**Technical Specifications**

**Project title:** *Support to Southern African States in Nuclear Safety and Safeguards*, a EU funded project INSC/2016/379-139

**Objective**: Create a web-based information system (IS), providing a platform for data exchange on transportation of ionizing radiation sources and uranium ore

**Beneficiary**: Participating countries, potentially also the Secretariat and Member States of the Southern African Development Community (SADC) including the Republic of South Africa

**Duration**: up to 8 months

**Duty Station**: the Republic of South Africa, Pretoria, the National Nuclear Regulator at Centurion, South Africa

**Estimated starting date**: 29 June 2018

# Background information

The Southern African Development Community (SADC) is an inter-governmental organization headquartered in Gaborone, Botswana. Its goal is to further socio-economic cooperation and integration as well as political and security cooperation among 15 southern African states. At least five of the SADC Member States mine or intend to explore uranium ore mines and export uranium oxide concentrate (UOC, “yellow cake”) for further processing, typically to the USA or to Europe.

The transportation of the UOC from two of the manufacturer states – Malawi and the United Republic of Tanzania, is carried out by road to the seaport of Walvis Bay in Namibia. This is a trip of more than 5000km through the territory of four states (Tanzania, Malawi, Zambia and Namibia).

A map, showing the transport route of UOC is shown in Figure 1.

UOC is packaged in sealed 200 litre steel drums meeting IP-1 industrial package standards. Each drum has a tight-fitting lid, which is secured to the drum with a steel locking ring that is clumped by a locking ring bolt. The drums are marked and labelled and then stowed securely within 20 ft ISO freight containers, using a strapping system to withstand the G-forces expected during road, rail and sea transportation and associated handling operations. The containers are marked and placarded or labelled, and then inspected and sealed with consecutively numbered bolt-type seals fixed to the door of each container. The containers remain sealed throughout the journey from the mine site to the ultimate point of delivery. The seals are checked for integrity at all trans-shipment and discharge points.

The requirements related to the safe transport of radioactive material are specified in the IAEA Specific Safety Requirements SSR- 6 “Regulations for the Safe Transport of Radioactive Material”, 1012 edition. Paragraph 109 of the Requirements states that “Measures should be taken to ensure that *radioactive material* is kept secure in transport so as to prevent theft or damage and to ensure that control of the material is not relinquished inappropriately”.

Radioactive material (defined as [Class 7](http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/transport-of-nuclear-materials/transport-of-radioactive-materials.aspx#Notes) material in the UN Model Regulations on Dangerous Goods) is not unique to the nuclear fuel cycle. Radioactive substances are used extensively in medicine, agriculture, research, manufacturing, non-destructive testing, and minerals exploration.

The SSR-6 states that a graded approach shall be applied depending on the characteristics of the materials. In the case of UOC, which is a Low specific activity (LSA-1) non-fissile or fissile-excepted material, the requirements are rather relaxed and are restricted to the proper labeling and procedures in case of incidents. It is also required that the packages of materials shall be transported along pre-defined routes, with predefined stop positions and by registered transport vehicles. Transport-related data should include the identification of vehicles and of drivers.

The information system to be developed within the Project should help the regulatory authorities collect and evaluate all relevant data in a fast, continuous, comprehensive and consistent manner. It should provide an opportunity for information sharing among the participating countries initially while allowing for additional SADC users at national and international level.

# General system requirements

## Hardware

The information system shall consist of a main server and Database server, based in the National Nuclear Regulator (NNR) of South Africa and 5 workstations (users).

The location of the equipment is given in the following table:

|  |  |
| --- | --- |
| System component | Location of equipment |
| System server; Database | National Nuclear Regulator (NNR)  Pretoria, Republic South Africa |
| Workstation | Gaborone, Botswana, SADC Secretariat |
| Workstation | **Tanzania Atomic Energy Commission (TAEC)**  Arusha or Dar es Salaam office, Tanzania |
| Workstation | Ministry of Lands and Natural Resources  Lilongwe, Malawi |
| Workstation | Zambia Radiation Protection Board  Lusaka, Zambia |
| Workstation | Atomic Energy Board of Namibia  Windhoek, Namibia |

A possibility to extend the number of users up to 16 shall be envisaged in the system configuration. The user workstations will be located in the member states of SADC.

A schematic diagram of the system is shown in Figure 2.

