

## **Specifications for Experimental recirculating aquaculture systems: 9 units**

The Buyer has a right to reject the tender if there are any deviations from these quality standards, but may accept deviations if the overall tender is deemed responsive. Performance beyond the required quality standards will be awarded a higher score.

The performance of the equipment system under “Technical solution” will form a significant part of the evaluation of the tenders under the Quality award criterion.

The tender should include answers/comments to all of the requirements, and a further description where appropriate – highlighting the functionality of the system and its user friendliness. The description should also include any additional functionality or other options that adds value for the Buyer.

*The technical solution shall:*

**Objective of the equipment:** To run experimental trials on Atlantic salmon investigating different pathogens contamination dynamics and disinfection strategies in recirculating aquaculture systems, mimicking commercial conditions.

### **General requirements:**

- Modular/flexible design to allow future units replacement/addition. For example: protein skimmer, ozone, UV, different mechanical and biological filtration units.
- Easy access to all parts of the system to enable an effective disinfection.

**Equipment assembly:** Plug and play solution with the assembling at the Havbruksstasjonen i Tromsø experimental facility, Kårvika, Tromsø, Norway.

**Timeline:** The equipment should be delivered and assembled as soon as possible. Please describe the estimate for delivery date.

**Equipment:** Required: nine (9) independent and identical RAS units *each* consisting of:

- I. fish tank and tank lid
- II. mechanical filtration unit – drum filter
- III. Moving bed biofilm reactor (MBBR), including bio media and aeration grids
- IV. gas exchange unit – degasser, including media
- V. oxygenation – oxygen cone, including oxygen regulators and diffusers
- VI. temperature control unit – heating and cooling
- VII. water flow control unit before the fish tank water inlet
- VIII. water flow meter at the freshwater inlet and seawater inlet (new water).
- IX. oxygen, pH and water level sensors
- X. pump

XI. connecting pipes and valves

Equipment not required: air compressor, oxygen, feeders, lights.

**Equipment requirements and details:**

<b>General characteristics</b>		
Salinity range	0 - 34	ppt
Temperature range	8 - 14	°C
Primary fish species	Atlantic salmon parr, smolts and post-smolts	
Fish size range	10 - 500	g
Max. biomass	50	kg
Max. feed load	1	Kg/day
Protein content feed	50	%

<b>Facility</b>		
Fish Health Lab, Havbruksstasjonen i Tromsø		
Available total surface area	31	m <sup>2</sup>
Height	2.25	m
Width	3.6	m
Length	8.5	m
Existing water inlet treatment	Mechanical filtration (60 µm) + UV	
Compressed air	Available in the room	
Oxygen	Available in the room	

<b>Fish tank</b>		
Shape	Preferably: cylindro-conical	
Diameter	e.g 100	cm
Hight	e.g 75	cm
Volume	0.5	m <sup>3</sup>
Water flow	333 – 1000	L/h
Outlet	bottom centre	

<b>Mechanical filtration</b>		
Type	drum filter	
Mesh size	20 - 100	µm

<b>Biological filtration</b>		
Type	moving bed biofilm reactor	
Media specific surface area	> 700	m <sup>2</sup> /m <sup>3</sup>
Bioreactor filling factor	50 - 70	% media
Aeration system	yes	
Compressed air	Available in the room	

<b>Gas exchange unit - degasser tower</b>		
Aimed degasser outlet CO <sub>2</sub> concentration	< 3	mg/L

<b>Heating/cooling unit</b>		
Inlet water temperature range	0 - 20	°C
Room temperature	15 - 25	°C

RAS water exchange rate range	100 - 1500	L/kg feed
Estimated maximum water exchange	1500	L/day

<b>Water flow</b>		
Water flow control	Yes, preferably before the fish tank	
Water flow meter	Yes, for both freshwater and seawater inlets	

<b>Sensors</b>		
Existing facility system	PLC and SCADA system	
Optical dissolved oxygen sensor	Modbus serial protocol	
pH probe	Modbus serial protocol	
Water level probe	4-20 mA signal	

<b>Pipes</b>		
	Preferably with a by-pass of each unit, i.e. drum, MBBR, degasser, heating/cooling and flow control, for the unit's maintenance.	

<b>Saturation cone</b>	Yes	
<b>Emergency oxygen system</b>	Yes, oxygen available in the room.	