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# **Self-assessment of the Sudanese Nuclear Infrastructure for the First Research Reactor Project**

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# Introduction

# Sudan Location



# Applications of Radiation in Sudan

- ❑ Sudan has commenced applications of radiation since the Radiation and Isotopes Center of Khartoum (RICK) was established in 1967.
- ❑ Nowadays, many applications of radiation have been expanded and developed in a variety of sectors such as:
  - Medical (Radiotherapy, Nuclear Medicine, etc.)
  - Industrial (Well logging, Non-Destructive Testing, etc.)
  - Co-60 Irradiator (at Sudan Atomic Energy Commission)
  - Research & training (Universities and Institutes).

# The First Research Reactor in Sudan

Recently, Sudan has planned to establish its first research reactor with the **four main goals** as follows:

1. Strengthening nuclear infrastructure
2. Providing technical facilities
3. Furnishing appropriate training and experience for future nuclear power projects
4. Producing radionuclides for national applications.



# Methodology

# Specific Nuclear Infrastructure

- When a country embarks on their research reactor project, **a specific infrastructure supporting the project shall be implemented.**

Nuclear Security



Emergency Preparedness and Response

Nuclear Safety

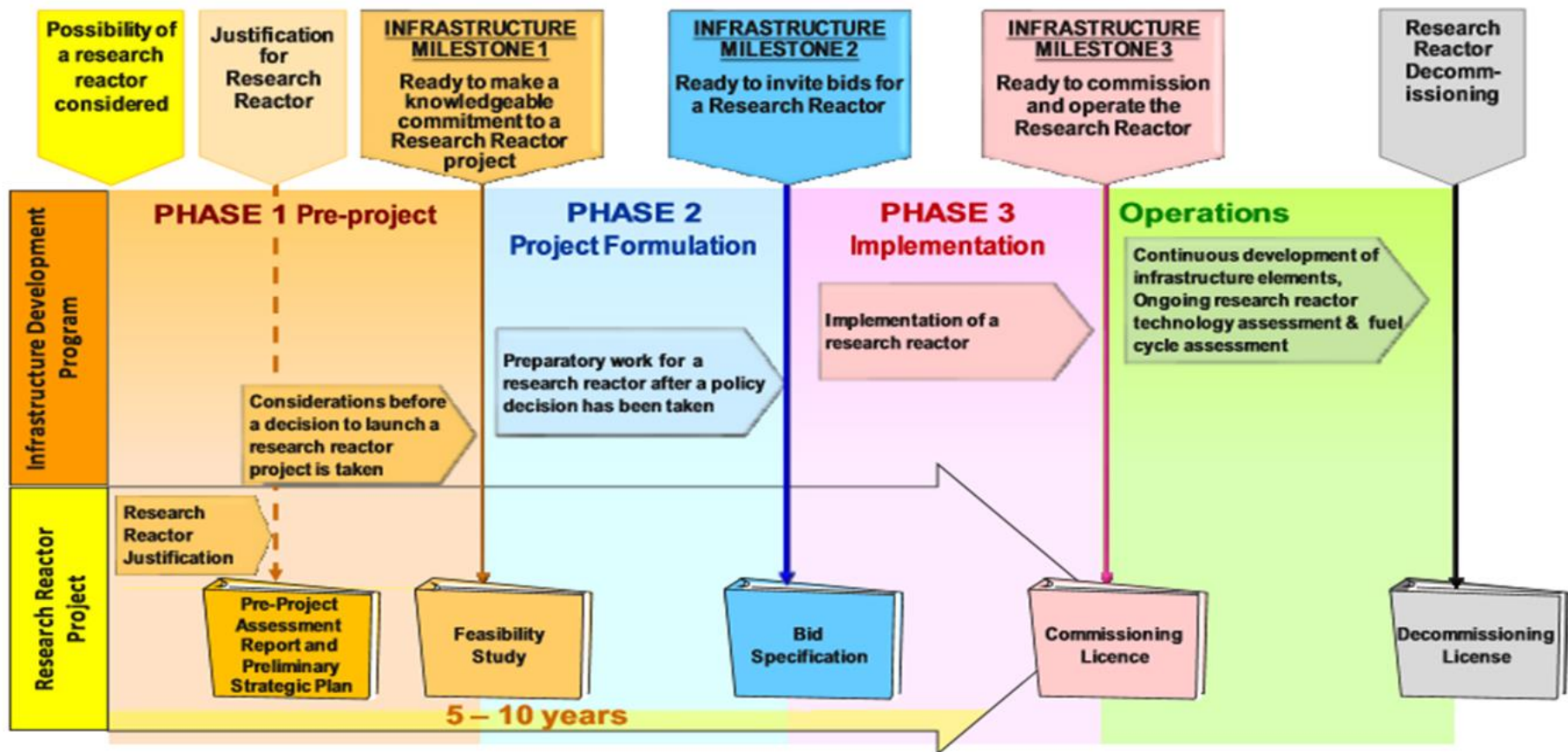


Regulatory Framework



# Milestone Approach for a RR project


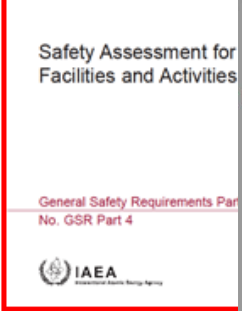
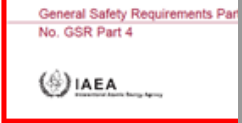

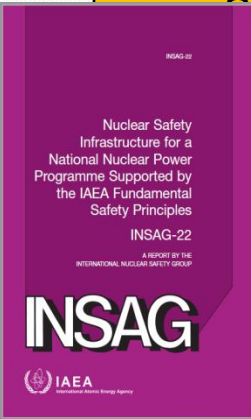



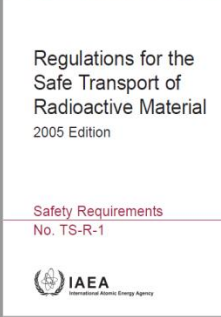


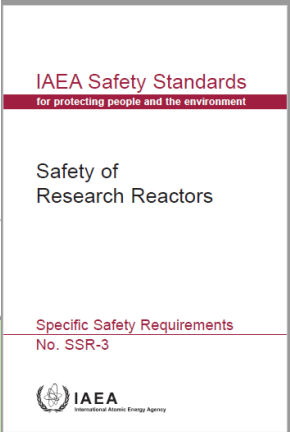
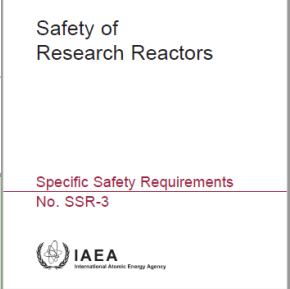
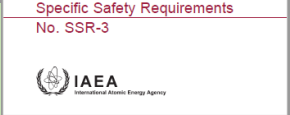

The development of the a specific infrastructure for supporting a RR project can be **divided into three sequential phases**.



