Statement of Work for the Provision of Passive Gamma Emission Tomography Systems

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1. Purpose and Scope

1.1 Purpose

1.1.1 The IAEA seeks to procure the Contractor's services for manufacturing, assembling and delivering Passive Gamma Emission Tomography Systems (hereinafter referred to as "PGET") to be used for verification of spent fuel assemblies from Light-Water Reactors. The PGET shall be capable of operating underwater (at a depth of at least 10m), to be used to examine a Trans axial region of a spent-fuel assembly (minimum 2-year cooling time) and create a tomographic slice of the gamma-ray activity in the region under inspection. In addition, the PGET shall be capable of measuring gross neutron count rate and performing medium resolution gamma-ray spectroscopy.

A prototype PGET has been developed and undergone extensive testing during the first quarter of 2017. The PGET shall be built as per the design documentation listed in Annexes A, B, and C.

1.1.2 In addition, the IAEA seeks to procure services related to updates to the PGET hardware and software and repair of the units. These services are detailed in Section 2.2 below.

1.2 Scope

The scope of the SOW include the manufacture, delivery and support of PGET as per the below requirements.

2. Requirements

2.1 Manufacturing Requirements

The Contractor shall:

2.1.1 In strict conformity with the design documentation, acquire or manufacture all components necessary for the PGET except those listed in Annex C.

2.1.2 Assemble all components into a fully functioning system and test prior to delivery to the IAEA.

2.2 PGET Services Requirements

2.2.1 Modify and enhance PGET hardware and software periodically as required.

2.2.2 Carry out repairs as required to keep PGET in fully operational condition

2.2.3 Provide and ensure availability of the spare parts indicated in Annex B for the full lifetime of PGET.

2.2.4 Provide an alternative replacement option having equivalent characteristics if a particular component is not available.

2.2.5 Implement the changes described in Annex C (prior to delivering the first PGET), including:

- Modification of cabling with an easily replaceable cable and connector;
- Modification of the torus housing to allow routine leak testing;
- Redesign of gamma-ray collimators according to IAEA specification;
- Re-sizing of gantry components to accommodate new collimators, as needed.

2.2.6 Provide support of the system-setup software, data-collection software, and firmware modifications.

2.3 Deliverables

2.3.1 The Contractor shall provide complete PGET as follows:

- A watertight compartment (torus) with all detector, mechanical, and electronic components mounted and properly connected. External surfaces of the torus shall be electroplated to allow easier decontamination;
- Control unit with a data acquisition system computer;
- Connecting cable in a halogen-free protective sleeve;
- Re-usable transportation container (see Annex C);
- Installation disk with the system-setup and data-acquisition software;
- Documentation: Test reports, User Manual, and Software Manual.

2.3.2 For any design modification, the Contractor shall provide:

- A description of the implemented solution including all relevant background information;
- All relevant test documentation (i.e. test report) demonstrating compliance with requirements; and
- Updated versions of Annex A and the relevant operating documentation (i.e. User and Software Manuals) including all design and operating modifications.

2.3.3 Each PGET shall be delivered to the address stated in Section 2.10 below within six (6) months of the date of receipt of the Purchase Order.

2.3.4 IAEA Contributions

For each PGET, the IAEA will provide:

- Optionally, one hundred and seventy four (174) CdZnTe front-end detection modules that have been specifically developed for PGET by RITEC http://www.ritec.lv/;
- Two (2) Boron-10 detectors RS-B1-0403-231 with two (2) pre-amplifier PDT30A;
- All necessary Data Processing, Analysis, and Evaluation software.

2.4 Contractor's point of contact

The Contractor shall assign an English speaking representative to serve as a focal point of contact for the full duration of the Contract and provide contact information (i.e. name, title, phone number and e-mail address).

2.5 Sub-Contractors

It is understood that the manufacturing of PGET components would require a wide range of capabilities and infrastructure that may be beyond the scope of a single contractor. Without prejudice to Clause 5 "Sub-Contracting" of the IAEA General Conditions of Contract, the Contractor may sub-contract to other suppliers certain PGET components. The IAEA will validate the selection of the sub-contractors involved in the design and production of identified critical components and may reject sub-contractors if they are not deemed acceptable by the IAEA.