There are no specific requirements to the server and the workstations with respect to environmental conditions. The equipment will be installed in office spaces. On the basis of the specific indicators defined by the web-based system developer the needed hardware for the server and for each workstation should be agreed upon with each user, as well as the optimal mode of equipment procurement, be it by purchase on the local market or by import. The IS developer will assure maintenance of the system for the duration of the project.

The system developer shall specify any specific requirements with respect to environmental conditions and uninterruptible power supply.

Data related to the location of the radioactive materials are to be acquired in real time using a GPS system, pertinent to each transport vehicle. The entity to be recognized by the system shall be a freight container. The system should generate records at pre-set time intervals. The contents of each record is to be agreed with the participating countries.

Also, the possibility to transmit data from the officials in charge of the vehicle or convoys shall be provided, e.g by mobile phone or other portable devices. The data transfer shall be compatible with the system.

The communication between the server and the user workstations shall be protected from unauthorized access.

Sensitive information shall be transferred in a secure (encrypted) way. Unauthorized access shall be excluded. The structure of the system should allow various levels of authorized access. The specification of “sensitive information” is to be provided by the participating countries and the hosting organization - the RSA National Nuclear Regulator. NNR).

Reliable measures against loss of information shall be provided.

## Software

The system should acquire real-time data related to the location of the radioactive materials.

As long as the transport vehicles will cross several borders, a record should be generated upon crossing a checkpoint. Each record should contain the identification of the vehicle, the identification of the checkpoint and the time of crossing.

Following the requirements of SSR-6, records should be generated when a predefined stop position is reached and left.

Both the border checkpoints and the stop positions are part of the pre-defined transport route, therefore their co-ordinates can be an input to the system and their reaching could be detected automatically.

The responsibility for a given transport is transferred from the authority of one country to another at the border checkpoints, therefore creating a record conforms this transfer. For this reason, the crossing of borders should be input to the system by the driver or by the official in charge of the vehicle or convoy by mobile phone.

The system should detect the transfer of responsibility and transfer the input as shown in Figure 2.

In case of an incident during transportation, a report has to be prepared following the requirements of IAEA and the local safety authorities. This report is handled separately, but brief information should be input to the system, at least time and location.

Based on the above input data, including the identification of the transport and transport packages, the system software shall provide:

* Retrieval of data over selected time intervals and/or on specified dates and time;
* Generation of reports on selected parameters, e.g. type of material, activity inventory (if applicable), place of origin, place of final destination, transportation route, important timing ,etc.;
* Incidents during transportation;
* Other, as specified by the regulatory authority (NNR).

Each report should include as a heading the identification of transport.

Initially the software should be based on the transportation of UOC (yellow cake). The records structure shall allow expansion in order to cover other radioactive materials (e.g. from medicine, agriculture, research, manufacturing, non-destructive testing, and mining).

## Compatibility with RAIS

It is highly recommended that the system is compatible with the IAEA Regulatory Authority Information System (RAIS). RAIS is a software application developed by the IAEA, to assist its Member States in managing their regulatory activities in accordance with IAEA Safety Standards and guidance, including the Code of Conduct on the Safety and Security of Radioactive Sources and supplementary Guidance. The current web-based version of RAIS (RAIS 3.3 Web) is used as the National Dose Register (NDR) by the RSA Regulatory authority. The NDR Portal (a web application) interacts with the RAIS database, which is installed on an SQL Server. The interface includes functions related to submission and analyses and provides assistance in the form of a user manual.

IAEA RAIS promotes a consistent and common approach to the regulatory control of radiation sources while offering the flexibility to respond to the specific needs of the Member States, with respect to their national legislative frameworks, administrative structures and institutional and regulatory frameworks.

The following specific information for transport authorization is included in RAIS 3.n Web:

* Package type
* Package category
* Transport index (TI)
* Transport mode(s), including multimode transport
* Consignor
* Consignee
* Carrier
* Consignee authorization, which allows it to receive the source
* Place of origin
* Destination
* Date of shipment
* Date of receipt
* Exclusive use (y/n)
* Special arrangement (y/n)
* Existence of a security plan for transport of sealed sources of specific security classes.

This information is to be ready for uploading to RAIS.

## Categories of Users

The following groups can be identified as target audiences

1. System Administrator, (enabled to control access to the system);
2. System Managers, (enabled to initiate and conduct information exchange and to introduce changes in the data his/her country specific data base);
3. Users (enabled to receive and monitor information flaws and to register comments, questions and to suggest reactions).