# Milestone Approach for a RR project

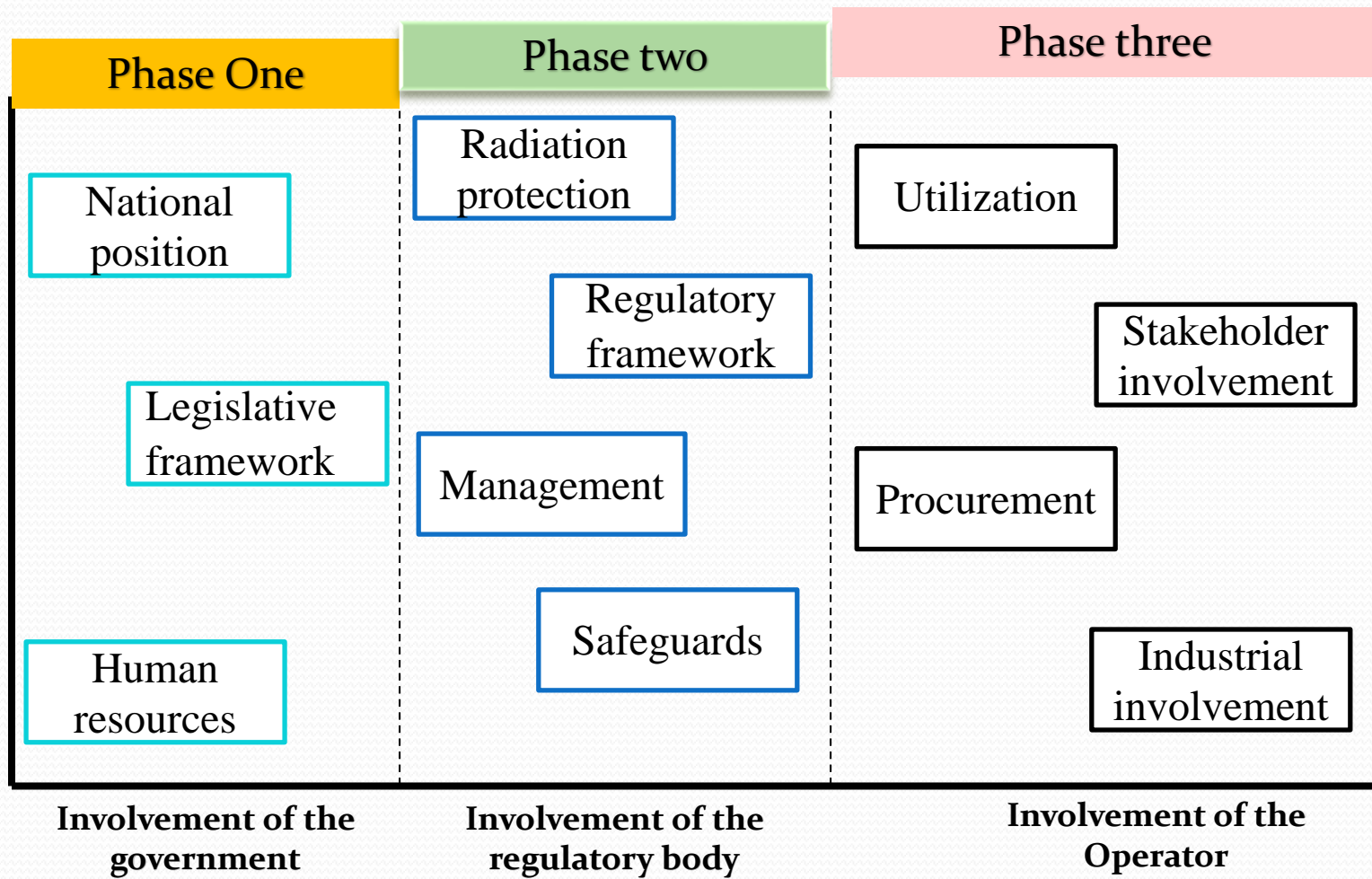
- ❑ The first phase is to **describe justification of the research reactor and earlier considerations**, as outcome of this phase *a country must be ready to make a well-informed commitment to the research reactor project.*
- ❑ Second phase is to discuss **preparation work for the construction of a research reactor after policies and strategies have been put in place**, as a result of this phase *the country has to be ready to request vendor bids for research reactors.*
- ❑ The final phase is to **implement the project**; therefore, *the country must be ready to commission and operate the research reactor.*

# 19 Infrastructure Milestone Issues for Each Phase

Issues	Milestone 1	Milestone 2	Milestone 3
(1) National position	      	       	<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><b>Conditions</b></p>
(2) Nuclear safety ←			
(3) Management			
(4) Funding and financing			
(5) Legislative framework			
(6) Safeguards			
(7) Regulatory framework			
(8) Radiation protection			
(9) Utilization			
(10) Human resources development			
(11) Stakeholder involvement			
(12) Site survey, site selection and evaluation			
(13) Environment protection			
(14) Emergency Planning			
(15) Nuclear security			
(16) Nuclear fuel management			
(17) Radioactive waste			
(18) Industrial involvement			
(19) Procurement			

