



## *JRTR: Management System During Construction and Commissioning Phases*

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### **JRTR Manager During Construction & Commissioning Phases**

The University of Jordan &  
Jordan Atomic Energy Commission



Reactor Type	Open Pool
Thermal Power (MW)	5 (upgradable up to 10)
Max. Thermal Neutron Flux (n/cm <sup>2</sup> ·s)	1.5 (1.8 Linear Fit) $\times 10^{14}$ in the core (central trap) 0.4 $\times 10^{14}$ in the reflector region
Fuel Type & Material	Plate type; 19.75% enriched, U <sub>3</sub> Si <sub>2</sub> in Al matrix
Fuel Loading	18 fuel assemblies, 7.0 kg of U <sup>235</sup> (Equilibrium cycle)
Coolant/Moderator	H <sub>2</sub> O
Cooling Method	Downward, forced convection flow
Reflector	Be + D <sub>2</sub> O
Utilization	Multipurpose - Neutron beam applications (n science, n radiography, etc.) - Neutron irradiation services (RI production, NAA, NTD, etc.)



### Production and Handling Capabilities

Isotope	Hot Cell Handling Ci/year	Isotope Production Ci/year
Mo-99	1000	240
I-131	2000	960

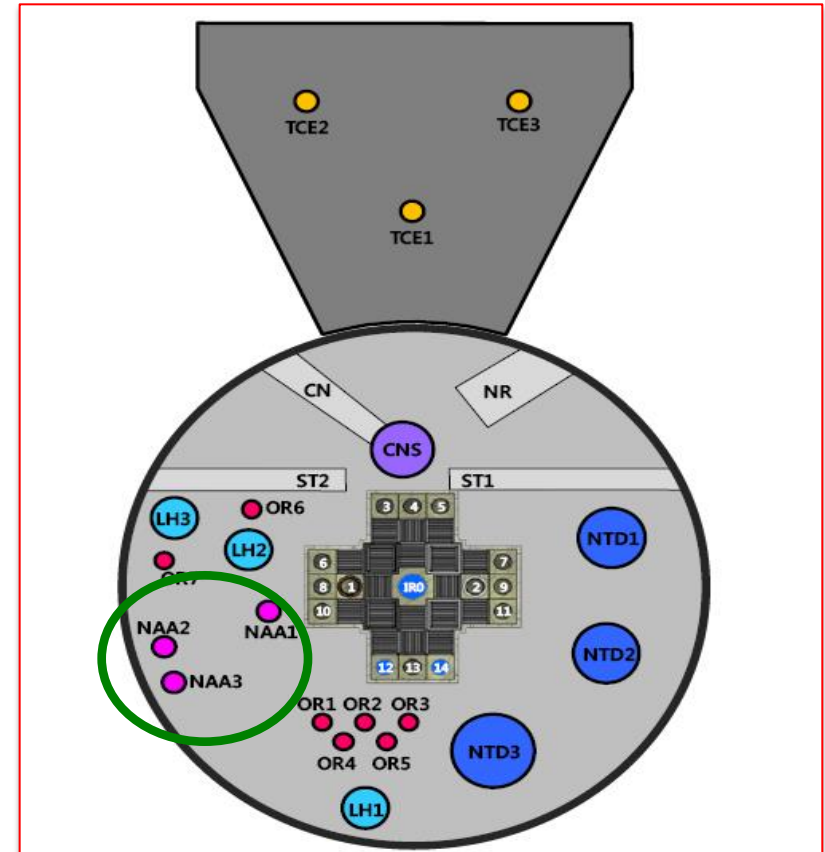
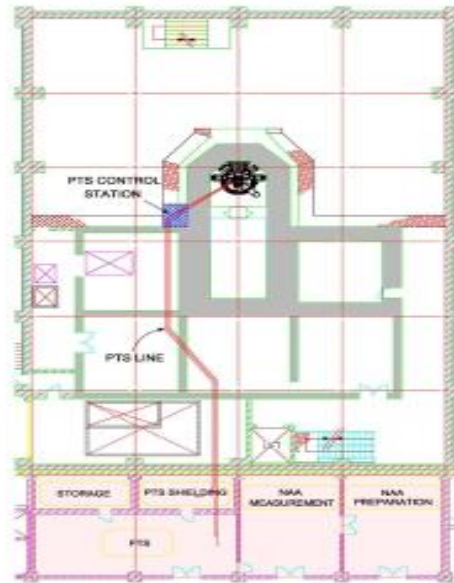
### Potential Radioisotopes from JRTR

<b>I<sup>131</sup></b>	<b>Mo<sup>99</sup></b>	<b>Tc<sup>99m</sup></b>	<b>Ir<sup>192</sup></b>	
<b>Au<sup>198</sup></b>	<b>Cs<sup>137</sup></b>	<b>Co<sup>60</sup></b>	<b>Zn<sup>65</sup></b>	<b>Sr<sup>90</sup></b>
<b>Hg<sup>197</sup></b>	<b>Fe<sup>59</sup></b>	<b>Fe<sup>55</sup></b>	<b>Cd<sup>109</sup></b>	<b>S<sup>35</sup></b>
<b>Hg<sup>203</sup></b>	<b>Mn<sup>54</sup></b>	<b>Ni<sup>63</sup></b>	<b>I<sup>125</sup></b>	<b>Ca<sup>45</sup></b>
<b>P<sup>32</sup></b>	<b>Na<sup>24</sup></b>	<b>Cs<sup>134</sup></b>	<b>Cr<sup>51</sup></b>	

