Water Cooling System

Chosen liquid cooling components:
3 x Bay Voltex Rack Mount Fluid to Fluid Heat Exchanger
(http://www.bvthermal.com/rack-mount-fluid-fluid-heat-exchanger)
1 x EXC-800 Portable 800 W Recirculating Liquid Chiller
(https://koolance.com/exc-800-portable-800W-recirculating-chiller)

Cooling/Heating Specifications:
EOS Laser:
Must be maintained at a temperature between 16 and 18 degrees Celsius
Requires 400 W of cooling.

ANU Laser:
Unknown temperature numbers
Requires potentially two different temperatures
Requires a combined maximum cooling of 400 W
Combined flow rate needed of 8 litres/minute

Power Supply Requirements:
Bay Voltex:
120V, 5A, Single-Phase

EXC-800:
650W, 110 VAC, 60 Hz

Four power points are required for this setup, which are in limited supply in the dome. The power supply in the dome is 240 V, so it is necessary to use voltage converters to convert to 120 V, as well as a frequency converter to change the input to the chiller to the correct frequency.

Placement: The chiller will be placed on the first floor, which is semi-insulated, so that the expelled heat does not affect the temperature of the rest of the dome. Two water pipes will be run up from there, along the wall, to the third floor, where the heat exchangers will be placed on the cabinet opposite the laser mounting. Another set of six water pipes will run from the heat exchangers, along the floor, to the laser components on the mounting that require cooling.

Operation and Maintenance: The chiller is a liquid-air system, that cools itself by expelling waste heat into the air; therefore, it is placed on the partially-insulated ground floor, to avoid heating up the telescope room. The heat-exchangers create a closed loop by exchanging heat to this water loop from another loop between them and the laser components. All these loops will need to be periodically refilled, which can be done easily with direct access to them, and water of a sufficient purity (supermarket purified water seems to suffice).

Control System: The heat exchangers and chillers control the temperature of the water in their, which can be set directly by accessing them manually, and they will also be turned on or off by a connection to a cooler switch in the communications box which is located on the first floor of the telescope. This will be controlled by an Ethernet cable routed from the main control room.

Other Notes:
Uncertain number of chillers:

The chiller produces a total thermal cooling of approximately 800 W, while the EOS laser requires cooling of 400W and the ANU laser a maximum of 800W. Only a single chiller is included in the design because it is assumed that only one of the lasers is operating at a time; if both lasers are required to operate at the same time, it is possible that the cooling produced by one chiller will not be sufficient. If this functionality is needed, more than one chiller needs to be installed.

Uncertain number of heat exchangers

There are three heat exchangers included in this design, under the assumption that three different temperatures of cooling are required. It is however, possible that the two cooled components of the ANU laser will require the same temperature, and thus reducing the number of required heat exchangers to two. If this temperature can be constrained to the same 17 +-1 degrees of the EOS laser, then only a single heat exchangers will be required. In the same situation of more than one laser operating at a time though, it is possible that the flow rate of a single heat exchangers will not be sufficient to satisfy both the lasers, and thus a bigger heat exchanger might be needed.

Potential replacement of chillers

Depending on the price of the chillers, it is possible to remove the chillers and instead connect the loop to the observatory's cooling system. This is a difficult process due to the distance and components required, as well as the difficulty of sending water up the cable wrap (although this is somewhat mitigated by the small size of pipes due to the relatively low amount of cooling required). Overall, this is not a likely solution, but it could perhaps be implemented if the cost of installing chillers is too high, or if there are other projects in or around the telescope that will require cooling in the future too that the cooling system for the lasers can piggyback on.