SPECIFICATION

Recirculated Aquaculture System (RAS)

1. Scope

This Specification describes the requirements for a **recirculated aquaculture system** (hereinafter referred to as "the RAS") where water is continuously filtered and reused within the system. While meeting the specific needs of the research project under the IAEA Project TUN5032 entitled "Establishing a National Certified Pipeline to Produce Aquaculture Vaccines by Irradiation", the intended purpose of this RAS is to provide a controlled environment to conduct vaccination and pathogen challenges experiments which is funded by IAEA Project RAF5092 Enhancing Agricultural Productivity for Improved Food Security in Africa (AFRA).
National Centre for Nuclear Science and Technology (CNSTN) is the main counterpart of the TUN5032 project which is the beneficiary of the RAS. CNSTN will conduct experiments using the RAS at the National Institute of Marine Science and Technology (INSTM), Tunisia, (Annex of Kheireddine) (hereinafter referred to as "the End-User").

2. Requirements

2.1. Functional and Performance Requirements

The RAS shall meet the following functional and performance requirements:

2.1.1. A mechanical filtration shall be provided between water towers and the RAS's enclosed space. The mechanical filtration unit shall be located immediately after the seawater pumping station and before the water enters the experimental RAS tanks within the enclosed RAS facility. This positioning ensures that all incoming seawater is mechanically filtered prior to distribution to the tanks used for the experiments;

2.1.2. The RAS shall include the basic water treatment system consisting of pumping for recirculation, biological treatment, UV disinfection and aeration/ stripping;

2.1.3. The RAS shall provide the testing of different treatments at the same time, thus a minimum of three (3) independent but identical mini-RAS (Treatment lines) with distinct pumping, biological filters, and UV filters is required; (Annex 2)

2.1.4. Each mini-RAS shall contain triplicate rearing tanks of 300-liter volume;

2.1.5. The RAS shall include one entry tank of 0.5+/- 0.1 m^3 which shall serve as quarantine facility to isolate and treat sick or newly introduced fish before adding them into the mini-RAS;

2.1.6. The RAS shall also include one collection tank which will serve to collect and treat the wastewater once the treatment is finished;

2.1.7. The RAS shall be scalable, allowing for easy expansion or modification to increase production capacity, treatment or integrate additional species;

2.1.8. The tanks shall be equipped with proper inlets and outlets for easy water exchange filling or flushing;

2.1.9. The RAS shall ensure adequate dissolved oxygen (DO) levels (above 6 mg/L) maintained by water aeration and recirculation to support the metabolic needs of the cultured species;

2.1.10. The RAS shall be designed for maintaining young fish (10-200 gr of individual fish weight), taking into account water temperature (25°C) and maximal stocking density (4 kg/m^3); and

2.1.11. The RAS shall maintain the water temperature at 25°C within ±1°C, regardless of external environmental conditions.

2.2. Technical Requirements

The RAS shall meet the following technical requirements:

2.2.1. The tanks for fish rearing shall have a volume of 250 to 350 liters and be Cylindric with a lid. If tank support is needed, it shall be in un-corrosive material. The maximum overall height (tank + support) shall not exceed 100-120 cm;

2.2.2. Individual tanks shall be sized based on the species and stocking density according to specific experimental/treatment conditions: starting fish weight: 10 - 15 gr, starting fish number 300 per tank, ending fish weight: 200 gr, feeding level and farming management shall be the closest to the industry;

2.2.3. The size of the tank can vary between 250 to 350 liters;

2.2.4. The size of the quarantine tank can vary between 0.5 to 0.7 m^3;

2.2.5. The size of the collection tank can vary between 500 to 700 m^3;

2.2.6. The tank material shall be resistant to chemical interactions with water and contaminants, such as polyester/glass-fiber or high-quality plastic (e.g., polypropylene);

2.2.7. The RAS shall include an adjustable thermostat for water to adjust the temperature from 18 to 34°C, with a precision of +/-0.5°C. An indicator light shall indicate whether the heating is in operation or not. It shall also be equipped with Thermo Safety Control function which shall provide protection against dry running;

2.2.8. The pump of each mini-RAS shall achieve a water recirculation rate sufficient to ensure that the entire volume of the RAS is filtered and treated at least 2-4 times per hour;

2.2.9. The RAS shall continuously filter and recirculate water within the system to remove waste products, maintain water clarity, and ensure a healthy environment for aquatic species; and

2.2.10. The RAS lab (experimental system) shall include an ozone machine which allows to reduce microbial counts by 5-6 log in a few minutes, transportable on wheels, powerful and robust, with a stainless-steel ozone compatible pumping large mass transfer of ozone in water, suitable for tanks up to 0.7 m^3.