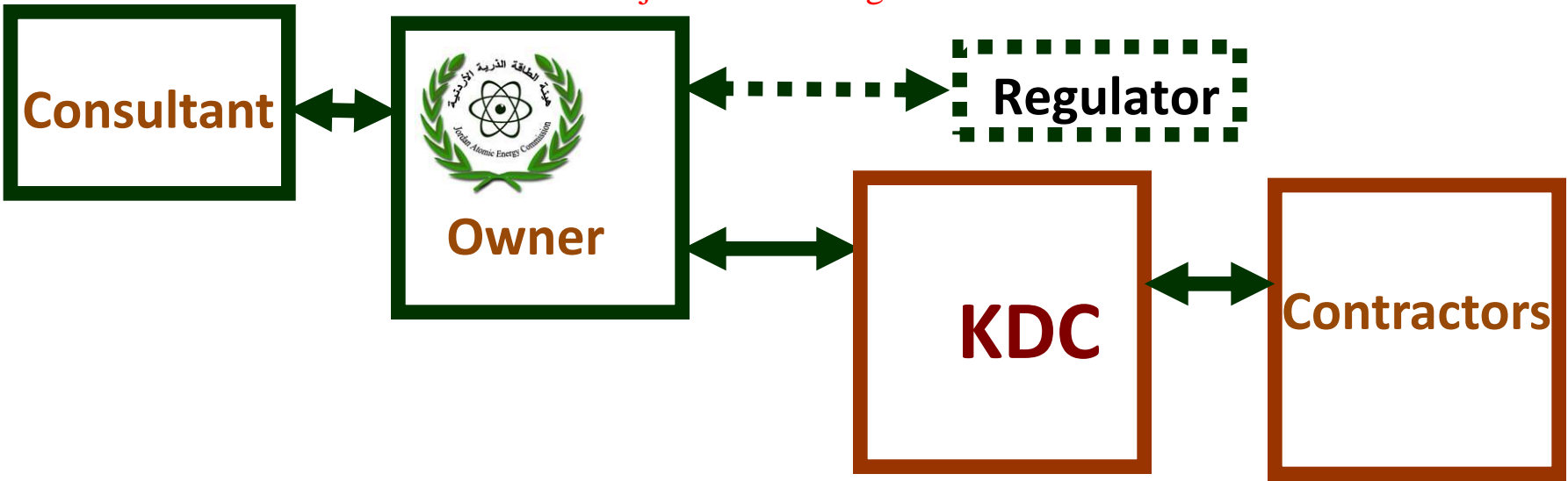
## Neutron Activation Analysis Facility (NAAF)

### Main parts:

- \* NAA lab consists of 3 rooms for pretreatment of the sample, measurement, and remote neutron irradiation activities
- \* PTS: 3 PTSs driven by N<sub>2</sub>
- \*  $\gamma$ -ray spectroscopy system (HPGe)



JRTR Project Overall Organization




# EVOLUTION OF JRTR QA SYSTEM

Actual QAP  
for Design  
Review and  
Construction  
phase

 <b>Jordan Atomic Energy Commission</b> Jordan Research & Training Reactor		Document No. QA-RR-QAP-001 Pages 33 Revision Revision 0
<b>JRTR Quality Assurance Program</b>		
Revision 0		
Prepared by N. Matar 25/06/2013 	Prepared by A. Dohi 16/06/2013 	Reviewed by A. Wakabi 05/07/2013 
Approved by Safety and Licensing consultant L.P. Sayed 27/06/2013 	Quality Assurance Consultant V. Lathoud 15/06/2013 	Nuclear Research Commissioner and JRTR Project Manager Dr. K. AbuSaleem 15/06/2013 
JAEC Chairman and JRTR Project Director Approval Dr. Khalid Toukan 26/9/2013 		



 <b>Jordan Atomic Energy Commission</b> Jordan Research & Training Reactor		Document No. QA-RR-QAP-001 Pages Revision Revision 1
<b>JRTR Quality Assurance Program</b> <b>Revision for the "Operation stage"</b> <i>Shall be in force day one of fuel loading in the core*</i>		
<small>* The commissioning plan, KDC-Daewoo document JR-060-KA-449-001 rev.0, gives precise definition of the so-called "stage B" of the commissioning process when JAEC will take full responsibility of operation (§4.1.2, page 14/33).</small>		

