***Technical specification for the IAEA procurement:***

***System for environmental and public protection for Bushehr for normal operational conditions and for emergency situations***

*(System for assessment of radiological impacts of airborne and liquid discharges from normal operation of Bushehr NPP and for* *emergency response to accident with release of radionuclides into the environment.)*

**Technical specification**

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# Specific technical requirements

The subject of delivery is system (software package) for environmental and public protection for normal operational conditions and decision support system for public protection in case of emergency situations for Bushehr NPP.

The task of the system for routine operational conditions is to evaluate radiological impacts (effective doses to the population affected) caused by routine operational airborne effluents to the atmosphere and routine operational liquid discharges to the marine environment from normal operation of Bushehr NPP.

The task of decision support system for emergency conditions is to estimate the source term on the base of symptoms measured or detected by NPP operator, to calculate radiological impacts to the vicinity of NPP and to recommend urgent protective measures for population in the vicinity of the NPP Bushehr.

Demanded is delivery of software package which will consist of two components or modules, **Component I.** - for normal operation and **Component II.** - decision support system for emergency situations.

The duty of the contractor (supplier) is to deliver 2 licenses for the system for routine operational conditions (i.e. Component I.), including adaptation to local conditions, implementation and on-site training, and 1 license for server and 1 license for client of decision support system for emergency conditions (i.e. Component II.), including adaptation to local conditions and data, implementation and on-site training. Server part of decision support system for emergency conditions (i.e. Component II.) has to be delivered in way allowing future potential extension the number of clients connected to the server from 1 to higher amount.

The contractor (supplier) will, in close cooperation with the IAEA, participate as lecturer on additional comprehensive training course (workshop) at the IAEA in Vienna for 3-6 experts from the end-user (Bushehr NPP), duration of the course will be 2 weeks, the course will be organized by the IAEA no later than 2 months after the final delivery of software packages to the end-user (Bushehr NPP).

# Characteristics of the software Component I.

The software will evaluate radiological impacts of routine airborne effluents to the atmosphere and liquid discharges to the marine environment from NPP Bushehr and will calculate effective doses to the population living in 100 km vicinity of the NPP Bushehr and especially effective doses to the members of representative groups of inhabitants in the vicinity of NPP.

The software will calculate effective doses and committed effective doses from external irradiation from cloud, from deposit, from inhalation and from ingestion, by age categories in compliance with the IAEA BSS.

The processes more relevant to dose estimations will be identified by the contractor and a conceptual model which represents the identified relevant dispersion and transfer pathways will be described by contractor. In the frame of this, description of behaviors, characteristics and specific pathways of irradiation of representative group members will be defined by contractor and adapted or modified by contractor after confirmation from the end-user.

Exposure pathways considered by the contractor in the process of creation of conceptual model for the software delivered will be at least:

Inhalation of radionuclides in an atmospheric plume (gases, aerosols);

Inhalation of resuspended material;

Ingestion of crops and/or other relevant agricultural products;

Ingestion of animal food products (milk, eggs);

Ingestion of aquatic food (seawater fish, crustaceans, molluscs);

External exposure from radionuclides in an atmospheric plume (cloud shine);

External exposure from radionuclides deposited on ground (ground shine) and surfaces;

External exposure from radionuclides in water and sediments (i.e. from activities on shores, swimming and fishing).

The assumptions and approaches to deal with particular exposure pathways in the model applied will be described and referenced in User Manual and/or in accompanying documentation.

Contractor will use and implement into the system publicly available statistical data about agricultural (farmers) production, consumption of agricultural and marine products and number of inhabitants. This data will be site specific in the extent available to the contractor and will be described and referenced in User Manual and/or in accompanying documentation to the software. The software will enable the end-user to input, to edit or to modify this data.

Included in the software will be mathematical model for atmospherical dispersion of operational atmospherical effluents based on the PTM (puff trajectory model).

Included in the software will be mathematical model for aquatic (marine) dispersion of operational liquid discharges to the Persian Gulf. The model will take into account the specific site conditions.

Radioactive decay chains will be taken into account by the software. The assumptions and approaches to deal with progeny will be described in User Manual and/or in accompanying documentation.

Deposition (and subsequent resuspension) of radionuclides from the atmosphere on the ground will be taken into account in the model approach and described and referenced in User Manual and/or in accompanying documentation.

Accumulation (and subsequent remobilization) in aquatic sediments will be taken into account in the model approach and described and referenced in User Manual and/or in accompanying documentation.

Transfer and accumulation of radionuclides to plants and animals in the food chain will be taken into account in the model approach and described and referenced in User Manual and/or in accompanying documentation.

The software will be GIS based.

The software will consider real points of releases of operational effluents to the atmosphere and to the Persian Gulf.

The software will use for calculation of radiological impacts caused by effluents into atmosphere meteorological data measured on-site and provided by the end-user. The software has to be able to read this data automatically from the txt or xls file.