2.3. Other Requirements

Other requirements are as follows:

2.3.1. Enclosure (Annex 3) for the RAS with a metal frame covered in sandwich panels with the stripping of topsoil, foundation elements: soles, stringers, backfill, reinforced screed, supply and installation of aluminum window including all closing accessories, necessary hardware and all constraints, installation of a wrought iron protective grille, and non-slip floor covering executed in epoxy resin-based floor paint soles; and

2.3.2. The installation of the Enclosure shall be completed before the delivery and installation of the RAS.

3. Marking

The RAS shall have all safety markings in English, French or Arabic languages.

4. Packing

The RAS, for the shipment by air to the End-User, shall be packed in accordance with international standards that are applicable for the shipment by air of this kind of equipment.

5. Quality Requirements

5.1. The System shall be manufactured and installed in accordance with the Contractor's ISO quality assurance system or an equivalent quality assurance system.

5.2. The Contractor shall document the compliance with this quality assurance system.

6. Testing and Acceptance

6.1. The RAS, prior to shipment, shall be tested for conformance of the RAS with manufacturer's performance specifications and the minimum requirements specified herein.

6.2. The RAS, after installation, shall be tested by the Contractor together with the End-User to demonstrate that the performance meets the manufacturer's performance specifications and the minimum requirements specified herein as determined by the IAEA and the End-User.

6.3. The results of the testing of the RAS shall be documented by the Contractor in an acceptance protocol that shall be signed and dated by the End-User.

7. Installation and Training

7.1. The Contractor shall install the RAS at the End-User location in a dedicated area having a total surface ranging between 100 to 120 m^2;

7.2. The RAS shall be placed 100 meters away from water towers where sea water is punctually pumped from the sea and stored (see Annex 1);

7.3. The Contractor shall provide one (1) day training for up to three (3) staff of the End-User in the operation and maintenance of the RAS at the End-User's location immediately after the installation of the RAS.

8. Deliverable Data Items

The Contractor shall provide two (2) complete sets of operation and servicing manuals and technical drawings in the English, French or Arabic language(s).

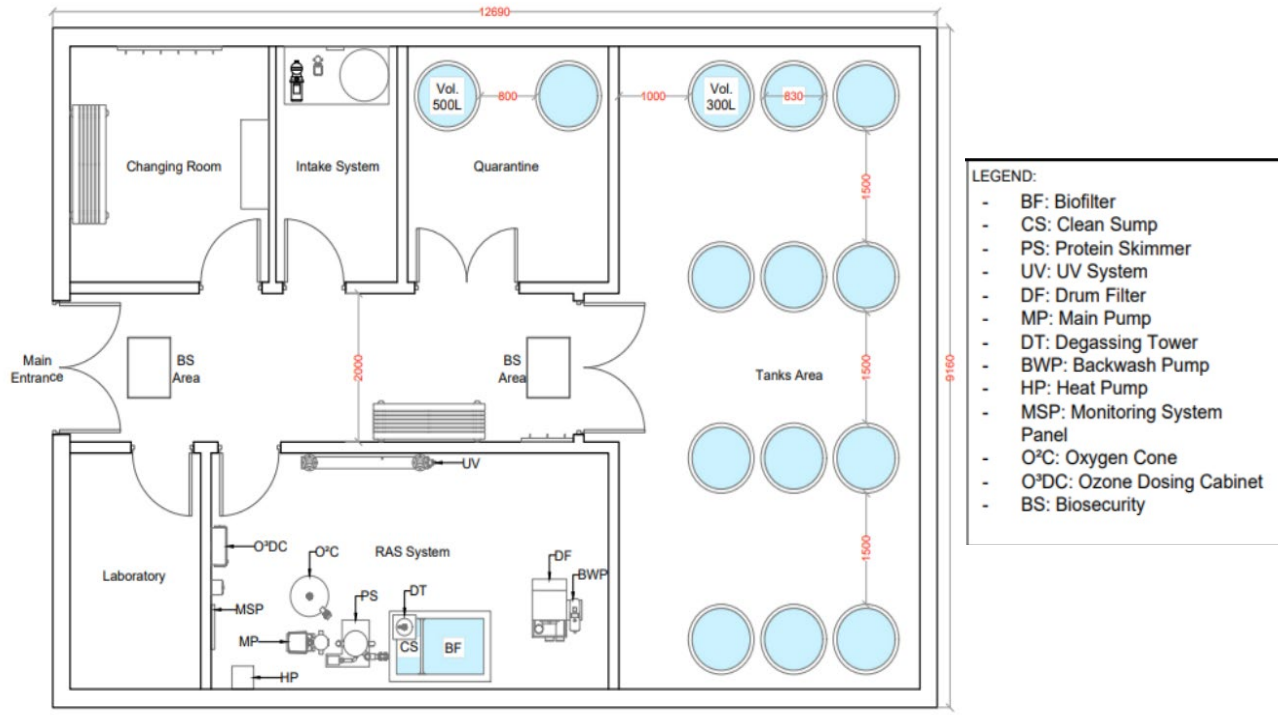
9. Optional Maintenance

For the End User's consideration, the Contractor shall provide annual pricing for up to five (5) additional years of preventive and corrective maintenance services following the one (1)

year full warranty period, including labour and spare parts. Any costs associated with such services shall be borne by the End User.