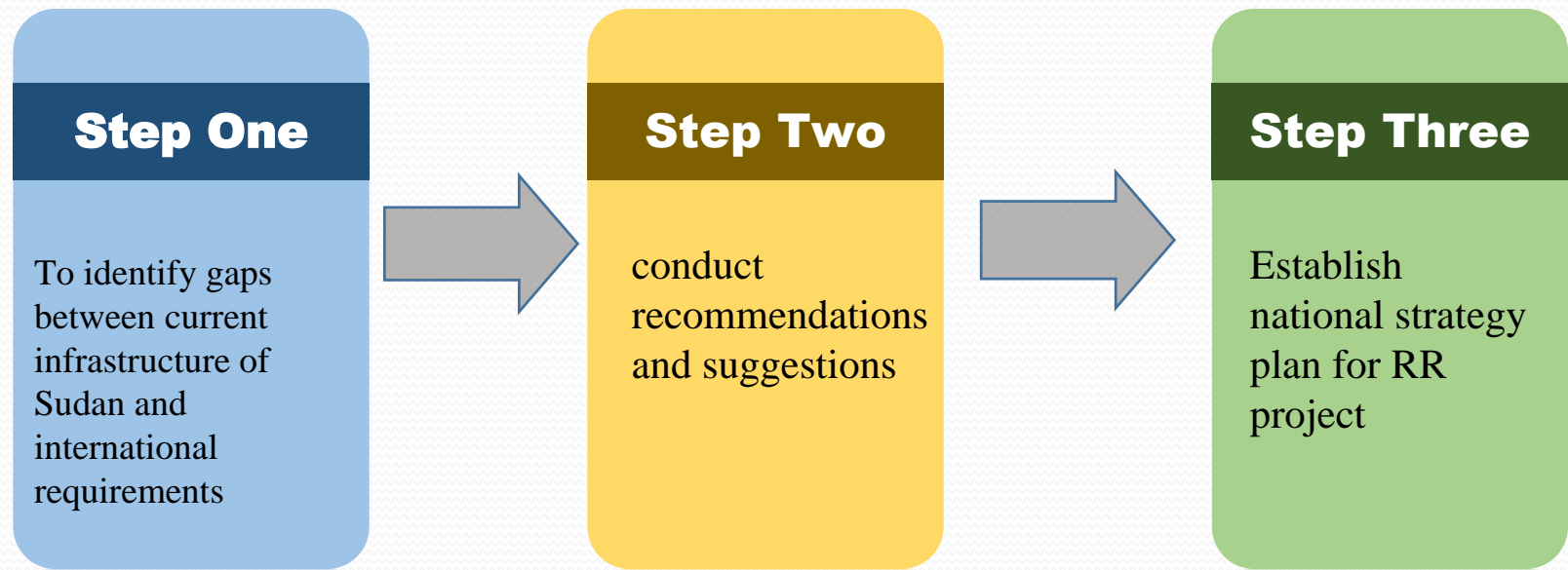
# Importance of Infrastructure issues through three different phases

Significant actions of the milestone infrastructure issues are depend onto **a phase type and organization** (*government, a regulatory body, and operators*).



