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Preservation of the FCwave module:

Dry Out

When all Sat tests are completed, and it is agreed no more operation of the modules will take place the System is requested to run the Dry out program.

The Purpose of running Dry Out is to remove liquid water from the module, such that stacks are in a “dry” condition after completing this procedure. This is intended to be the final part of the last operations cycle before long time storage or transport of the module, where temperatures may reach freezing conditions.

The request to start Dry Our is communicated via MODBUS.

When requested to start Dry Out, the module ramps I_Allow to 0A. This will prevent the module from delivering current. When current is reduced to < 5A the module begins the dry out process.

Internally in the system the module will ramp up temperature and airflow to accomplish the dry out process. During this state the air compressors are operating at high power level.

When the module has completed the dry out process or 6 min has elapsed, the module will perform a controlled shutdown process, identical to normal operation shutdown. After the shutdown, the module is prepared for long time storage, for 6 month or longer.

<u>Restarting after Dry Out and Long Time Storage:</u>

When the module is to be operated again after long time storage/Dry Out procedure, integrator must operate the module in a low power regime (50 to 75kW) for at least 20 minutes before increasing power. This allows the stack to return to proper humidification conditions.

Expect that performance is impacted until stacks are re-humidified. This is temporary and can be helped by performing a conditioning cycle – contact Ballard for details.

The procedure is described in the Integration Manual for the FCwave modules.

Drainage of internal HT cooling water in the FCwave module:

Drainage of glycol within the closed HT cooling loop circuits of the FCwave modules is not recommended / required according to Ballard. However, it is for the integrator to decide if draining of the HT system is required.

The internal HT cooling loop can be filled and drained by a connection installed in the base of each Fcwave module. An external pump is connected and used for filling as well as draining. Connecting point shown in drawing below.

Each FCwave module contains 45 litre of cooling liquid.



Draining of external cooling systems.

The draining of both external HT and LT cooling system will be performed by Ballard.

Small quantities of cooling located at low points in the HT and LT external cooling system is considered as insignificant.

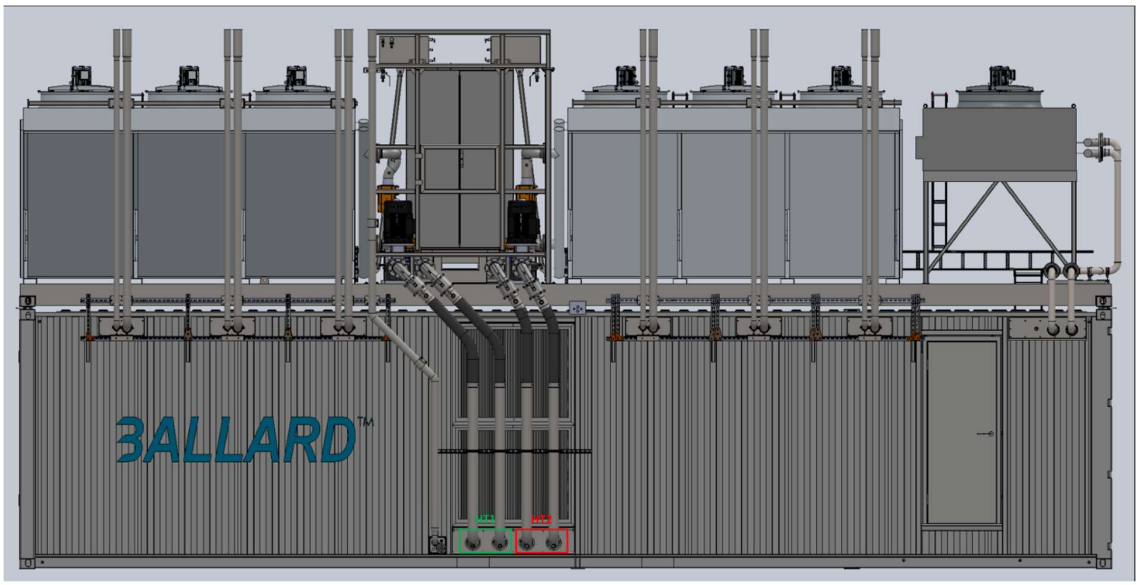
External HT cooling Loop

The HT cooling loop is divided into two loops. When the cooling media is drained of the HT system each loop must be drained.

