hydraulic Integration)

The following figure describes the physical interconnection of the Hydra Balance units to both the cold and hot loops.

Each unit has an outgoing and an incoming pipe to each loop.

All piping work and material related to the interconnection of the Hydra Balance units to the existing AC and water heating systems shall be isolated.

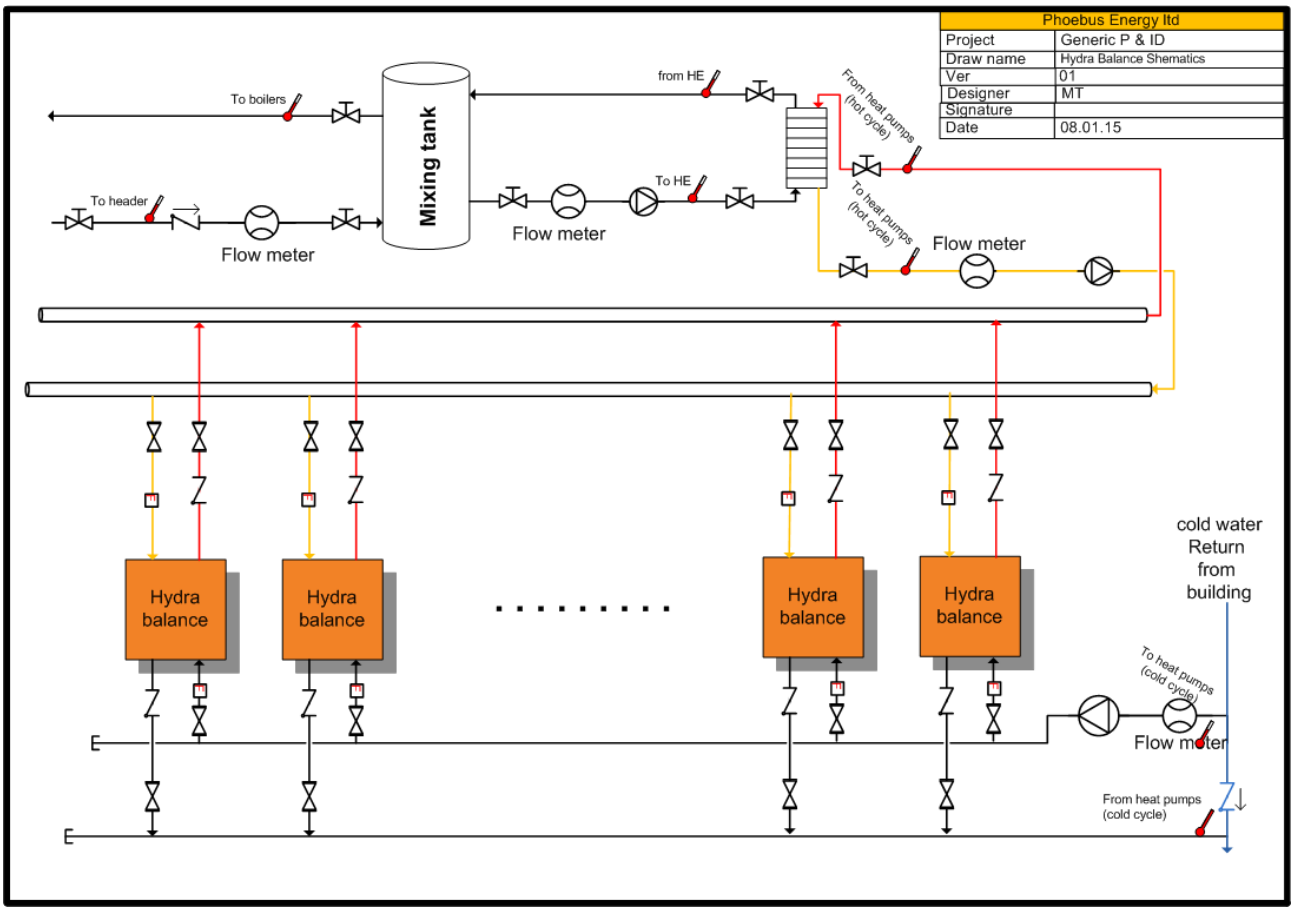


Figure 9 - Loop Interconnection

Electricity

Component
Main fuse box supplies electricity to the Hydra Balance units (including all required protections and hazards. Each unit uses 3* 25AMP
Electricity line from main electricity rook to the Hydra Balance fuse box
Electricity line that supplies electricity to the Hydra Balance units

Typical installation pictures

Figure 10 – Hydra Balance @ Sheraton TLV

Figure 11 – Hydra Balance @ Crowne Plaza City Center TLV

3. Software licenses

Each system (project) is provided by default with a **Server** license for each Hydra Balance Unit and with 10 **Client** licenses (10 user names & passwords).
A symbolic annual license fee will required after the guarantee period.

4. Maintenance

During the guarantee period all the systems are monitored via the cloud on line 24x7 by Phoebus Energy's service department as well as by the local partner. Most of the typical failures will be detected by Phoebus on line service but some may be detected and reported by the customer.

Preventive Maintenance

Phoebus provides during the guarantee period a preventive maintenance service in order to maintain the proper system operation to meet the optimal operational parameters. Service preventive maintenance will be carried out in coordination with the customer and with minimum of ongoing operation disruption of the system. Preventive maintenance will be conducted at least once every 6 months and will include the following:

a) Overhaul test
b) Abnormal noise test
c) Testing the operation pressures of the compressors
d) Electric current tests
e) Monitor & control system test
f) Reinforcement of bolts
g) Protections test
h) DT test
i) Heat pumps performance tests
j) Troubleshooting
k) Electrical panel check
l) Reinforcement of bolts in Electrical Panel
m) Overheating tests of electrical components

Corrective maintenance

Failures will be categorized into one of the following levels:

Critical –

1- Any failure that prevents the water to be at the committed temperature.
2- Any major water leaking related to the heating system installed

Major –

1- More than 50% of the Hydra Balance units composing the "system" stop working
2- Decrease of system COP in more than 20%
3- Communication failure (for more than 6 hours)
4- Any Energy meter failure (for more than 6 hours)

Minor –

1- Any other sensor and/or meter failure (for more than 6 hours)
2- Decrease of system COP in less than 20%
3- Failure of single Hydra Balance unit

Status	Action
Critical	1.1 Partner and / or Phoebus shall produce an action plan within one (1) business day from detection/notification of the failure 1.2 Phoebus will supply a workaround within two (2) business days from detection/notification 1.3 Partner may use spare parts in order to fix the problem
Major	1.1 Partner and / or Phoebus shall produce an action plan within two (2) business days from detection/notification of the failure 1.2 Phoebus will supply a workaround within four (4) business days from setting the action plan
Minor	1.1 Partner and / or Phoebus shall acknowledge the error within five (5) business days from detection/notification of the failure 1.2 Phoebus will supply a workaround within ten (10) days from the acknowledging the error.

Spare Parts

Phoebus Energy/ Local Partner will keep an upfront inventory of spare parts at a local warehouse. This inventory will include all the required items (Hydra Balance units, compressors, Control items, etc.).