The format and the content of input files (txt or xls) with atmospherical effluents and liquid discharges from NPP Bushehr used for calculation of operational impacts will be defined by the contractor and adapted or modified by contractor after confirmation from the end-user during implementation stage of the software. The software must be able to read this input data automatically.

Transfer factors, concentration factors and other parameters applied for calculation will be explicitly described and reported (including citation of the source of information) in the documentation for the end-user. The software will enable the end-user to edit, to change or to modify these parameters.

The software will allow to report the results (relevant effective doses) in the form of maps and in the form of tables.

Graphical user interface (GUI) and User Manual and/or accompanying documentation of the software will be delivered in 2 languages: in English and Russian language.

The software will be implemented and operated on HW which is described in Appendix 1.

# Characteristics of the software Component II.

The task of decision support system for emergency conditions is to estimate the source term, and to calculate radiological impacts to the vicinity of NPP.

Input to the software will be relevant technological and radiological data measured by NPP operator or information entered to the system manually by the user during the course of accident.

Algorithms for evaluation of the symptoms, will be defined and described by the contractor and modified or accommodated by the contractor after confirmation from the end-user. This will be performed in the implementation stage of the delivery. The format and the content of input data will be defined by contractor and modified by contractor after confirmation from the end-user.

1. The task of the software is to estimate predicted source term (release to the atmosphere of the environment) on the base of symptoms evaluated. Predicted source term should be assimilated to really measured responses of radiation detectors inside and outside reactor building.

Appropriate inventory of reactor core and inventory of spent fuel pool which will be used as one input to the calculation of estimated predicted source terms will be defined by the contractor. The software will enable the end-user to edit or to modify reactor inventory and spent fuel pool inventory applied for calculation of predicted source terms.

2. Further task of the software will be to calculate radiological impacts of estimated predicted source term to the vicinity of NPP Bushehr. Included in the software will be the appropriate mathematical model for atmospherical dispersion.

The software will calculate effective doses and committed effective doses from relevant exposure pathways. Exposure pathways and intervention levels for protection of inhabitants considered will be described in a conceptual model defined by contractor and adapted or modified by contractor after confirmation from the end-user.

For calculation of atmospherical dispersion the software will use relevant meteorological data provided by the end-user and numerical weather prediction data provided by the end-user. The software has to be able to read this data automatically. The content and range of numerical weather prediction data will be defined by contractor and adapted or modified by contractor after confirmation from the end-user during implementation stage of the software.

3. Further task of the software will be to recommend urgent protective measures for population in the vicinity of the NPP Bushehr. This task will be based on prediction of radiological impacts calculated by the system and on intervention levels defined by the contractor. Intervention levels for evacuation, sheltering and iodine prophylaxis will be defined by contractor in compliance with relevant international standards and adapted or modified by contractor after confirmation from the end-user during implementation stage of the software. The software will enable the end-user to edit or to modify intervention levels applied.

The software (decision support system) will report its results and conclusions in the form of short messages, sentences, maps, graphs and in the form of tables.

Graphical user interface (GUI) and outputs and User Manual of the software will be delivered in 2 languages: in English and Russian language. The end-user will have possibility to change the language of the GUI on-the-fly. The relevant most important warnings of the system to the crisis staff will be generated and reported by the system also in Persian language (Farsi).

The software will be GIS based, basic maps will be delivered by the contractor (supplier), and the map layers will be taken from publicly available sources or will be prepared specifically by the contractor. Additional special map layers can be provided by the end-user and adapted to the system by contractor during the implementation stage of the system.

Contractor will use and implement into the system publicly available statistical data about number of inhabitants by villages and by age for the vicinity of NPP Bushehr. The software will enable the end-user to edit or modify this data.

The software will be implemented and operated on HW which is described in Appendix 2.

# General Software requirements

1. Operating systems for delivered software will be Microsoft Windows 7 or higher for client and stand-alone part of the system, for server part of the system the run will be on Microsoft Windows Server 2008 or higher.
2. Third party software requirements for proper software run: Microsoft Office.
3. Required is individual installation DVD for normal operation (Component I. - stand-alone application) and installation package including server and client part for emergency part of the SW package delivered (Component II.)
4. Security aspects:
	* The system will be designed in such a way not to interfere with the plant safety.
	* Encrypted communication between the client and server will be secured by encryption and certificates.
	* The system (Component II.) will be operated in the manner which allows different levels of rights (to input data manually, to operate the system) controlled by passwords and user names. Different levels of rights will be manageable by the system administrator of the end-user.