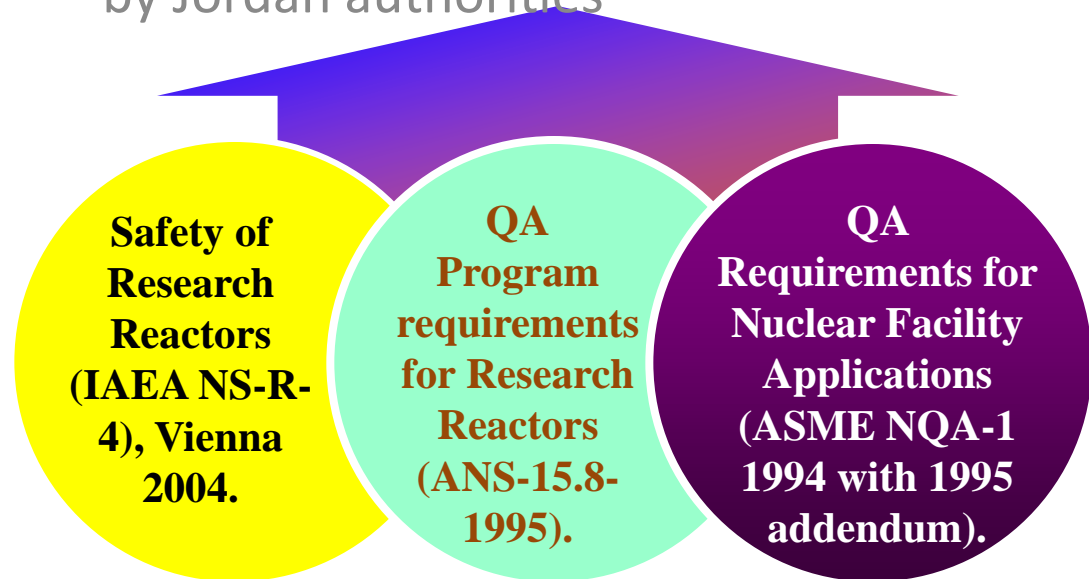
Specific QAP  
for OL  
application

# JRTR MANAGEMENT SYSTEM

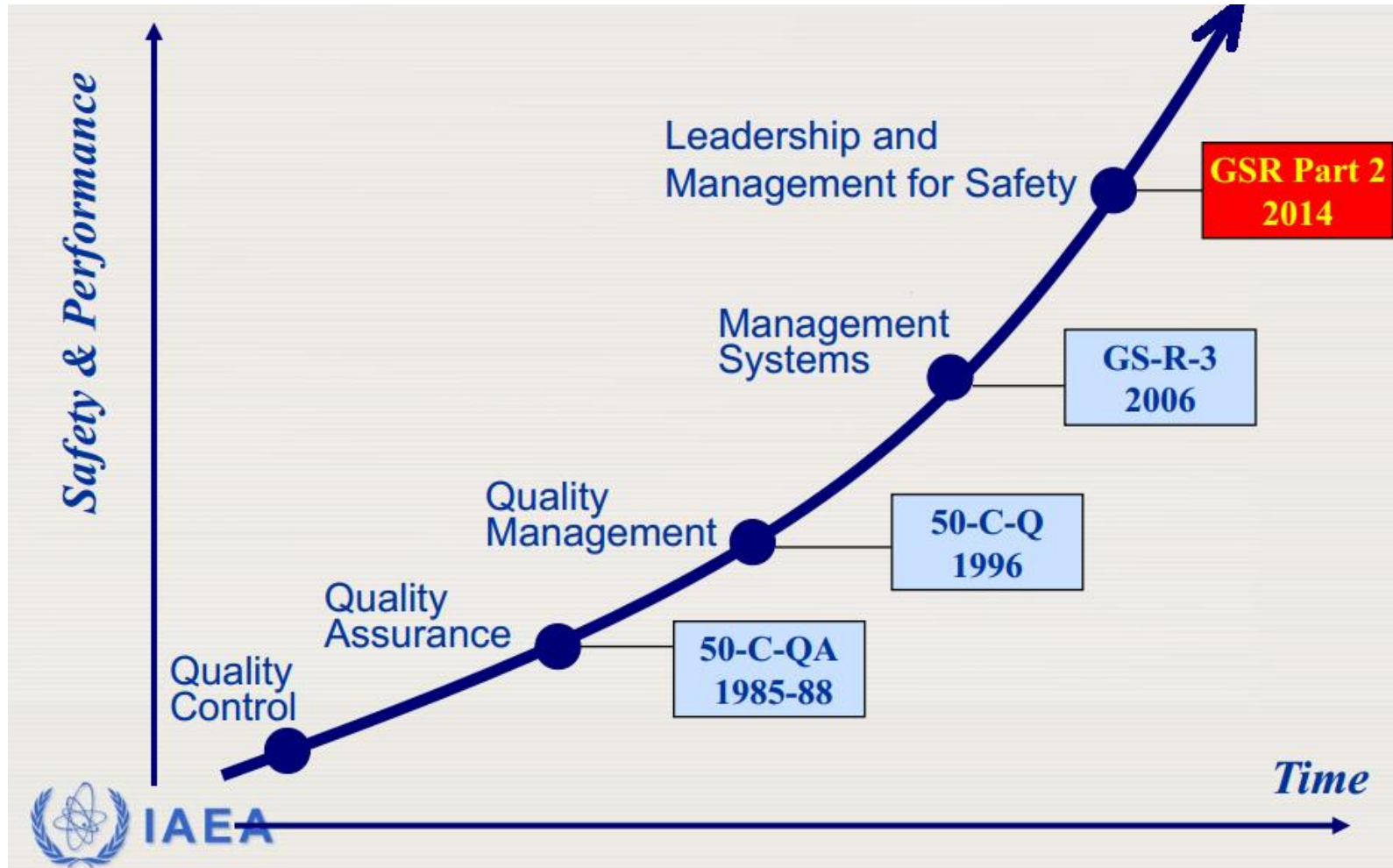
JRTR Management system has been developed and implemented to take into account :

International guidance and practice on management systems

Contractual reference frame proposed by the contractor and accepted by Jordan authorities



## EVOLUTION TO MANAGEMENT SYSTEM



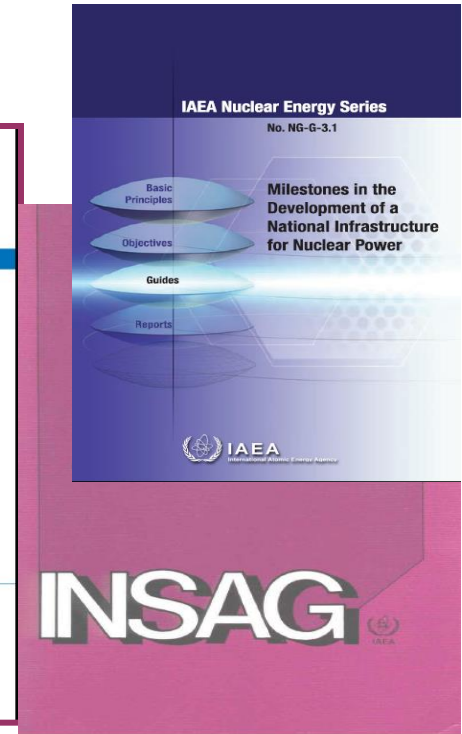
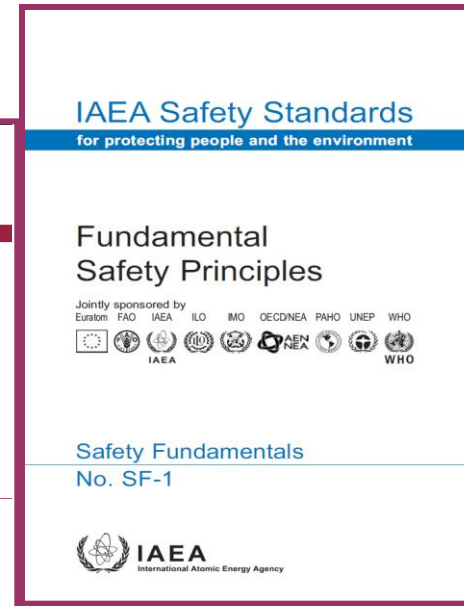
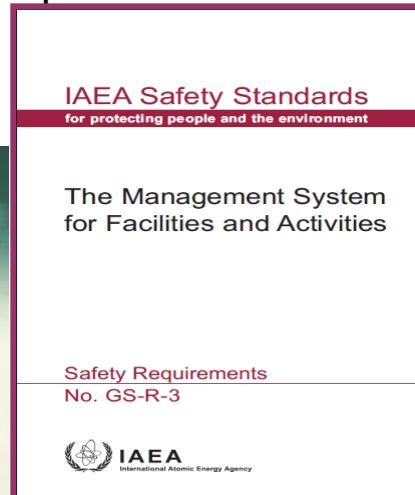
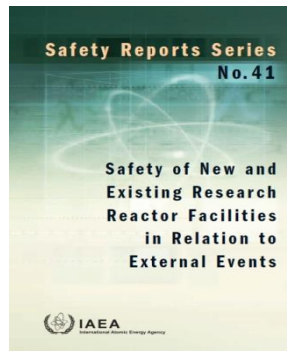
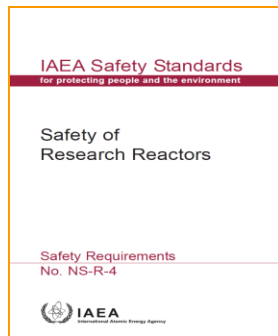


**QA Standards** Power Reactors: US RG. 1.28, US RG. 1.33, ASME code NQA-1 2008 with 2009 addenda, GS-R-3.

Research Reactors: US RG. 2.5, ANSI 15.8 1995, NS-R-4

- SF1 – Fundamental Safety Principles
- “Milestone document”, NG-G-3.1
- NS-R-4 Safety for Research Reactors
- GS-R-3 Management System
- INSAG 4 Safety Culture
- INSAG 10 Defense in Depth
- SRS N°41