2.6 Acceptance Testing

2.6.1 Location of acceptance testing

Final acceptance testing of the PGET shall take place at the Atominstitut (Vienna, Austria). Acceptance testing will consist of verifying that all technical, functional and design requirements are met. The testing will be performed by the IAEA within one (1) month upon receipt of the PGET. Upon successful completion of the Acceptance Testing, the IAEA will sign an Acceptance Test protocol.

2.6.2 Contractor's participation

The Contractor is allowed to nominate a technical representative(s) at its own cost to participate as an observer in the Acceptance Test to be performed by the IAEA.

2.6.3 Payment Schedule

Without prejudice to Clause 27.6 "Inspection and Acceptance" of the IAEA General Conditions of Contract, each PGET will be accepted and paid as per the below milestones based payment schedule:

Milestone	Planned Completion	Percentage Payment
Progress Review 1 (based on evidence presented by the Contractor and accepted by the IAEA)	As mutually agreed (Approximately 1 month after receipt of PO)	20%

Progress Review 2 (based on evidence presented by the Contractor and accepted by the IAEA)	As mutually agreed (Approximately 3 months after receipt of PO)	30%
Completion of the Acceptance Test by the IAEA	As mutually agreed (Within 6 months after receipt of PO)	50%

2.7 Warranty and customer support

2.7.1 Period of warranty

The warranty period on the deliverables under this SOW shall be of at least two (2) years from the signature date of the Acceptance Test protocol. The warranty shall include labour, travel if applicable, and parts.

2.7.2 Support service

During the warranty period the Contractor shall provide a support service to assure response to the IAEA inquiry within 24 hours during working days and 36 hours on weekends and public holidays.

2.8 Quality Requirements

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

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

2.9 Licensing

None of the PGET components shall require additional licenses from any third party; otherwise these licenses shall constitute a mandatory part of the delivery of the PGET.

2.10 Shipping Address

The Contractor shall deliver the PGET to the following address:

TU Wien, Atominstitut

Stadionallee 2

1020 Wien, Austria

To the Attention of:

MAYOROV, Mikhail m.mayorov@iaea.org

WHITE, Tim t.white@iaea.org

3. Annexes

A. Design documentation

The design documentation can be retrieved from the following link:

https://share.iaea.org/pub/index.php/s/xxxxxxxxxxxxxxx

The IAEA will provide the full link and password subject to the signature of an IAEA's Non-Disclosure Agreement by the Contractor.

B. List of Spare Parts

No	Component
1	Motor with controller
2	Leakage sensors
3	PCB with end-stop sensors
4	Teeth belt
5	Power supply unit (85-264VAC/42VDC)
6	CdZnTe detector on Front-End-Board (FEB)
7	Back-end-Board (BEB) module
8	BEB central PCB
9	PCB with end-stop sensors
10	Stainless steel bolts M10×50
11	Neutron detector RS-B1-0403-231
12	Pre-amplifier PDT30A
13	Set of O-rings, includes 6 pcs: – 915 × 6 mm – 895 × 6 mm – 390 × 6 mm – 380 × 6 mm – 368 × 6 mm – 360 × 6 mm
14	Spare cable Harting 0945 600 0342 with connectors 20 m
15	Spare sleeve KOBRA EPDM 15 m
17	Hose clamp ø 30 mm

C. Required system modifications

Below is a list of required modifications to the existing PGET:

a) Watertight Data Cable:
The existing data and power cable is rigidly attached to components in the torus, passes through a port on the bottom half of the torus and terminates in an RS485 connector (at the control module). The pass through for the cable is fitted with a gasket, and the cable is housed in a flexible tube fitted with hose clamps. The pass through represents a weak point for water intrusion. It is required that the cabling be redesigned to include:

   a. Two separate cables, one inside the torus terminated in a socket on the outside of the torus, and a second cable (15m) that connects from the socket to the control box (terminating in an RS485 connector.
   b. The socket shall be waterproof (leak tight).
   c. A protective EPDM sleeve shall cover the cable. It shall not be required that the cable connectors be removed in order to install the sleeve.