# Technical features

1. Language of graphical user interface:
* Language of the graphical user interface will be English and Russian (selectable by the operator of the specific client, switchable during the run)
1. In-build databases - Component I of the SW package:
* database of constants and factors for each calculated radionuclide,
* statistical database of foodstuff production and consumption of interested regions,
* database of number of inhabitants in 100 km zone around the site of interest (NNP Bushehr): for each city, town and village and for each calculated age category.
1. In-build databases - Component II of the SW package:
* database of core inventory and spent fuel pool inventory and database of basic types of severe accident source terms (potential releases to the atmosphere)
* database of constants and factors for each calculated radionuclide,
* database of number of inhabitants in 100 km zone around the site of interest (NNP Bushehr)

# Stages of delivery

Implementation scheme demanded is as follows:

**1. Up to 30 days after date of acceptation of the bid, the contractor will submit all the relevant necessary basic information and the requirements to be fulfilled by the contractor.**

**2. Then, no later than in 20 days, the end–user will submit to the contractor:**

- comments, amendments or proposed modifications (if any).

**3. Then, no later than in 20 days, the contractor will:**

- implement proposed modifications or amendments to the software. The contractor will do it on the base of his best knowledge, it means that the range and method how the proposed modifications from the end-user are finally implemented to the software will be based on the contractor´s best knowledge and belief. Contractor (supplier) has the right not to accept certain demands or to implement certain demands in his own way.

- inform the IAEA that the delivery is ready to be supplied and implemented at the premises of the end-user.

**4. Then, no later than 70 days after date of acceptation of the bid, the contractor will:**

- start with implementation and tests on-site, at the location of the end-user, i.e. Bushehr NPP. Implementation and tests on-site will take no more than 3 days and after or in parallel the on-site training course for the end-user experts will be performed by the contractor. The on-site training course will be performed at the premises of the end-user and will take no more than 5 days.

- after implementation, tests and training course on-site the final protocol on delivery will be signed by the end-user.

**5. Then, during next 6 months after the signing of the final protocol on delivery:**

- the contractor will provide remote technical support and maintenance subject to the initial contract with IAEA.

- the end-user can report to the contractor the existence of technical issues or problems detected by the end-user, e.g. need of additional messages, changes in colors, background maps.

- the contractor will provide basic updates in the frame of technical support and maintenance specified in the initial contract.

- the contractor will provide to the end-user support for preparation of one scenario for nuclear emergency exercise.



# Technical documentation

User Manuals in English language and in Russian language will be delivered separately for both software components (Component I and Component II).

Model applied will be described in the User Manuals.

The testing, benchmarking and validation process of the systems delivered (Component I and Component II) will be described in the User Manuals.

# Appendix 1: Hardware for Component I – the stand-alone application for routine operational effluents

Table: Configuration of the stand-alone application for routine effluents (e.g. Dell OptiPlex 9030, HP ProOne600):

|  |  |
| --- | --- |
| **CPU** | Intel(R) Core(TM) i7-3612QM CPU @ 2.10GHz |
| **RAM** | 8 GB |
| **HDD** | 240 GB SATA, RAID 1 |
| **GPU** | 1GB (e.g. NVIDIA Quadro 400 / 420) |
| **GPGPU** | - |
| **Other** | DVD/CD-ROM, keyboard, mouse, all-in-one type of desktop PC |
| **OS** | Windows 7 64bit (EN) |
| **LCD** | resolution min 1280x1024 |

Note: Hardware has to be provided by the user and will be already implemented on site (at the location of the end-user, i.e. NPP Bushehr) at the implementation stage of this delivery.

# Appendix 2: Hardware for Component II – decision support system for emergencies, server and client

Table 1: Configuration of the server for emergency (e.g. HP proline DL370G3, or HP Z840):

|  |  |
| --- | --- |
| **CPU** | Xeon, E5540, 2,53 GHz |
| **RAM** | 12 GB |
| **HDD** | 240 GB SATA, RAID 1 |
| **GPU** | Nvidia Quadro 2200/4200 |
| **GPGPU** | Nvidia Tesla c2050 / k20 |
| **Other** | DVD/CD-ROM, keyboard, mouse |
| **OS** | WIN Server 2008 64bit (EN) |
| **LCD** | resolution min 1280x1024 |

Table 2: Configuration of the client for emergency (e.g. Dell OptiPlex 9030, HP ProOne600):

|  |  |
| --- | --- |
| **CPU** | Intel(R) Core(TM) i7-3612QM CPU @ 2.10GHz |
| **RAM** | 8 GB |
| **HDD** | 240 GB SATA, RAID 1 |
| **GPU** | 1GB (e.g. NVIDIA Quadro 400 / 420) |
| **GPGPU** | - |
| **Other** | DVD/CD-ROM, keyboard, mouse, all-in-one type of desktop PC |
| **OS** | Windows 7 64bit (EN) |
| **LCD** | resolution min 1280x1024 |

Note: Hardware is provided by the user and will be already implemented on site (at the location of the end-user, i.e. NPP Bushehr) at the implementation stage of this delivery.

Note: The network and connections (between client and server, and between server and data sources) will be the responsibility of end-user, i.e. NPP Bushehr.