**QA Standards & IAEA Framework documents**





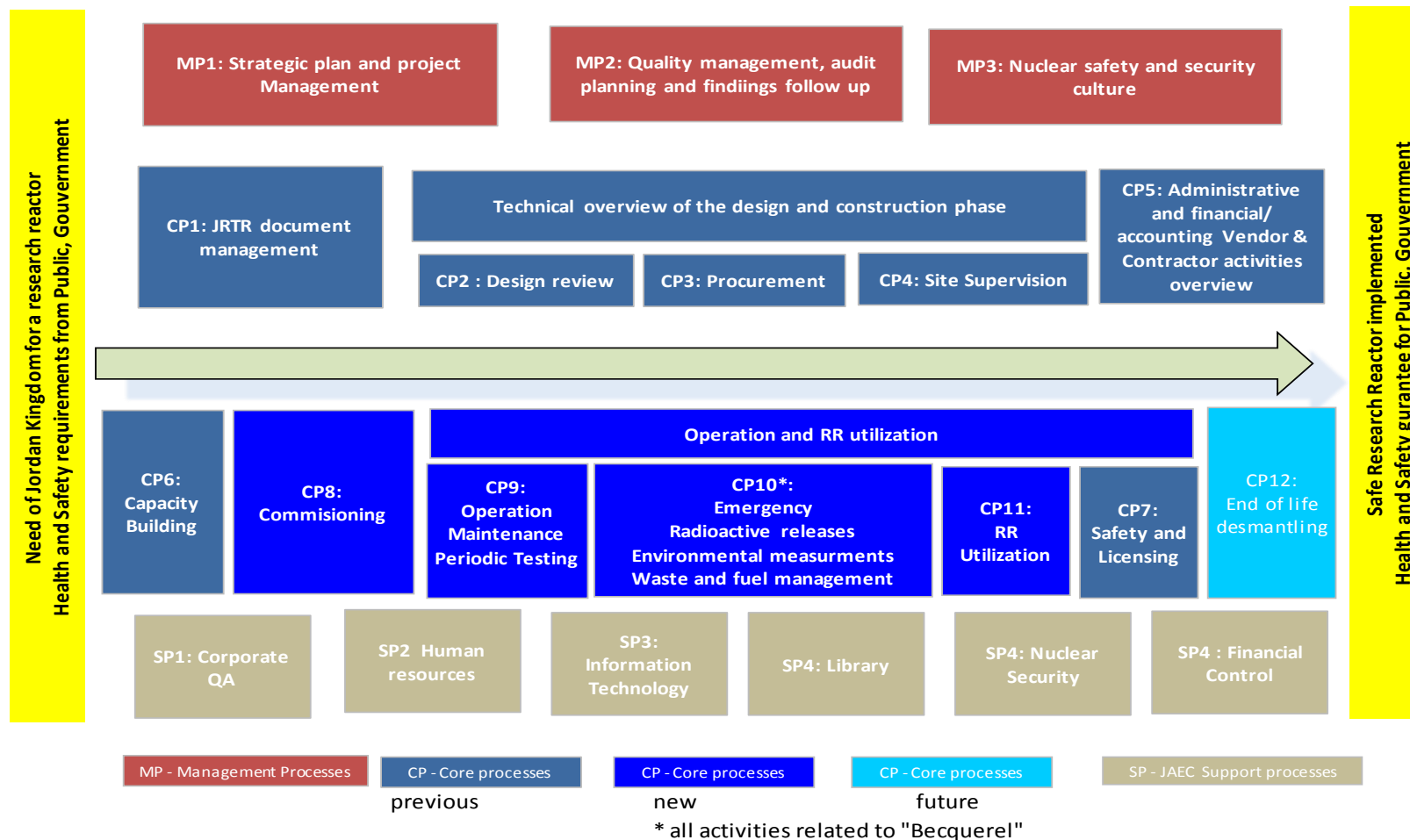
## Integrate GS-R-3 with NQA-1

IAEA GS-R-3: defines the requirements for establishing, implementing, assessing and continually improving a management system for facilities and activities that integrates safety, health, environmental, security, quality and economic elements. It is useful for all relevant parties can also be tailored to fulfil any special requirements.

Quality Assurance Requirements for Nuclear Facility Applications (ASME NQA-1-2008 and NQA-1a-2009 Addenda) is an example of such a standard, which is a national consensus standard that specifies requirements for a quality assurance program. The purpose of the quality assurance program is to achieve safe, reliable and efficient utilization of nuclear energy and management and processing of radioactive materials.