2.5 Access, Structure and Functional Requirements

2.5.1 The IS should contain the following functions:

1. The system must be developed in English;
2. Registration (delineation of access to the functional section and to the database of documents should be envisaged for the participating countries on the need to know basis);
3. The possibility of disabling or correcting registration should be envisaged (through manual registration);
4. The creation of Logging Accounts and the algorithm of Logging actions are to be provided ( with the possibility of self-recovering the password - by code word, or control letter to the mail);
5. Database of inputs should be delimited by subject and by country. The level of access to the country-specific database should be defined by the respective participating state.

2.5.2 Requirements for the functions (tasks) performed by the functional part of the system

The user interface should provide a clear and understandable representation of the structure of the information placed on it, a quick and logical transition to sections and pages. Navigation elements should provide an unambiguous understanding of the user's meaning: links to the pages should be provided with headings, the symbols correspond to the generally accepted ones. The system should provide navigation on all available sections to the user and display relevant information.

If selected any of the menu items must load the corresponding information page.

When registering a user, one must provide the following information:

* Last name;
* First name;
* Additional suffix;
* Country;
* Organization;
* Position;
* Login password;
* Password for editing personal data;
* E-mail.

The login is automatically generated and displayed at the stage of entering the first and last names. If this login is already reserved, the user adds an additional suffix.

The end of user registration is the approval of the administrator. The administrator determines the level of access to the documents (to which country). Also, the administrator can fill in data.

The shipments monitoring lock should provide the following opportunities:

* Send notification to the administrator about an upcoming delivery monitoring;
* Invite users to a session (Inviting to discussion can be either the author or administrator of the system);
* Feed in of data by the initiating country with a possibility of attaching files;
* Approval of users to join the session (When the comment is displayed, the following information should be displayed: Author, Date, Time);
* Real time discussion through exchange of comments, questions and recommendations.

2.5.3 Storage requirements

All data of the system should be stored in a structured format under the management of a relational DBMS. The system must provide backup of the data.

The backup should take place at least on a weekly basis. A procedure shall be developed for reliable backup of the data, complying with the relevant IAEA requirements and the regulatory requirements of the hosting countries. As long as compatibility with RAIS is required, data will be uploaded to RAIS where it will be available for further access. The web interface should be enabled to display the record for the last 60 days.

2.5.4 Requirements for programming languages

The server part of the system should be implemented in the PHP programming language.

To work with the database, the SQL query language must be used within the ANSI SQL-92 standard. This MySQL version is a minimal requirement that may be subject to further development in the future.

2.5.3 Software Requirements

The client software must meet the following requirements:

* Web browser of the latest versions: Internet Explorer, Firefox, Opera, Safari or Google Chrome; The system should be capable to work with all or most of these browsers;
* The system should be compatible with touch screen devices as iPad, iPhone, Samsung, etc.;
* The operational system should preferably be Linux;
* The disaster recovery of the data base period should be minimal, while HW failures should be recovered in the shortest timeframe possible;
* support for JavaScript and cookies should be included.

2.5.4 Hardware Requirements

The hardware of the server part must satisfy the following requirements:

* MySQL 5.5 – as a minimal requirement;
* Free space on the disk - at least twice the current size of the database and consistent with the requirements for the backup data preservation.

2.62. General Requirements for Acceptance of Tasks

Acceptance of tasks should be carried out by an acceptance commission, which should include representatives of ISTC and the Supplier, as well as of interested beneficiaries, within three working days after completion of work. The results of the work of the commission should be formalized by an act signed by the members of the commission and approved by ISTC.

The conditions for acceptance of tasks fulfilment includes technical support for correction of errors and edits on the site (if any) within 3 months from the date of signing the act of receiving and transmitting the result of services.

# Main activities

The main activities of the projects will be:

1. Design of a web-based information and communication system

The system should meet the general requirements stated above. At the first stage in should comprise a server and four operator stations, as well as GPS receivers to be installed on selected transportation entities. Communication with the vehicle-based GPS receivers is acceptable.

The equipment, necessary for the development of the system, including software, is to be purchased on behalf of the beneficiary countries and transferred to them at the end of the project.

1. Programming of the system in accordance with the design architecture;
2. Commissioning report

The commissioning report shall include at least the following information: system description; user manuals and programmers’ guides; verification and validation (V&V) matrices and acceptance criteria; results of the execution of the V&V programme, including records demonstrating the fulfilment of the acceptance criteria. The V&V programme is to be fulfilled at the supplier’s premises. Upon request of the Beneficiary, presence of its observers shall be possible at the Supplier’s premises.