# Three Steps for developing national Infrastructure

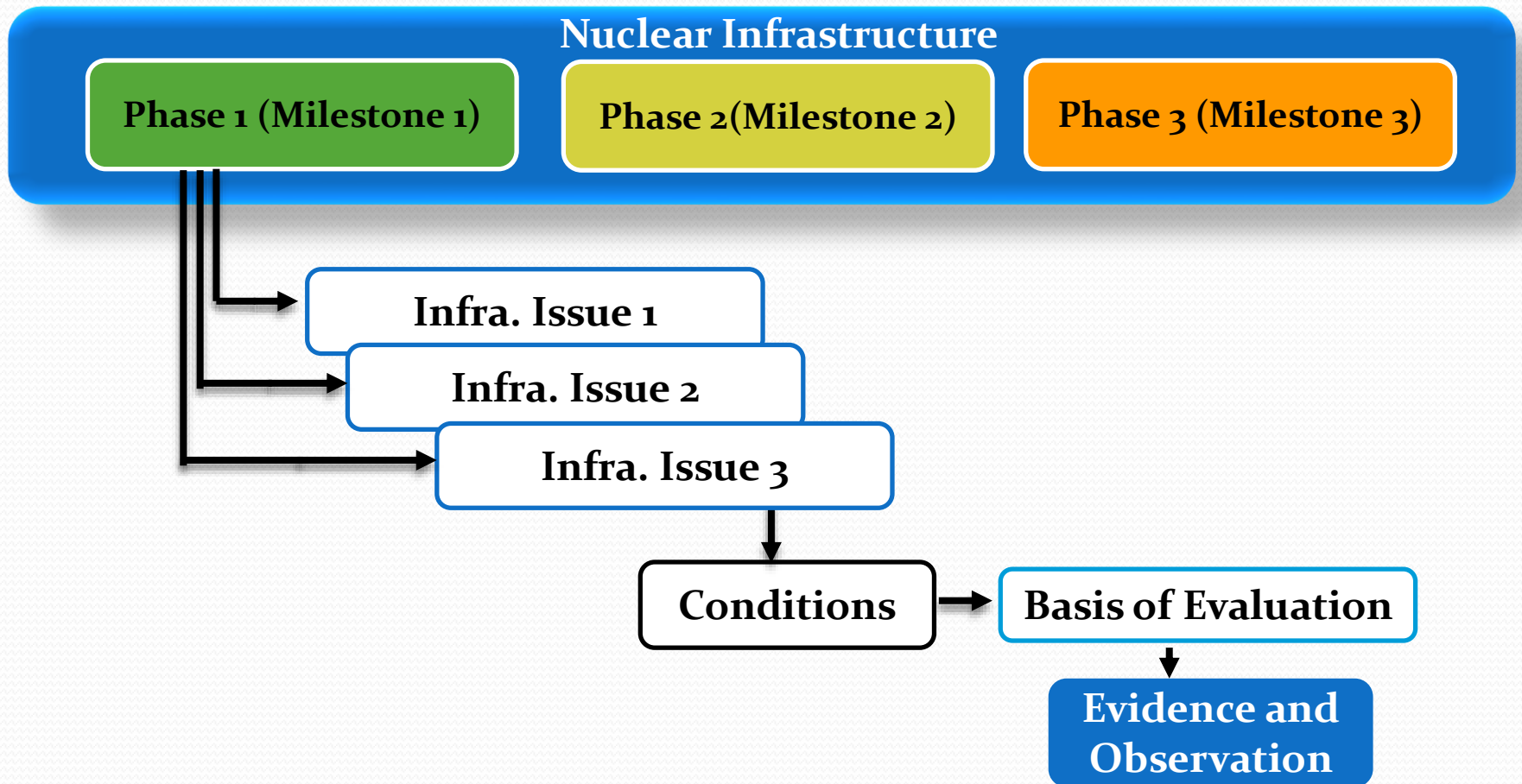
- In order to develop specific national infrastructure for RR project, **three steps should be followed**



# Self-assessment Approach

- IAEA provides the self-assessment methodology which is essential to ascertain the current overall national infrastructure status and **identify weakness and additional works needed** to be developed that will help a country to implement a new research reactor project.

# Structure of Self-assessment of Nuclear Infrastructure of RR

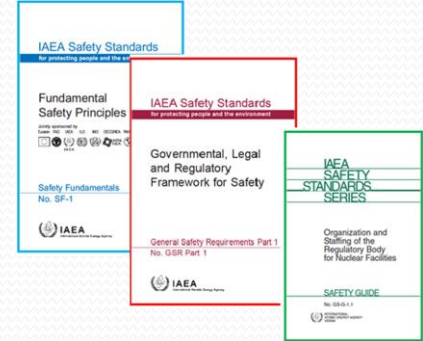


# Template of self-assessment

**Infrastructure issue**

**Condition**

**Basis of Evaluation**



## Legislative framework

1.1 Government plans to develop the required national nuclear legislation are in place

**Basis of Evaluation**

**Evidence**

**Observation**

1.1.1 Establishing independent regulatory body

Evaluation :  Significant       Minor       No actions needed

Documentation by Sudanese government such as : laws and decrees, formalized agreements, meeting notes.





# Results of Self-assessment

# Results of Self-assessment

In this study, as an example, four infrastructure issues were selected for Sudan as follows: legislative framework, regulatory framework, radiation protection, and emergency preparedness and response with respect to the **Pre-Project phase (Milestone 1)**.