## JRTR Process Map



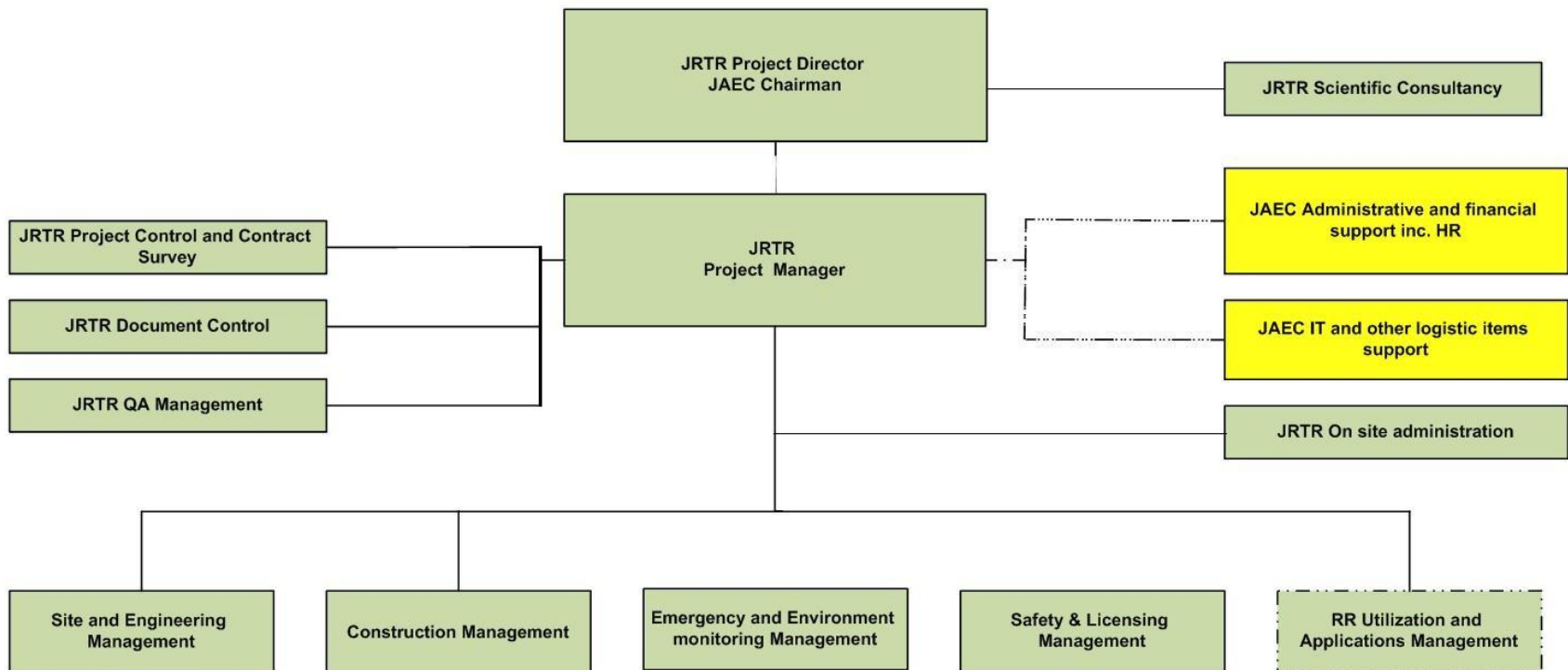


# (Construction)



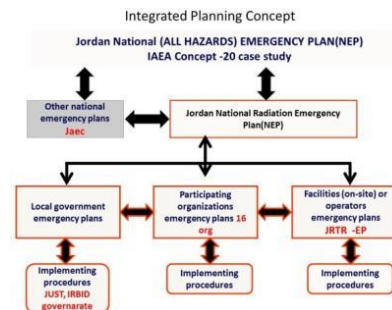
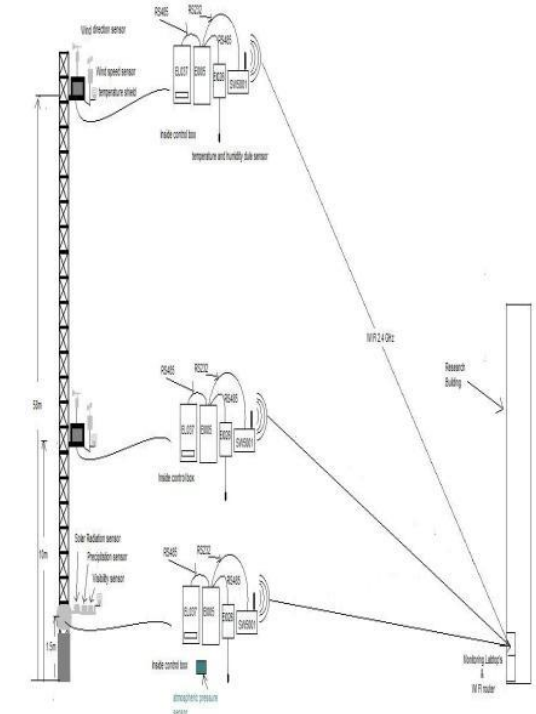
## JRTR Project Management - Generic Organizational Chart

SEP 2013

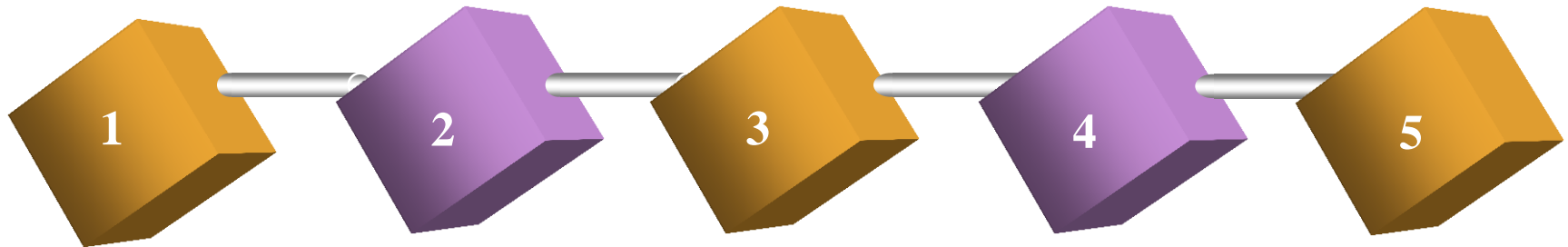


## JRTR TEAMS

**Quality Assurance / Management**  
**Document Control**  
**Project Control**  
**Engineering**  
**Construction oversight**  
**Emergency and Environment**  
**Radiation Protection Program**  
**Safety, Security and Licensing**  
**RR Utilization and application**



# Project Control



Maintain  
and  
monitor  
project  
schedule

Progress  
assessment  
and  
reporting

Cost  
tracking  
and  
reporting

Prepare  
periodic  
status  
reports for  
JRTR  
project

Monitor  
project  
execution  
in relation  
to the main  
contract



# Communication Management

Weekly Team Meeting

Bimonthly Seminar

Monthly QA meetings

Technical Specific meetings

Monthly Site Meeting

Project Review Meeting

Weekly activities / Monthly reports

## Site Supervision (Safety Standards During Construction DS441)



### Site joint Team Tasks

- ▶ Checking the conformity of the construction with the contract, specifications and good practice in the nuclear industry, detecting and reporting non-conformities
- ▶ Progress and general reporting
- ▶ Schedule checking and reporting
- ▶ Making sure that the site QA system of the Design-and-Build contractor is operational and efficient
- ▶ Checking and validating the construction and installation procedures elaborated on site
- ▶ “Flagging-up” any serious breach in the principles of good practice in nuclear construction, and quality assurance
- ▶ Random Quality Control checking on construction and installation



