Considerations and Infrastructure Milestones for A Research Reactor Project

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Contents

- Introduction
- IAEA milestone approach for a research reactor project
- Specific considerations in different phases of establishing the first research reactor
- IAEA assistance to countries establishing their first research reactor
- Concluding remarks

Introduction

- For more than 60 years, research reactors have been a corner stone in the development and application of nuclear science and technology.

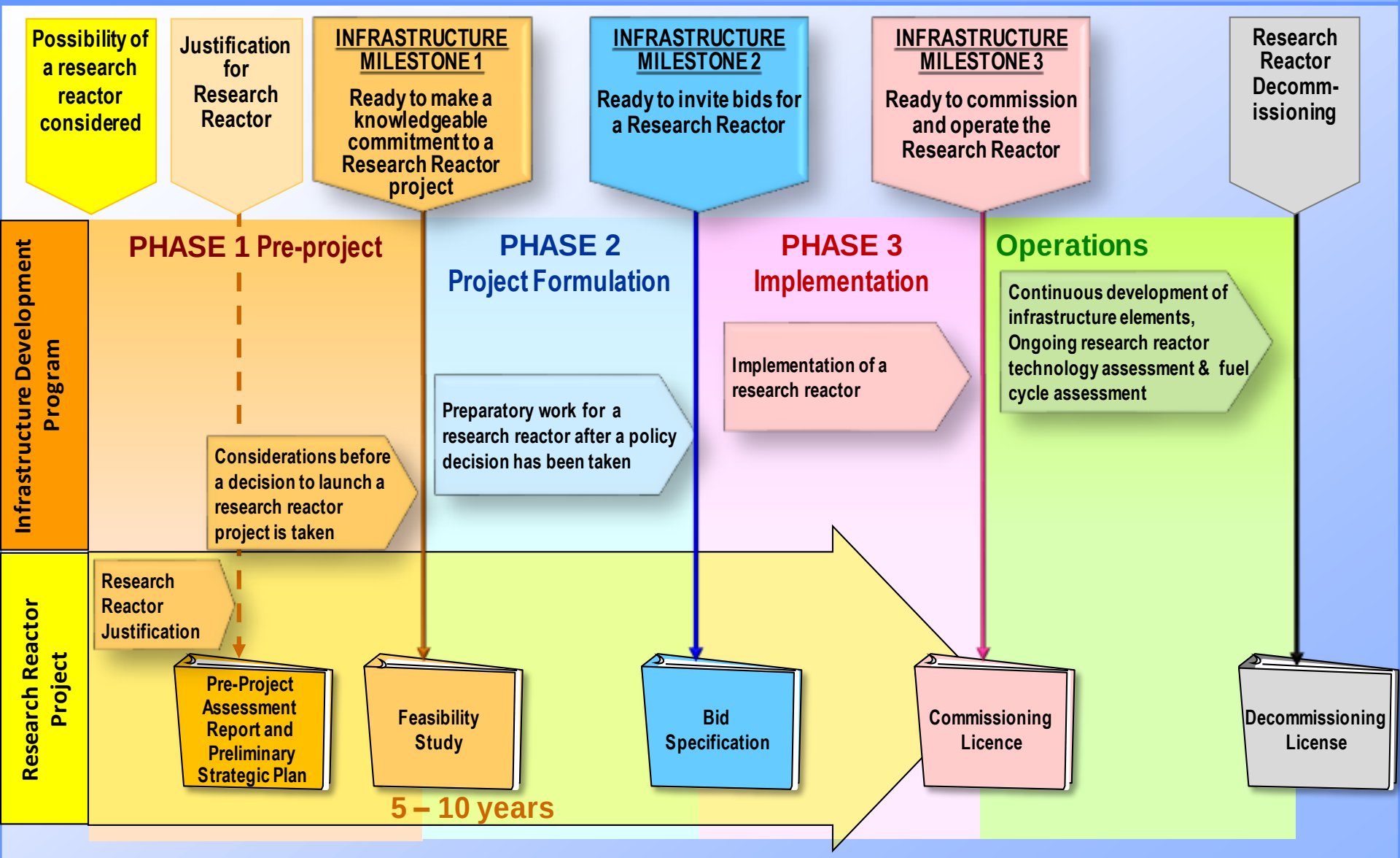
- Some countries considered research reactor as an important step to the development of a power reactors.

- Recently, a number of countries have started planning to build their first research reactor as a tool to develop the necessary national infrastructure for embarking on a nuclear power programme.