Connect a hose to the interface at the filling/drain valve. Each system is equipped with two valves. (only one valve to be connected and opened)

Have a tank of sufficient size connected to collect the cooling water. Each HT loop contains 700 litre of cooling liquid.

The HT cooling loop is an open system as the expansion-/header tank is equipped with venting to atmosphere. The system is drained by gravity.



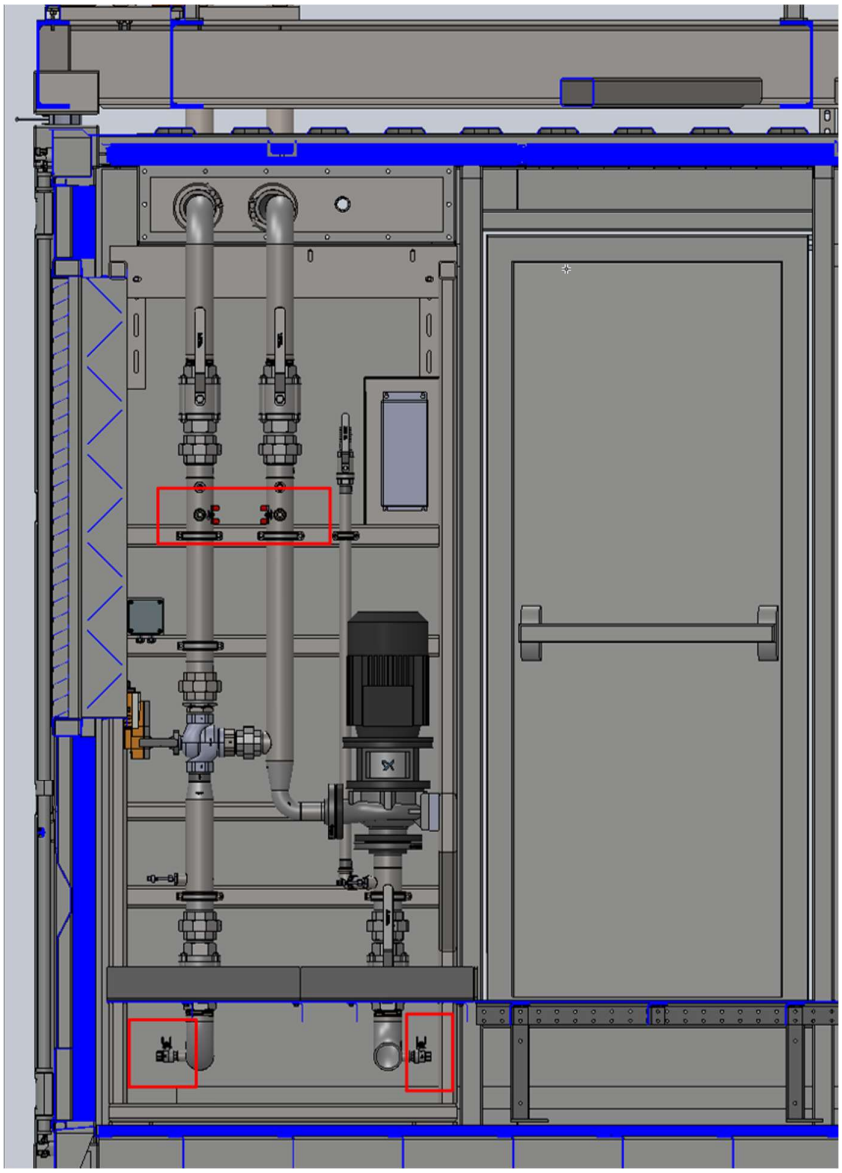
External LT cooling loop

The LT cooling system is a single system. The drain valve is located inside the container.

