**Technical Assignment**

**for modernization of Radiation Monitoring System of the stack of BNPP-1**

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**ABBREVIATIONS**

|  |  |
| --- | --- |
| BNPP-1 | Bushehr Nuclear Power Plant, Unit 1 |
| RMS | Radiation Monitoring System |

# Project description

The Technical Assignment governs the design, engineering, supply of equipment, installation and testing of the system, equipment, components and other required items for the modernization of the Radiation Monitoring System of the stack of BNPP-1

## Project introduction and description

Currently two (2) sampling lines and one flow rate meter are installed in the stack of BNPP-1. The 2 sampling lines are independent and are fully operational. Both sampling lines are equipped with measuring equipment for aerosols, iodine, noble gases and sampling for tritium and carbon-14. The measuring equipment in one of the lines is fully operational, but the measuring equipment on the other line has some problems and not all measuring devices are operational.

This Technical Assignment forms part of the Contract for the modernization of RMS of the stack of BNPP-1 and determines:

* The phases of the design and the necessary design parts;
* The requirements for the equipment;

## Functional requirements

The main goal of the new RMS of the stack is to ensure on-line measurement of aerosols, iodine, noble gases and tritium and to provide sampling for tritium and carbon-14. Measurement of flow rate, temperature and humidity is also required. All measurement results should be displayed on a separate monitor in the radiation control room. It is also required a signalization about the status of the pump (on/off) on the sampling line to be displayed in the radiation control room.

## Functional guarantees

The Contractor shall guarantee to supply the RMS and services that meet all the functional and design requirements contained in, or reasonably inferred from this Technical Assignment.

The contractor shall provide the guarantee of products and repair services of the RMS for 2 years after trial operation of RMS (guarantees period). During this period, all spare part and maintenance of equipment shall be provided by the contractor on its own expenses.

The Contractor shall support the guarantees with test results documentation and/or certificates verifying that the relevant standards and Technical Assignment requirements are met during the design of the system and supply of the main and auxiliary equipment.

# Extent of supply

## Contractor’s scope of supply

This is a design and installation contract for the modernization of the RMS of the stack of BNPP-1. The Contractor’s scope is to provide all the design, procurements/fabrication of the equipment, testing, inspection, shipping, documentation, documentation to support the licensing process, training, installation, commissioning and other associated activities needed to modernize the RMS of the stack of BNPP-1. The contractor’s scope of supply shall consist of as a minimum of design work, supply and installation of all necessary equipment and elaboration of the relevant documentation necessary for carrying out the commissioning activities.

As a minimum, the Contractor’s scope of supply shall consist of:

* Design;
* Materials and equipment;
* Fabrication
* Installation;
* Inspection;
* Testing;
* Training;
* Documentation;
* Supply of spare parts and consumables.

## Employer’s scope of supply

The Employer’s general scope of supply is to:

* Set up files required for the issuance of permits and obtain all necessary permit(s) from the involved regulators based upon the Contractor’s provided deliverables;
* Review and approve Contractor’s documents within fourteen (14) calendar days;
* Provide the regulatory contact point, and management of all communications with regulatory authorities for license(s), permit(s) and/or certificate(s);
* Provide access and use of the existing transport routes on the BNPP site, and on-site warehousing space and conditions for materials and equipment supplied;
* Provide training premises if necessary to the Contractor. Provide personnel from BNPP site for training purposes;
* Provide administrative assistance to the Contractor for the transportation of materials and equipment through the access system of Bushehr NPP;
* Provide site access for Contractor’s personnel according to BNPP rules;
* Provide routine lifting and handling equipment to move supplied materials and equipment from warehouses, provided by the Employer to the installation site;
* Provide additional power supply if required for the new equipment and installation works.

The Employer shall provide the following specific items:

* Power supply connection point(s);
* Installation of all new cables based on the design specification; (Personnel – the Employer shall provide personnel to attend the Contractor’s training. This training shall permit the operational personnel to be available for operating the equipment during the tests. The Employer shall also provide maintenance personnel to attend the Contractor’s training and to assist the Contractor’s maintenance staff (thereby obtaining on-the-job training) during the tests.

# Design

The Contractor shall develop, supply and submit to the Employer for approval all necessary design documentation and equipment specification (including packing and handling transportation conditions to and on the site). The Employer shall review the design documentation within fourteen (14) calendar days of receipt.