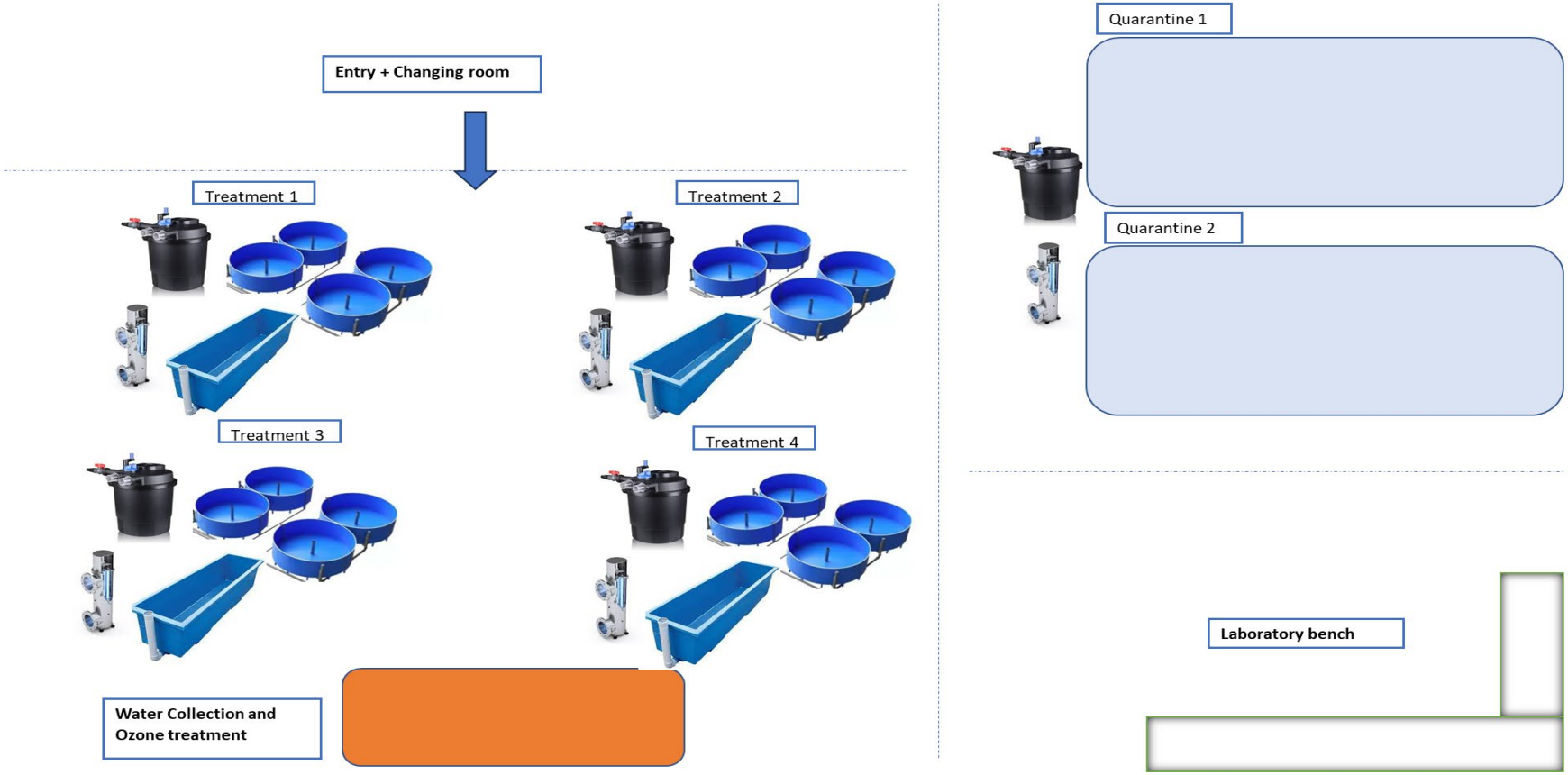
Annex 1

Photo 1: INSTM- Kheireddine department. Geographic position of the dedicated surface for the RAS system installation and a suggested plan view of the RAS system



unit (considered ONLY for example).

Annex 2: Schematic representation of the experimental fish disease and vaccination unit (quarantine, Draining and RAS units)



Annex 3: Schematic representation of the metal roof and the sandwich panel of the RAS hangar