Connect a hose to the interface at the filling/drain valve. As the system is equipped with 4 valves it is possible to choose which valve to use. (only one valve to be connected and opened)

Have a tank of sufficient size connected to collect the cooling water. The LT cooling loop contains 400 litre of cooling liquid.

The LT cooling loop is an open system as the expansion-/header tank is equipped with venting to atmosphere. The system is drained by gravity.



When the BLPH is at location and before system is taken into operation the system must be filled again. Air trapped in the system must be vented out.

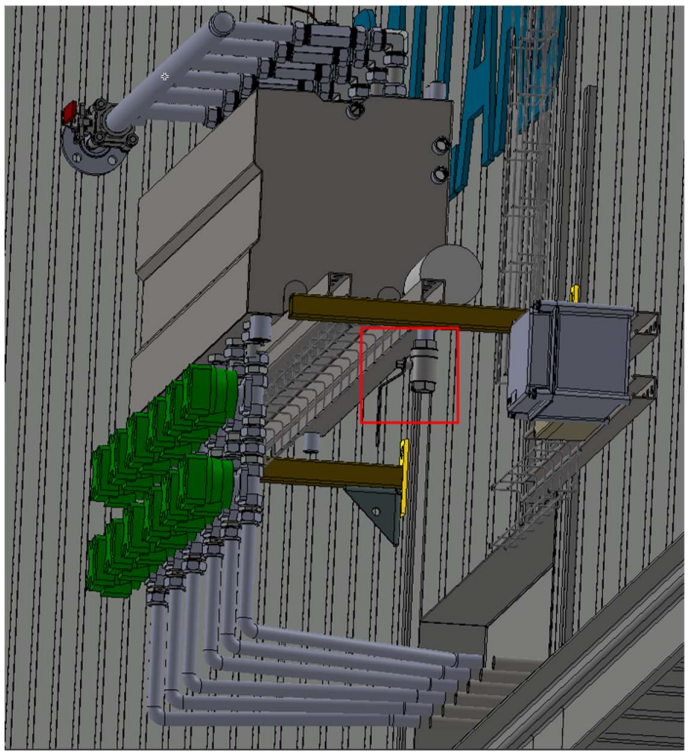
Draining of H2 manifold heater.

The H2 heater is filled with water/glycol. This system must also be drained before Sea Trail. It is an independent closed system.

Connect a hose to the interface at the filling/drain valve.

Have a tank of sufficient size connected to collect the cooling water. The H2 heater contains 200 litre of cooling liquid.

The H2 heater tank is equipped with venting to atmosphere. The system is drained by gravity.



When the BLPH is at location and before system is taken into operation the system must be filled again. Air trapped in the system must be vented out.

