**Liquid Immersion Cooled HPC System**

# **System Requirements**

We require a full immersion tank solution suitable for HPC workloads, containing servers, fluid, etc.

### **Immersion Tank**

### The tank should be capable of hosting at least 20U of kit.

### The tank should include remote monitoring capabilities which should be specified. e.g. temperature sensors, flow rate sensors, etc.

### The tank cooling system should have the ability to operate redundantly, though this could be as part of a possible future upgrade.

### The tank should have a heat dissipation capacity of at least 1kW/U, under ideal input cooling conditions which should be specified. A goal of 3kW/U should be a target.

### The tank should include remote alerting capabilities (e.g. sending an email if a problem is detected)

### The necessary heat exchanger/CDU should be provided.

* 1. The immersion tank should use single phase immersion cooling based on a mineral oil.
	2. The immersion tank should have a lid.
	3. The immersion tank should have active convection within it.
	4. A lifting apparatus should be provided for extraction of servers, heat exchangers, CDUs, etc.
	5. The tank should be plumbed into the existing primary cooling circuit (2-inch connectors).
		1. The existing cooling circuit has a 18-20 degree C input, and a typical return of 23-25C, though the return can be higher as needed. The primary flow rate is around 100-140 litres/minute. It is expected that the input temperature will be raised in the future, and so the maximum supported input temperature of the tank should be specified, and should not be below 30 degrees C.
	6. Node, tank and CDU/heat exchanger power supply efficiencies should be stated in the tender.
	7. All heat from the tank should be removed via the heat exchanger (except for convective leakage and black-body radiation).

### **Servers**

* 1. This tank should contain a minimum of 5 servers each using dual AMD Bergamo processors (256 cores per node) and 1.5TB RAM and NVIDIA Connect-X6 HDR200 InfiniBand connectivity, and a boot drive (e.g. 240GB).
	2. It should also contain at least one Intel CPU node with at least 64 cores per node, 512GB RAM, Connect-X6 HDR200 InfiniBand connectivity and a NVIDIA H100 GPU, and a boot drive.
	3. Each compute node should also have 1G or 10G Ethernet RJ45.
	4. Each compute node should have a management interface (e.g. IPMI). This can be on a separate or shared NIC.
	5. Cables for connectivity with a EDR InfiniBand switch, model SB7890, should be provided for each node, suitable for immersion. The IB switch will be provided by Durham University.
	6. Cables for connectivity to a 10G Ethernet switch should be provided (RJ45), suitable for immersion. The 10G Ethernet switch will be provided by Durham.

\*Note: The Ethernet switch and InfiniBand switch will be provided by Durham

* 1. Durham have a APC AP8886 Power Distribution Unit (PDU) which is available for use with this system, offering 32A, 3-phase input and x12 C19 and x30 C13 outlets. However, if this PDU is not suitable for use with the system (e.g. it is physically too large), a 32-A 3-phase PDU should be provided with sufficient capacity to power the requested compute nodes (UK standard).
	2. Any software licences must be perpetual.
	3. The nodes should be capable of PXE booting and use UEFI.

### **Delivery & Installation**

* 1. Assistance is available at Durham to physically move the tank to its installation location from a raised loading bay.
	2. A lorry with a tail lift will be required for delivery of large/heavy components.
	3. Installation of the nodes, cabling, etc, can be done by Durham staff, who should be trained to do this. Installation can also be done by the installation staff.
	4. Operating system installation will be done by Durham staff.

### **Warranties & Maintenance**

* 1. A Next Business Day warranty/support service should be provided. We expect customer replacements with parts delivery and free pickup of faulty parts where necessary for most issues. Where an issue cannot be resolved in this way we would expect an engineer on site.
	2. Warranties should be at least 3 years, longer (particularly for the tank) is preferred and deviations should be specified.
	3. Options for ongoing maintenance contracts should be provided.
	4. Any dead-on-arrival issues should be dealt with prior to acceptance testing.
	5. The post installation service, support and warranties should be described in detail including full details of service levels.

### **Acceptance tests**

As part of the acceptance testing we require successful

* Tank installation
* Demonstration of tank operation, running for a 24-hour period
* Servers powered on in tank and contactable via IPMI

There is an expectation that servers will be able to operate indefinitely at full load. However, this is not part of the acceptance testing as the onus will be on Durham to install the operating system and operate the servers. Any inability of the servers to operate at full load will be resolved under the warranty process.