1. Procurement of the hardware envisaged above for the benefit of the participating countries and the SADC Secretariat. Pending of the specific conditions to be agreed by the users the Supplier will either perform the procurement himself or specify recommended capabilities that will be used by ISTC and the beneficiaries for the acquisition of the needed hardware.
2. Installation of the system

The system will be installed at the locations specified by the beneficiaries after the approval of the Commissioning report. Functional testing of the system shall be performed by the Supplier prior to the beginning of trial operation.

1. Training of local personnel

As a result of the training, the personnel of the Beneficiary should be capable of operating the system in data acquisition mode, generating of reports, upgrading of the system software (modification of records format and expansion of the records format by adding of new fields), adding of new workstations, etc.

A training programme, covering the above aspects as well as the number of trainees, should be prepared by the Supplier and approved by the participating countries.

1. Site acceptance tests and trial operation

The site acceptance tests are to be performed according to a programme, elaborated by the Supplier and approved by the participating countries. The site acceptance tests shall be performed by the Supplier, with the participation of the personnel of the concerned countries. The results of the tests shall be documented.

The trial operation of the system shall have a duration of 6 months. It shall be performed by the personnel of the participating countries under the supervision of the Supplier. The trial operation shall demonstrate that all technical requirements are met and that the system is operating reliably and securely. The results of the trial operation shall be documented and approved by the participating countries Beneficiary.

# Data to be provided by the Beneficiaries

The following data is to be provided by the Beneficiary:

* Types of radioactive materials to be introduced to the system;
* Specific regulatory requirements related to transport of radioactive materials;
* Information on RAIS implementation by the South Africa regulatory authority (version of RAIS, platform, application, etc.);
* Description of transports – packages, containers, vehicles, etc.;
* Environmental conditions at the premises where the server and the work stations will be installed;
* Specific information related to power supply, including reliability.

# Key deliverables

As a result of the project the following shall be delivered to the participating countries:

* Hardware of the system according to the design;
* Source codes of the software, developed by the Supplier;
* Operations manuals, User manuals and Programmer’s guides;
* Commissioning report, demonstrating the V&V activities completed at the Supplier’s site;
* Training programme and training materials;
* Report on the site-acceptance tests of the system;
* Report on the trial operation of the system.

# Quality assurance

The Supplier should present a Quality System Certificate according to ISO 9001:2015 or compatible, covering the type of activities to be performed within the Project. For this Project the Supplier shall prepare a Quality Plan according to ISO 10005.

# Tentative time schedule:

|  |  |  |  |
| --- | --- | --- | --- |
| Stage | Description of work | Start | End |
| Task 0 | Preparation of a Quality plan |  |  |
| Task 1 | Conceptual design |  |  |
| 1.1 | Elaboration of a preliminary system design |  |  |
| 1.2 | Approval by ISTC and the Beneficiaries |  |  |
| Task 2 | Basic design and system elaboration |  |  |
| 2.1 | Purchase of equipment and design of system |  |  |
| 2.2 | V&V of the hardware and software by the Supplier. Elaboration of a commissioning report |  |  |
| 2.3 | Delivery of the system and relevant documents to the beneficiaries |  |  |
| Task 3 | Installation and training |  |  |
| 3.1 | Installation of the system |  |  |
| 3.2 | Training of personnel |  |  |
| Task 4 | Trial operation and hand-over |  |  |
| 4.1 | Trial operation of the system. Identification and implementation of necessary modifications. Approval by the Beneficiary |  |  |
| 4.2 | Final hand-over of the system |  |  |

# References

1. INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material, SSR- 6, IAEA, Vienna, 2012
2. INTERNATIONAL ATOMIC ENERGY AGENCY, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, Safety Standards Series No. GS-R-1, IAEA, Vienna, 2000.
3. INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA, Vienna, 2004.
4. INTERNATIONAL ATOMIC ENERGY AGENCY, Categorization of Radioactive Sources, IAEA Safety Standards Series RS-G-1.9, IAEA, Vienna, 2005.



Figure 1 Map of UOC transport routes



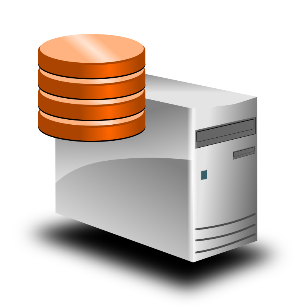
GPRS/GSM Network



Workstations



Communication and database servers



Workstation of the responsible national authority

Figure 2 Schematic diagram of the information system