Issues	Milestone 1	Milestone 2	Milestone 3
(1) National position	<b>Conditions</b>	<b>Conditions</b>	<b>Conditions</b>
(2) Nuclear safety			
(3) Management			
(4) Funding and financing			
(5) Legislative framework			
(6) Safeguards			
(7) Regulatory framework			
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# Results of legislative framework

## 1. Legislative framework

### 1.2 Government plans to develop the required national nuclear legislation are in place

Evaluation Basis	Evidence	Observations
1.2.1 Establishing independent regulatory body	The Nuclear and Radiological Regulatory Control (NRRC) Act of Sudan, 2017	<ul style="list-style-type: none"><li>- Based on The Nuclear and Radiological Regulatory Control Act 2017, <b>the Sudanese regulatory body was established officially in 2017.</b> Currently, the regulatory authority is under the Ministry of Higher Education and Scientific Research.</li><li>- The name of the regulatory authority is Sudanese Nuclear and Radiological Regulatory Authority (<b>SNRRA</b>).</li></ul>

# Results of legislative framework

## 1. Legislative framework (cont.)

1.2.2 Formulating policies , nuclear safety, nuclear security, and safeguards regulations for nuclear installations

- SNRRA Safety Regulations  
- Codes of Practice

- SNRRA has been **established and updated several safety regulations** for radiation activities including safety transportation of radioactive materials and radioactive waste management.  
- Also, **nuclear safety regulations have been drafted** which are ten regulations such as decommissioning of facilities 2016.  
- Nuclear security and safeguards regulations have not established yet.  
- **Codes of Practice have been established** for some the radiation activities such as code of practice for Protection in Education and Research.

1.2.3 Implementing import and export of nuclear and radioactive materials

NRRC Act of Sudan, 2017

SNRRA has been **implementing import, export, as well as transport** all radioactive sources according to NRRC Act 2017.

# Results of SA for legislative Framework

## 1. Legislative framework (cont.)

### **Evaluation : Minor Actions Needed**

*Legislative framework of Sudan has **extremely weakness in term of regulatory body independency and safety regulations***

### **Recommendations**

- The government **shall separate SNRRA from the promoters** in order to be full independent its decision making and regulatory functions. The government could decide to be SNRRA **under Ministry of the Cabinet Affairs** that will give full independency to SNRRA.
- Nuclear Safety regulations and some **code of practices that were drafted must be approved** by SNRRA' Board.
- **SNRRA have to establish committees** in order to create nuclear security and safeguards regulations that will to support research reactor and nuclear power plant projects.
- **Upgrading the safe transport of radioactive material and control and of radioactive waste management regulations** by SNRRA so as to including a research reactor project.

# Results of SA for Regulatory Framework

## 2. Regulatory Framework

### Evaluation: Minor actions needed

SNRRA has to be effective to **upgrade some existing safety regulations** to be satisfied with the research reactor project, **and Cooperation between SNRRA and national authorities.**

### Recommendations

- ✓ The Existing **Memoranda of Understanding need to approve** in order to regulate the radioactive materials that will support research reactor project.  
Also, **cooperation with Interior Ministry has to be created** by SNRRA in order to support transportation of radioactive materials.
- ✓ **SNRRA should cooperate with international regulatory authorities** in order to accomplish high level of safety and security to the country.

# Results of SA for Radiation Protection

## 3. Radiation Protection

### **Evaluation: Significant actions needed**

*The radiation protection issue needs considerable action to **enhancement the existing capabilities of radiation protection in term of safety regulations.***

### **Recommendations**

- ✓ **Establishment and improvement the policies and safety regulations** by SNRRA in order to ensure radiation protection for the RR.

# Results of SA for EPR

## 4. Emergency Preparedness and Response

### **Evaluation: Significant actions needed**

*Sudan has to take significant actions for **national emergency plan and National EPR Committee in order to be sufficient for research reactors.***

### **Recommendations**

- ✓ SNRRA have to **finalize and revise the EPR Regulations** then submit to approval by SNRRA Board.
- ✓ National Council of Civil Defense and SNRRA must to **activate the National EPR Committee** by approve the list of relevant organizations, after that calling representatives, then developing work plan.
- ✓ National Emergency Committee has to **develop the national emergency plan to be covered a research reactor project.**





# Conclusion

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- ❑ The self-assessment gives complete picture of the current national infrastructure to determine the weakness and actions that must be taken by Sudan in order to fulfill the requirements of a research reactor project.
- ❑ Suggested recommendations should be taken to fill in the gaps which are identified, and satisfy requirements of the Sudanese infrastructure for the research reactor project.
- ❑ Other milestone infrastructure issues can be addressed by expanded this study in order to evaluate overall current status of Sudanese infrastructure for supporting the research reactor project.



**Thank you**