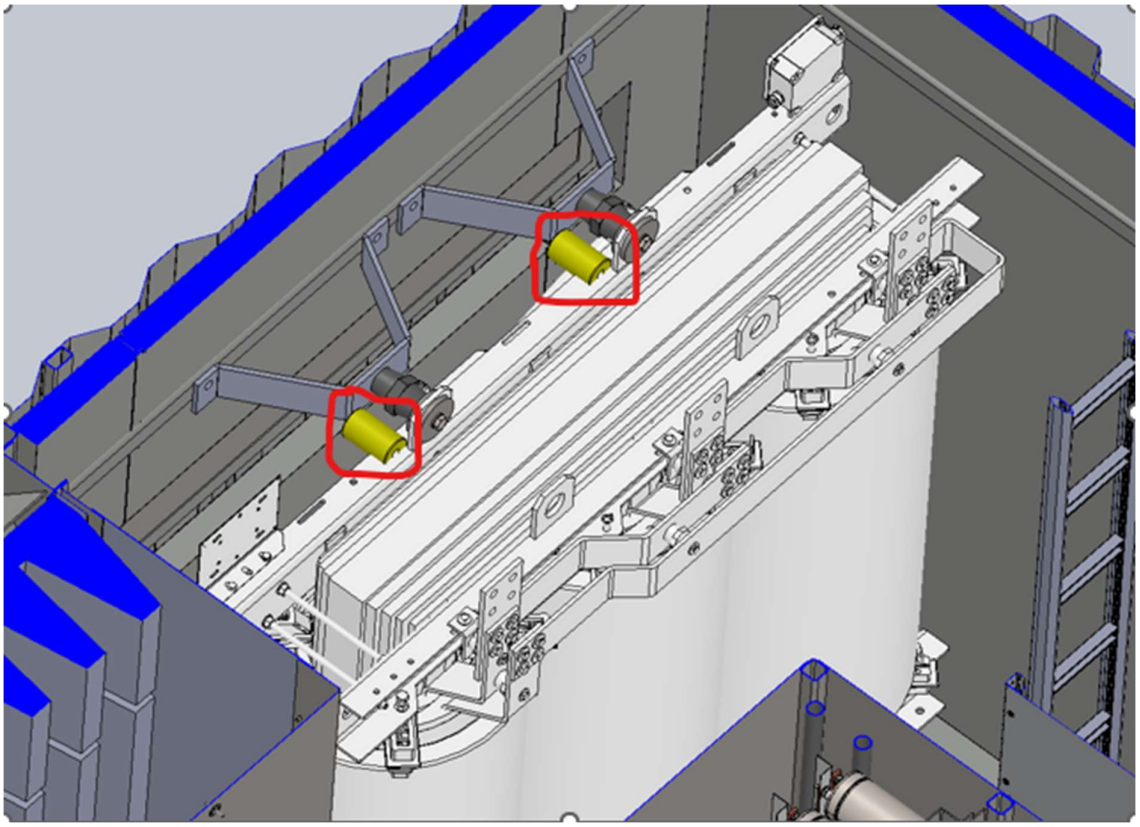
Preservation of container(s)

No other preservation actions are needed for the fuel cell package.

Sea Fastening

Preparation of transformer for sea trail.

Two Transport Brackets must be installed to ensure transformer is ready for the Sea trail. Ballard will deliver the brackets (Identification -brackets are painted yellow). Brackets will be delivered to Site by Ballard.



When the BLPH is at location and system is taken into operation the Transport Brackets must be replaced again with support brackets.

Sea fastening of external coolers.

Equipment outside the container must be secured for the Sea Trail. This will require additional support/straps that will be strapped to the container itself. Straps and other material will be delivered by Yard. The installation of the sea fastening straps will be performed by Ballard.

When the BLPH is at location and system is taken into operation the support and straps must be removed.

Sea Fastening of H2 manifold heater

The H2 manifold heated must be prepared for the Sea Train by building some wooden support or other support for mitigation of damage to installation and piping. Will be installed by Ballard just after completion of SAT. Materials will be delivered by the Yard.

When the BLPH is at location and system is taken into operation the wooden support must be removed.

Sea fastening of container doors.

All external doors to containers must be strapped to prevent unintended opening during the Sea Trail. Materials will be delivered by Yard. The installation of the sea fastening straps will be performed by Ballard.

Specification for materials for Sea Fastening

A sketch for the sea fastening straps is attached to this document with reference to each strap.

In total 8 are required for Sea fastening. Straps are listed below:

Pos No	Specification
1	Standard 50 mm lash, x 6-10 meter
2	Standard 50 mm lash, x 6-10 meter
3	Standard 50 mm lash, x 6-10 meter
4	Standard 50 mm lash, x 6-10 meter
5	Standard 50 mm lash, x 15 meter
6	Standard 50 mm lash, x 5 meter
7	Standard 50 mm lash, x 5 meter
8	Standard 50 mm lash, x 15 meter

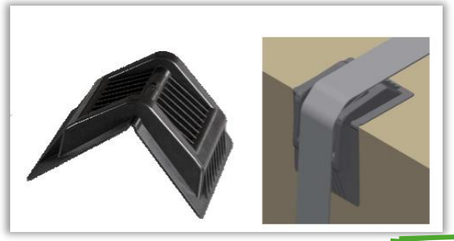
Furthermore 4 protection corners are needed for protection of the cooler metal frame