Introduction

- When the research reactor is the Member State's first significant nuclear facility, this requires establishing a dedicated infrastructure, which is not an minor undertaking.
- The IAEA recommends that Member Sates adopt a systematic approach for decision making for research reactor project, and for establishing supporting infrastructure in phases that are matched to the needs for a project.
- Guidance on establishing such infrastructure is provided in a recently developed IAEA document on specific considerations and milestones for a research reactor project.

IAEA milestone approach: Phases of Implementation of the first research reactor



Infrastructure issues and milestones

ISSUES	MILESTONE 1	MILESTONE 2	MILESTONE 3
National position			
Nuclear safety			
Management			
Funding and financing			
Legislative framework			
Safeguards			
Regulatory framework			
Radiation protection			
Research Reactor utilization			
Human resources development			
Stakeholder involvement			
Site survey, site selection and evaluation			
Environmental protection			
Emergency planning			
Nuclear security			
Nuclear fuel management			
Radioactive waste			
Industrial involvement			
Procurement			

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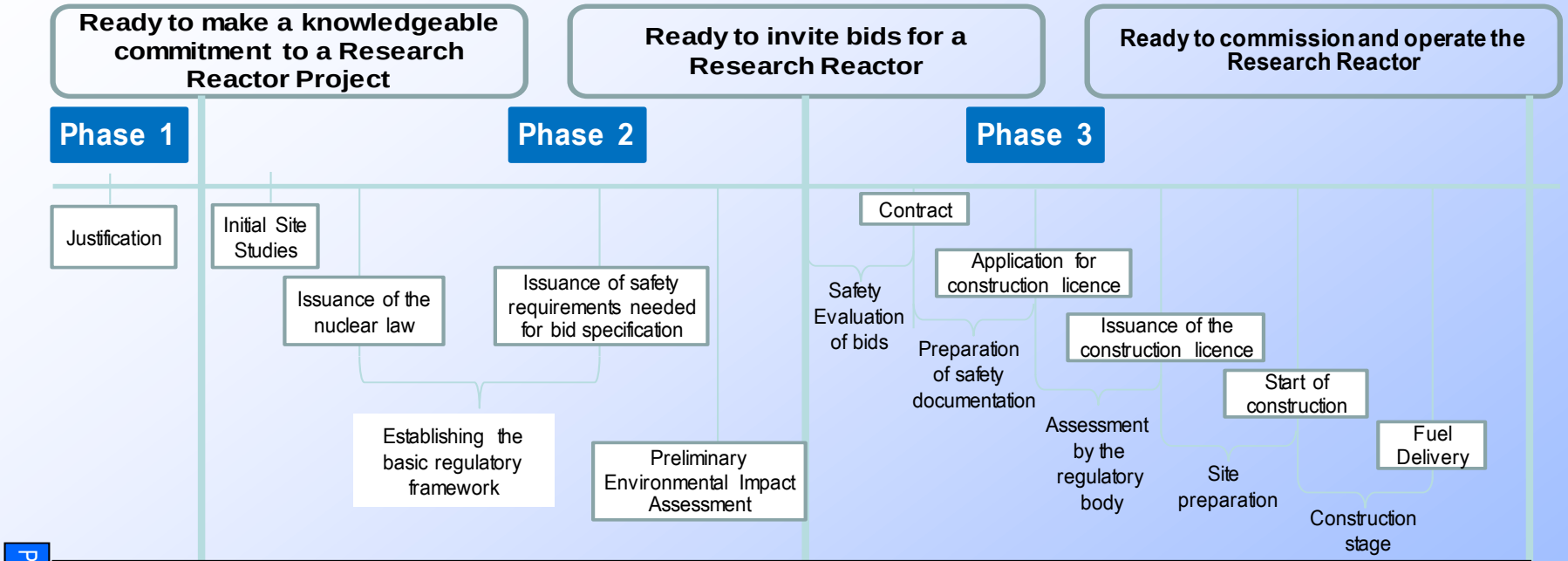
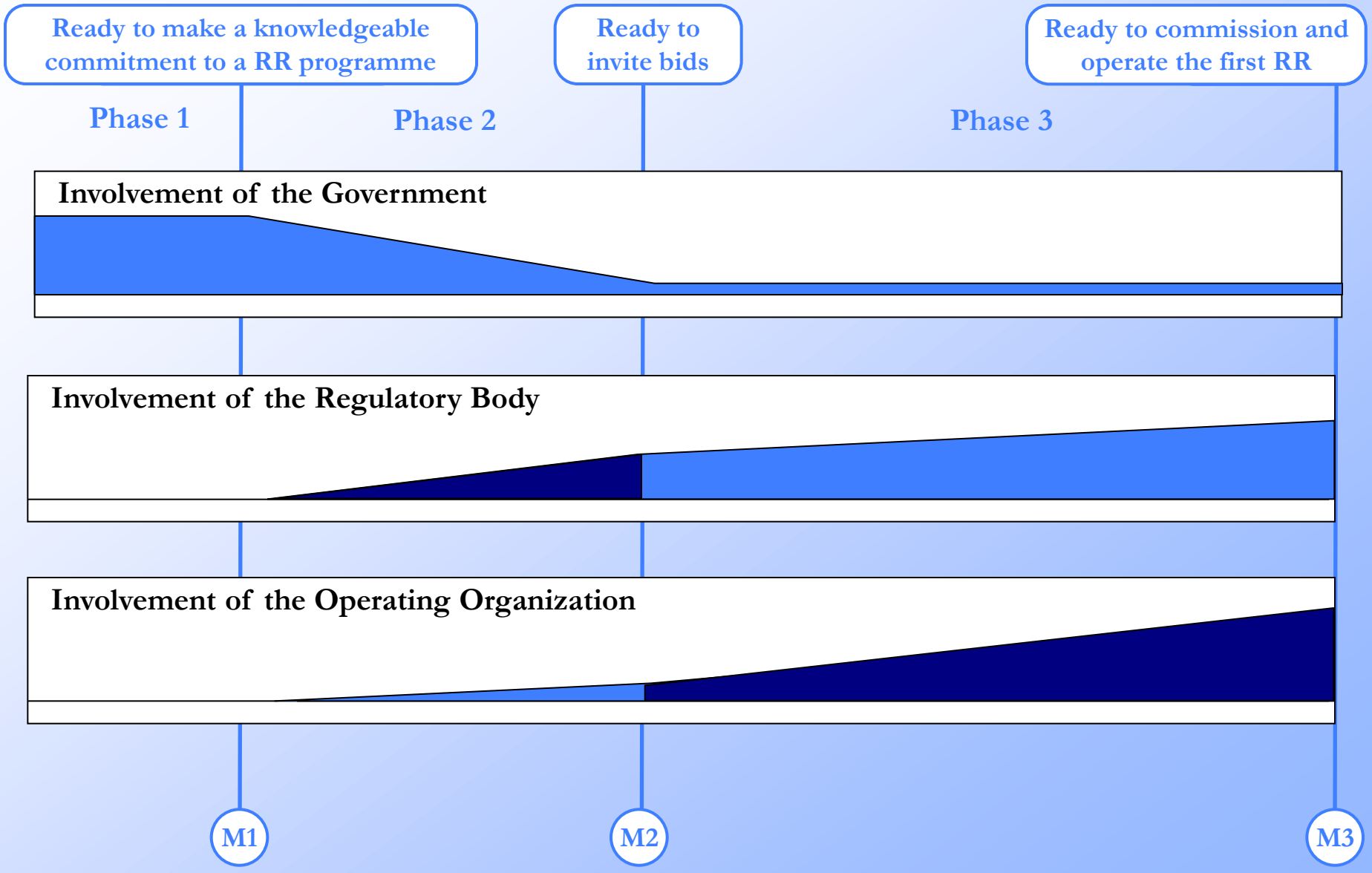
Major safety activities and the supporting main IAEA Safety Standards