The Contractor shall supply Technical design of the new RMS of the stack.

Detail design will be developed if necessary upon Employer’s request.

## Design requirements

The design shall ensure achievement of the functional requirements to the new system.

General design requirements:

* The existing sampling lines should remain intact;
* The new RMS of the stack shall use the sampling line which has damaged equipment;
* Signalization of the pump status (on/off) of the used sampling line shall be shown in radiation control room;
* A new flow rate meter should be installed in the stack for the purposes of the new RMS of the stack. The flow rate meter should transmit its measurements to all devices which need this data. The flow rate meter and the design of its location should be in accordance with the standards for such type of measurements;
* The devices of temperature and humidity measurements should be installed in the stack according to the relevant standards. Their data should be available for all devices which are needed for predication of desperation of radioactive material in the environment.
* The measurement equipment which will be installed on the sampling line shall include: (Please note that the numbers stated bellow consisting specification and they define the minimum requirements. Some of them are taken from the installed equipment, but these numbers will allow more equipment to be offered to BNPP)
  + Aerosol on-line monitor with the following technical data (or better):
    - Typical energy windows:
      * Alpha – 3 MeV ÷ 8 MeV;
      * Beta – 100 keV ÷ 3 MeV;
      * Gamma – 100 keV ÷ 3 MeV.
    - Typical measurement ranges:
      * Alpha – 10-2 ÷ 2\*105 Bq/m3;
      * Beta – 10-1 ÷ 106 Bq/m3.
  + Iodine on-line monitor with the following technical data (or better):
    - Measurement of I-131, I-132, I-133 and I-135;
    - Typical measurement range: 3.7 ÷ 3.7\*105 Bq/m3.
  + Noble gases on-line spectrometer with the following technical data (or better):
    - Typical energy windows:
      * Beta – 80 keV ÷ 2.5 MeV;
      * Gamma – 80 keV ÷ 2.5 MeV.
    - Typical measurement ranges:
      * Kr-85: 3.7\*104 ÷ 1012 Bq/m3;
      * Xe-133: 3.7\*104 ÷ 1012 Bq/m3.
  + Tritium on-line monitor with the following technical data (or better):
    - Typical energy window: 5 keV ÷ 6 keV (upper limit here could be 18 keV, which corresponds to the end point energy of tritium specter, but about 90% of the energy is in the window 5-6 keV – comment this with BNPP experts); it is prefer to consider 18 keV for upper limit.
    - Typical measurement range: 104 ÷ 106 Bq/m3.
  + Tritium and C-14 samplers
* All measurement equipment shall transmit the measurement results to the radiation monitoring control room;
* Existing cables should be used (if possible) for data transmission to the radiation monitoring control room;
* Appropriate software should be installed on the workstation in the radiation monitoring control room, which will allow visualization of the measurements on a separate monitor. The Contractor must check the possibility for installation of new monitor to the existing workstation. If it is not possible, additional graphic adapter, compatible with the existing workstation or new workstation shall be supplied;
* The software should allow integration of specific for BNPP mnemonic scheme of the stack with boxes for the measurement data;
* In the software design, the possibility should be considered for adding further measuring devices to the stack (as an example modernization of the old measuring line of the stack- line no. 1). The contractor should provide the necessary supports for the software upgrades in this respect.
* All measurements shall be stored in data base;
* The visualization software should further be installed on two (2) more work station – one for administrative purposes, allowing definition of the users and their privileges and the other for reporting purposes. . In addition, the data should be accessible in the radiation control room (in ZC building) and the local crisis center (in ZX building), it’s also required that the software and hardware provide the capability of expanding the data into the local management building and the crisis center outside BNPP-1 site ; The existing Ethernet computer network of the plant should be used for these purposes;
* The feasibility study for transferring and integrating the new measurement data with the old software for Automated Radiation Monitoring System (ARMS) installed in the radiation monitoring room and the main control room should be performed;
* Seismic resistance – the RMS system of the stack is classified as safety class 3 and seismic category 2 according to OPB-98. Therefore all measurement equipment and samplers supplied, should be designed and manufactured for this seismic category;

## Design input from the Employer

The Employer shall provide all design documentation of the existing structures, components and systems necessary to the Contractor to develop the design of the new RMS of the stack.