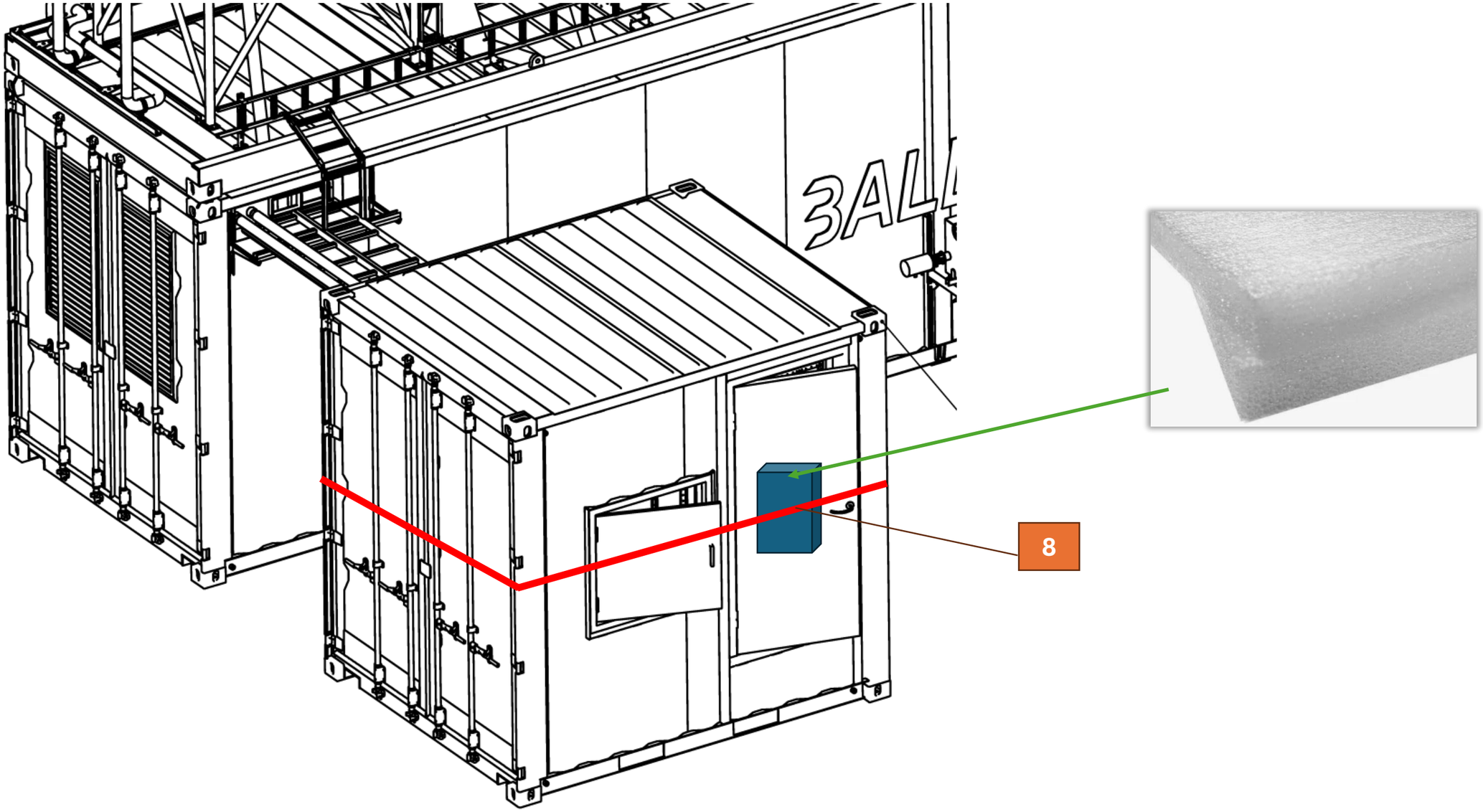
Finally, 3 pieces of structural foam blocks for support at doors. Foam blocks must be at least 200 mm thick

Sea Transport

Provided the preservation and sea fastening steps outlined above have been completed, no further precautions must be taken during the sea transport. No need for temperature or moisture control in the containers or record keeping.

ISOMETRIC VIEW




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