Progressive application of IAEA Safety Requirements

- **GSR-Part 1** – Government, Legal and Regulatory Framework for Safety
- **GS-R-3** – The Management System for Facilities and Activities
- **GSR Part 3** – Radiation Protection and the Safety of Radiation Source, and BSS115
- **GSR Part 4** – Safety Assessment for Facilities and Activities
- **WS-R-2** – Predisposal Management of Radioactive Waste including Decommissioning
- **GS-R-2** – Preparedness and Response for a Nuclear or Radiological Emergency
- **NS-R-4** – Safety of Research Reactors
- **TS-R-1** – Regulations for the Safe Transport of Radioactive Material

Involvement of the main entities throughout the establishment of the Infrastructure elements



Use of a graded approach

- The duration of implementation of the activities depends on:
  - *Existing infrastructure at the beginning of the project;*
  - *Resources available to the project;*
  - *Reactor type, size, and utilization programme;*
  - *Contract methodology.*

- While all safety requirements shall be considered, a graded approach may be used in their application based on the potential hazard of the reactor. Examples include size of the regulatory body, and requirements on human resources development, emergency preparedness, and radioactive waste management.

Specific considerations in the different phases of building the first research reactor

Phase 1: Feasibility study

- Justification of the need for a research reactor;
- Clear definition of the reactor purpose, utilization programme and users, pre-selection of the reactor type, size, and experimental facilities;
- Advantages and disadvantages of using alternative technologies;
- Possible use of research reactors in the region;
- Availability of a suitable site: Identification of the preferred candidate site(s) on the basis of existing data, supported by a radiological impact assessment.