## Design Stages and tasks

# (This section shall be completed taking into account the information about the design stages of the RMS, tasks and the type of the output for each task and also work breakdown structure with time interval).Equipment supply

## Equipment basis

All materials and equipment supplied as part of the project shall be new, and in accordance with the design, drawings, and specifications provided by the Contractor and approved by the Employer. These materials and equipment shall be approved by the Employer.

## Equipment testing

All supplied equipment shall be tested, as applicable, to demonstrate operability and compliance with RMS functional requirements.

The equipment shall be subject to factory inspection by the Employer before shipping to ensure conformity with the Technical Specifications given in this Technical Assignment.

The Contractor shall develop and submit Commissioning Test Plan(s) for the Pre-Commissioning and Commissioning.

Pre-commissioning tests shall be carried out in the Manufacturer’s facility, if applicable. These tests are required to demonstrate the compliance with the approved Technical Design and they will be carried out in accordance with the Contractor’s Pre-Commissioning Test Plan. On successful completion of the pre-commissioning tests, the equipment shall be supplied to the BNPP site.

## Warehousing and maintenance during storage

The Employer shall provide required on-site warehousing space for the Contractor’s supplied equipment, components and materials. The Employer will be responsible for the safeguarding of the equipment including compliance with reasonable environmental conditions specified by the Contractor. The Contractor shall retain responsibility for the materials in the warehouse in regards to adequacy of packaging and any maintenance that might be required. The Employer shall provide access for the Contractor.

## Spare part, consumables and calibration equipment

The Contractor shall provide the items as specified below:

* All spare parts and consumables recommended in the operational and maintenance technical manuals after approval by the Employer for routine, programmed maintenance and expected required operational replacements, to maintain stated processing availability for a period of three (3) years from end of guarantees period. . A list of expected spare parts and consumables for a further five (5) years of operation shall be provided with vendors from where the identified items can be obtained; The contractor shall be responsible for providing the items from the a.m. list in the further five years of operation time span.
* Any calibration sources and calibration equipment. Commonly used ionizing sources need not be provided, however the specifications of such sources shall be provided by the Contractor;
* Two (2) sets of specialized (if any) tools and equipment required for the assembly/disassembly of the equipment and its maintenance.

The Contractor shall also provide a list of spare parts including suggested vendors for the seven (7) years following the initial three years of operation.

## Notification for shipment

The Contractor shall notify the Employer in writing at least seven (7) calendar days in advance of proposed shipping date for all items being shipped.

# Installation

The Contractor shall provide all labor, supervision and documentation to carry out the installation of the equipment, testing and commissioning of RMS of the stack (personnel who will be involved to operate the RMS of the stack during commissioning to be provided by the Employer).

# Completion

## Functional testing

After installation of the equipment the Contractor shall perform functional test of the whole system to ensure the system operates as per this Technical Assignment and design developed. The test will be attended by the Employer representative(s). All tests carried out should be documented in appropriate form and reported. The Contractor retains all the testing equipment responsibility until it is handed over to, and accepted by, the Employer.

## 72 hours trial operation

Following the successful completion of the functional tests, the equipment will undergo active trial operation to demonstrate functionality and performance in accordance with the previous tests carried out in the factory and in BNPP site.

The successful completion of the trial operation will form basis for the acceptance of the equipment by the Employer.

## Acceptance

Acceptance by the Employer is an administrative action after the 72 hours trial operation and concludes in Employer’s acceptance of the entire project.

# Training

The Contractor shall provide training program, which shall contain details of the technical and craft labor personnel required for the operation and maintenance of the RMS of the stack, the description of the training modules and time schedule.

The training materials and the lessons shall be provided in English language.

Personnel satisfactory completing the training program(s) shall be certified by the Contractor as competent to operate and/or maintain the equipment, depending on the parts completed.

The Contractor’s training of Employer’s personnel (both operation and maintenance) shall be completed prior the beginning of Trial Operation.

# Documentation

Documentation submitted by the Contractor for approval shall be provided by hard copy and electronically. The format of the electronic copy shall be compatible with Microsoft Office (compatible with Version 2010) and/or AutoCAD (compatible with Version 2007). Alternative electronic formats may be considered by the Contractor but are subject to preliminary agreement by the Employer.

Documents to be submitted for Employer’s approval should be provided in three (3) hard copies in English language and one (1) electronic version of each in the format stated above and in ‘pdf’ and ‘Word’ format.

The results of all tests and inspections shall be documented and submitted to the Employer.