b) Water-tight testing capability:
A method for routine testing of the watertight seals (e.g. using a helium leak test) shall be provided. The valve for introducing gas to the torus must be protected from breakage during shipment and use.

c) External Markings:
The torus shall be marked externally to indicate the 0-degree position of detector head 1. The marking must be easily visible from the surface of a spent fuel pond and shall consist of a line that is parallel to and above the front of the collimator of head 1.

d) Gamma-ray Collimator Redesign:
The existing gamma-ray collimators (2) are larger and heavier than is needed. The present collimator can accommodate 104 detectors per head which is more than required by the imaging system. The design of the collimator shall be revised as follows:
   a. The collimator shall be redesigned to accommodate 91 detectors (7 back-end boards instead of the current 9 per head).
   b. The collimator shall be redesigned to enable easier placement of detector components (back-end board modules) inside;
   c. Cable penetrations shall be redesigned to allow easier installation.
   d. The horizontal pitch of the collimator openings (4.0mm +/- 0.01mm) and width (1.5mm +/- 0.01mm) shall remain the same, but it shall be manufactured to these higher tolerances.
   e. The vertical opening of the collimator shall be reduced to 3.0 mm on the detector side and 20 mm on the side closest to the fuel.
   f. The overall dimensions shall be reduced, maintaining a 20mm wall thickness around the electronic components.
   g. The method for securing the back-end boards within the collimator housing shall

be simplified.

A conceptual drawing of a cross section of the collimator is shown in Figure 1.

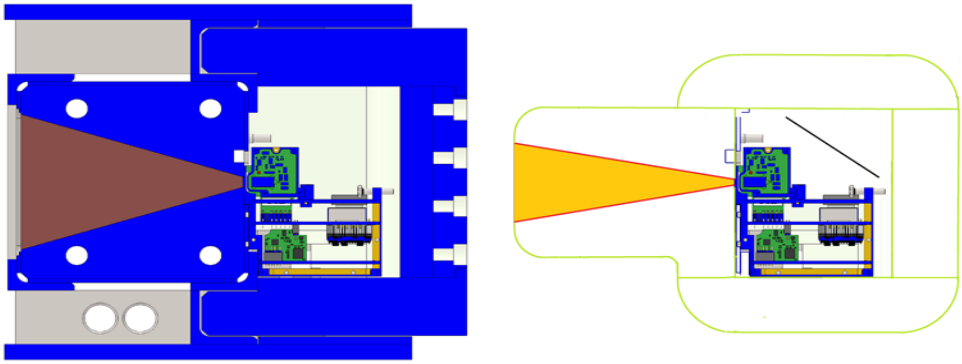

Figure 1 Side view of existing collimator (left). The blue regions represent tungsten. On the right is a concept for a smaller collimator that includes reducing the collimator opening angle and the internal volume for the electronics.

e) Additional design updates:
After the collimator has been redesigned, it will be possible to reduce the size of the rotating platform and thus reduce the overall width of the torus. The overall envelope of the PGET shall be reduced accordingly.

f) Data-Collection Software:
The data-collection software shall continue to include a stand-alone GUI and DLLs to perform the functionality outlined *SG-UR-14008 -- Passive Gamma Emission Tomography (PGET) Software -- v3 (2016-08-18)*. The data shall be stored using the existing header and data formats, using additional sub-header and data structures as needed. Additional requirements of the data-collection software include:
   a. The capability to collect full-spectra tomographic data in scanning single-channel-analyzer mode (PGET spectra mode);
   b. The capability to collect multichannel analyser (MCA) spectra from 14 detectors (1 detector per BEB) simultaneously with collection of tomographic data in 4-energy-window mode;
   c. The capability to set the acquisition mode, number of projections, and dwell time using a DLL call (instead of requiring interaction with the GUI window);
   d. The capability to perform energy calibration over a specified energy range.
   e. The capability to manually select the peaks in the energy calibration procedure in cases where the automated routine fails.

g) Transport and storage container:
The transport container shall be non-flammable and easily decontaminated. The PGET shall be secured firmly inside, with the weight resting on the central cylinder (i.e. not resting on the torus). There shall be space in the container for the cable and control box.

The bottom of the container shall be such that a forklift can lift it from underneath. No tools shall be required to open the container.