Phase 1: Feasibility study

- Government commitment to adhere to the international obligations and to apply the IAEA Code of Conduct on the Safety of RRs and the IAEA Safety Standards, including:

  – *Establishment of legal and regulatory framework;*
  – *Establishment of a sustainable financing system for all safety activities;*
  – *Establishment of an effective management system;*
  – *Provision of adequate arrangements for human resources development;*
  – *Development of a national strategy for long-term management of radioactive waste and spent fuel, and decommissioning;*
  – *Provision of adequate arrangements for emergency preparedness and response.*

Phase 2: Project formulation

- Establishment of the regulatory body and operating organization.
- Involvement of the regulatory body as early as possible including establishment of the safety requirements for the bidding process.
- Establishment of a licensing process.
- Site selection, including definition of the parameters which are needed for the reactor design and operation and inclusion in the bid specifications.
- Attention to be given to the availability of expertise in site selection, bidding, and evaluation of technical offers.

Phase 2: Project formulation

- Development of human resources and competences is a high priority task for both regulatory body and operating organization:
  - *Establishing regulations, performing regulatory review and inspection;*
  - *Safety assessment, commissioning, operation, utilization, maintenance, radiation protection;*
  - *Reactor physics, thermal-hydraulic, core management and fuel handling, quality assurance, safety culture.*
- Training could be obtained from the reactor vendor in accordance with the technical specifications of the bid. The project organization chart should include a group (or an individual) responsible for human resources development.

Phase 3: Project implementation

- Technical evaluation of the bids:
  - *Safety assessment of the design;*
  - *Adherence of the design to the IAEA Safety Standards should be one of the selection criteria of the winning bid.*
- The project schedule should include hold points for regulatory assessment and licensing of safety related stages/activities.
- Recruitment of staff should start early in this phase: significant development and training for all levels of staff, including participation in activities of different stages of the project.

Phase 3: Project implementation

- Preparation of the SAR should start as early as possible:
  - *Proper interaction with the reactor designer;*
  - *Assessment of the regulatory body prior to issuing the construction license.*
- During construction, the operating organization should ensure (and the regulatory body should verify) that:
  - *Systems and components important to safety are installed according to the approved design;*
  - *A process addressing changes in design is in place, in accordance with the management system;*
  - *Knowledge in the design and construction are maintained during the reactor lifetime.*

Phase 3: Project implementation

- Development of management programmes for reactor operation:
  - *Operating procedures;*
  - *Maintenance, periodic testing, and inspection programmes;*
  - *Operational radiation protection programme and emergency plan: should be fully applied at the time fuel is received at the rector building.*
- Preparation for commissioning include:
  - *Revision of the SAR, including establishment of the OLCs for commissioning;*
  - *Commissioning programme and procedures;*
  - *Assessment by the regulatory body and licensing of commissioning stage.*

IAEA assistance to countries establishing their first research reactors

- Publications: Safety Standards and technical guidelines;
- Fact-finding missions at the project planning stage:
  - *Results of the mission include identification of gaps and the associated action plans for establishing the necessary technical and safety infrastructures;*
  - *Upon request, the IAEA assists also in carrying out the established action plans.*
- Development of human resources for different stages of project phases, including a training workshop on the establishment of a new research reactor. This is conducted on the basis of the IAEA safety standards and international best practices, and addresses planning and implementation of different activities of the project.
- Supplementary publications and guides are planned

IAEA assistance to countries establishing their first research reactors

- Advisory service and expert missions in different phases of RR lifetime:
  - *Regulatory infrastructure and licensing process;*
  - *Justification of the RR and preparation of the feasibility study;*
  - *Organizational issues for sustainability and utilization planning*
  - *Site characterization and evaluation;*
  - *Project management;*
  - *Bidding process, including safety considerations of the technical specifications;*
  - *Strategy for human resources development;*
  - *Review of safety and technical provisions of the design;*
  - *Preparation and review of safety documents;*
  - *Commissioning programme and results;*
  - *Preparation for routine operation.*

Concluding remarks

- Decision to build a research reactor should be based on a feasibility study evaluating the real needs, utilization programme and availability of a suitable site, and should show the commitment to establish the necessary safety infrastructure.

- Establishment of the infrastructure should start early in the process and achieved progressively during different phases of the project; safety infrastructure is best achieved through the effective application of the IAEA Code of Conduct on the Safety of Research Reactors and the supporting Safety Standards.

Thank you for your attention