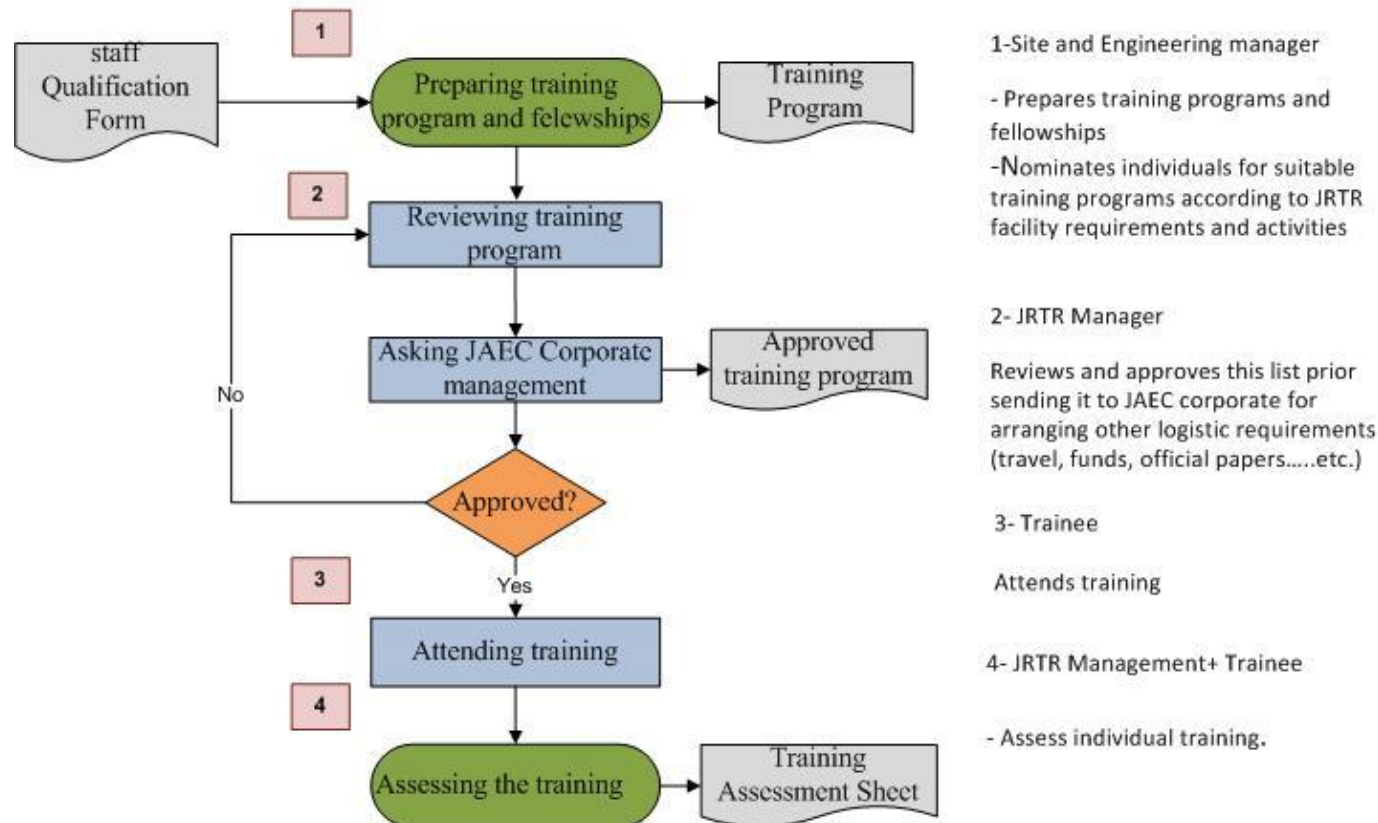


# Capacity Building



# Process Flowcharts/Example

## Training





### JRTR Staff Training and Education Program

Type of Activity	Area of Activity	Training Mode
A1	Operators	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>Joint Work at KAERI</li> <li>OJT</li> <li>Qualifying Exams</li> </ul>
A2	Design/Engineering	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>Design Activities at KAERI</li> <li>NE Degree at UST</li> <li>Joint Activities at HANARO</li> </ul>
A3	Maintenance	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>Joint Work at KAERI</li> <li>OJT</li> <li>Onsite Joint Work</li> </ul>
A4	Radiation Safety	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>OJT at KAERI</li> </ul>
B1	NA Operators	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>OJT at KAERI</li> <li>Onsite Training</li> </ul>
B2	RI Engineers	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>OJT at KAERI</li> <li>Onsite Training</li> </ul>
C1	QA	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>OJT at KAERI</li> <li>Onsite Training</li> </ul>
D1	Beamline Scientists	<ul style="list-style-type: none"> <li>Lectures at KAERI</li> <li>OJT at KAERI</li> <li>Onsite Training</li> </ul>

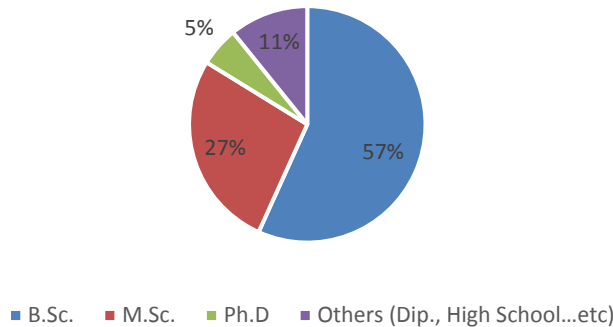


Written Examination	Practical (Talent) Examination	Written Examination
SRO	<ul style="list-style-type: none"> <li>Reactor Theory</li> <li>Structure, Material and Design of Reactor Facility</li> <li>Reactor Operation and Control</li> <li>Handling and Management of Fuel Material</li> <li>Radiation Safety Management</li> <li>Atomic Laws and Regulation</li> </ul>	<p>(In the control room)</p> <ul style="list-style-type: none"> <li>Procedures/activities for Reactor Operation</li> <li>Discrimination and measures on indicating signals</li> <li>Utilization and interpretation of instrumentation and control system</li> <li>Reactor Dynamics and operation</li> <li>Function and Application of Radiation monitoring facilities</li> <li>Radiation protection</li> <li>Countermeasures on emergency</li> </ul>
RO	<ul style="list-style-type: none"> <li>Reactor Theory</li> <li>Structure, Material and Design of Reactor Facility</li> <li>Reactor Operation and Control</li> <li>Radiation Safety Management</li> <li>Atomic Laws and Regulation</li> </ul>	<p>(In the control room)</p> <ul style="list-style-type: none"> <li>Procedures/activities for Reactor Operation</li> <li>Discrimination and measures on indicating signals</li> <li>Utilization and interpretation of instrumentation and control system</li> <li>Reactor Dynamics and operation</li> <li>Function and Application of Radiation monitoring facilities</li> <li>Radiation protection</li> <li>Countermeasures on emergency</li> </ul>

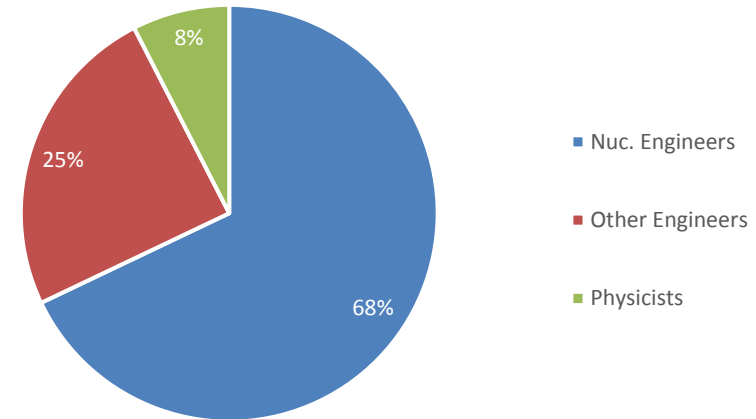


## Human capabilities (@ commissioning time)

Education/Degree



Specialization



Degree	No.
B.Sc.	43
M.Sc.	22
Ph.D.	4
Others (Dip. High school...etc)	8
<b>Total</b>	<b>77</b>

Specialization	No.	Place of Training
Nuc. Engineers	36	(28) Korean trained
Other Engineers	13	(7) Korean trained
Physicists	4	USA & China



# Strategic Planning (2017-2021)

**Executive Statement/Summary**

**Introduction**

**Facility Description**

**Capabilities**

**Existing Capabilities**

**Potential Capabilities**

**Stakeholders**

**Existing Stakeholder Needs**

**Potential Stakeholder Needs**

**SWOT Analysis**

**Mission and Vision Statements**

**Strategic Considerations**

**Structure and Personnel**

**Principal Objectives**

**Specific Objectives**

**Action Plans**

**Status Reporting And Review**

**Marketing**

**Finances**



# Principal & Specific Objectives of the SP

Principal objectives	Specific objectives
1. Educational growth in nuclear science and technology	1.1 Enhancing the training and education programs of nuclear engineering and physics students in nuclear science and applications 1.2 Improving the experimental experience of nuclear engineers and nuclear physicists in nuclear science and its applications 1.3 Developing the skills of EMRC staff through construction, licensing and operation of JRTR 1.4 Enhancing public awareness of nuclear energy and its applications
2. Increasing the utilization of neutrons in research, NAA and radioisotopes production	2.1 Adopting strategy for RI production and NAA 2.2 Establishing and developing research areas at JRTR 2.3 Increasing the utilization by increasing the capabilities of JRTR
3. Maintain a high level of safety and security in accordance with the national regulatory requirements and international standards	3.1 Maintaining a high level of safety in accordance with national regulatory requirements and international standards 3.2 Maintaining high level of security at JRTR in accordance with the national regulatory requirements and international standards
4. Enhancing the cooperation between the JRTR, national and international entities	4.1 Strengthening the technical cooperation between JRTR and IAEA through joint projects 4.2 Strengthening the scientific and technical cooperation between JRTR and national entities 4.3 Seeking for bilateral cooperation/agreements with neighbouring countries
5. To be a corner stone for the future nuclear power reactor program	5.1 Conducting studies for the potential benefits of JRTR to nuclear power program



# JRTR Fire Protection Program

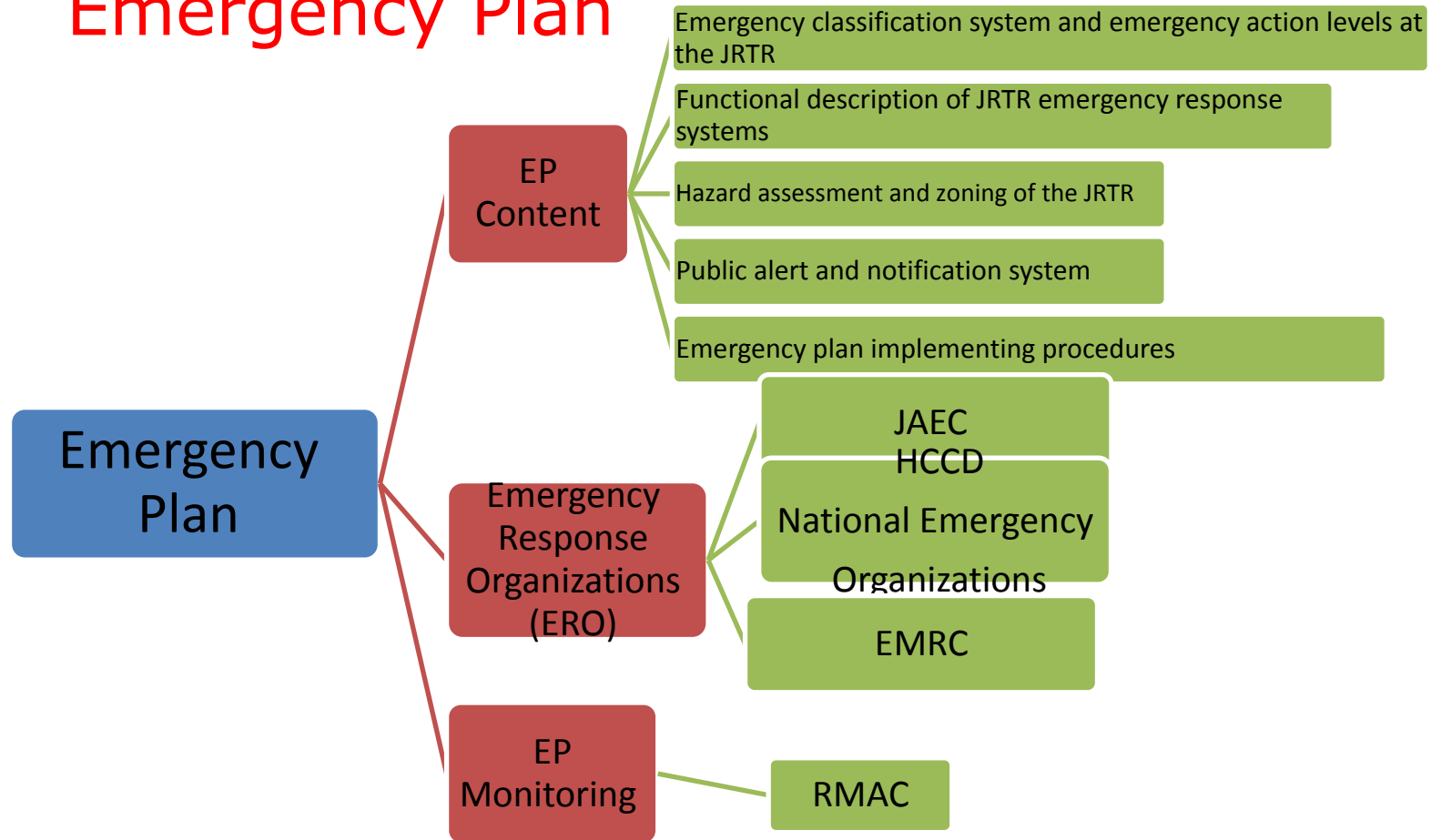
## Content

- Abbreviations and Definitions;
- Objectives of Fire Protection Program;
- The Role of Passive and Active Fire Protection;
- Components of the Fire Protection System;
- Fire Prevention;
- Fire Suppression





# Emergency Plan





# Security Plan

## Content

- Purpose and Scope;
- Responsibilities;
- Security Policy;
- Work Shift of the Facility Guards;
- Gate Control and Related Issues;
- Geographical Layout;
- Security of Storage Yards, Materials and Plant;
- On Site Accommodation;
- Security of Information, Communication System and Documents;
- Emergency;
- Threat of Site Security by Circumstances



# JRTR Radiation Protection Program

## Main Content

- Access control of radiological areas;
- Release of items from radiation control area;
- Radiation exposure control (external and internal);
- Work place monitoring;
- Radiation work control;
- Release and transportation of radioactive material;
- Records;
- Radioactive waste management
- Training



## Management of Commissioning

### Commissioning Objective

- For testing of the reactor components and systems after their construction to demonstrate that they are in accordance with the design objectives and meet the performance criteria

### Responsibilities

- JAEC, KDC and manufacturer have been involved in the preparation and execution of the commissioning plan to ensure an effective means and familiarizing with the features of the reactor. Close liaison has been maintained between the regulator and the involved parties. In particular, the results and analyses of tests directly affecting safety have been made available to the safety committee and the regulatory body for review and approval as appropriate.



## **JAEC Responsibilities During Commissioning**

- **Overall Responsibility for Effectiveness of Commissioning & Safety of Reactor**
- **Delegate all Commissioning activities to KDC from Planning to Implementation**
- **Establish Reactor Operation Group & Supporting Teams**



## Overall Commissioning Process

**Commissioning Plan**

**Administrative Procedures**

**Test Methods & Procedures**

**Test Equipment**

**Human Resource**

**Scheduling**

**Design**

**Procurement**

**Construction**

**CAT**

**Flushing**

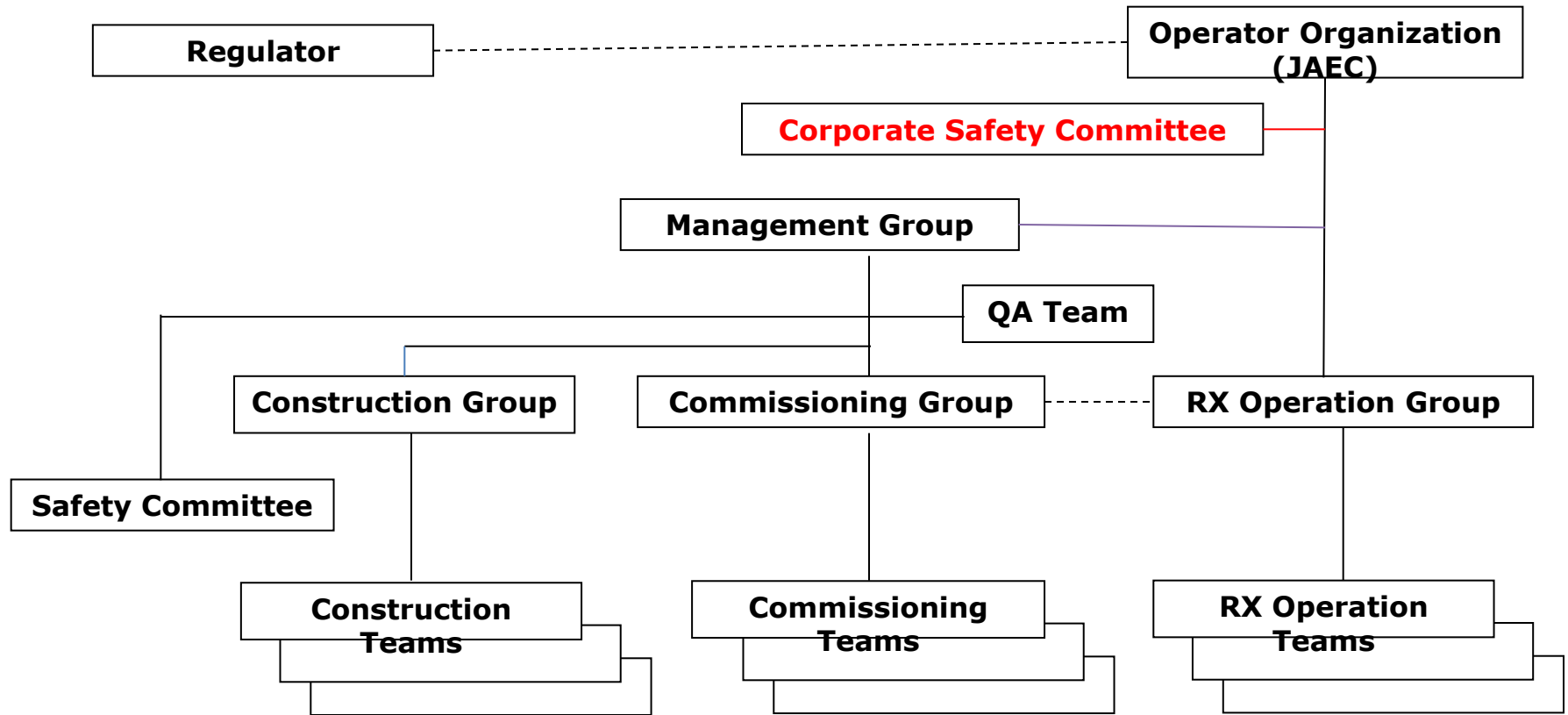
**SPT**

**IST**

**RPT**

**Turnover from  
Construction to  
Commissioning**

**Turnover from  
KDC to JAEC**





## IAEA Safety Guide, "NS-G-4.1

### Main stages of commissioning:

- a) Stage A (A1, A2, A3): tests prior to fuel loading;
- b) Stage (B1, B2): fuel loading tests, initial criticality tests and low power tests;
- c) Stage C: power ascension tests and power tests up to rated full power.

### Hold points

- Submission of Stage A Report (End of Non-Nuclear Tests)
- Submission of Stage B1 Report (End of Fuel Loading Tests)
- Submission of Stage B2 Report (End of Low Power Tests)
- Submission of Stage C1 Report (End of Power Ascension Tests)
- Submission of Commissioning Report Stage C2 (End of Full Power Tests)





## Management Group (JAEC/KDC)

- JRTR PM: Chair of Management Group
- Daewoo PM (On site KDC Representative)
- KAERI PM
- JRTR Reactor Manager

**The management group responsibility is to provide strategic oversight & resources for commissioning**

- Authorize the start of commissioning & declare acceptance of results;
- Review commissioning plan and monitor its implementation;
- Corrective actions & interface management between commissioning groups;
- Ensure resources & lines of communication



## Commissioning Group (JAEC/KDC)

Commissioning managers are responsible for overall commissioning activities:

- Planning to implementation of commissioning
- Preparation & implementation of commissioning procedures
- Safe operation of facility during commissioning

**Reactor Operation Group Organization during hot commissioning**

**Group Manager (JAEC)**

- Operator Staff
  - 1 SRO from KDC
  - 2 qualified ROs from JAEC

**JAEC personnel are being trained to be capable of operating the facility after hand-over**

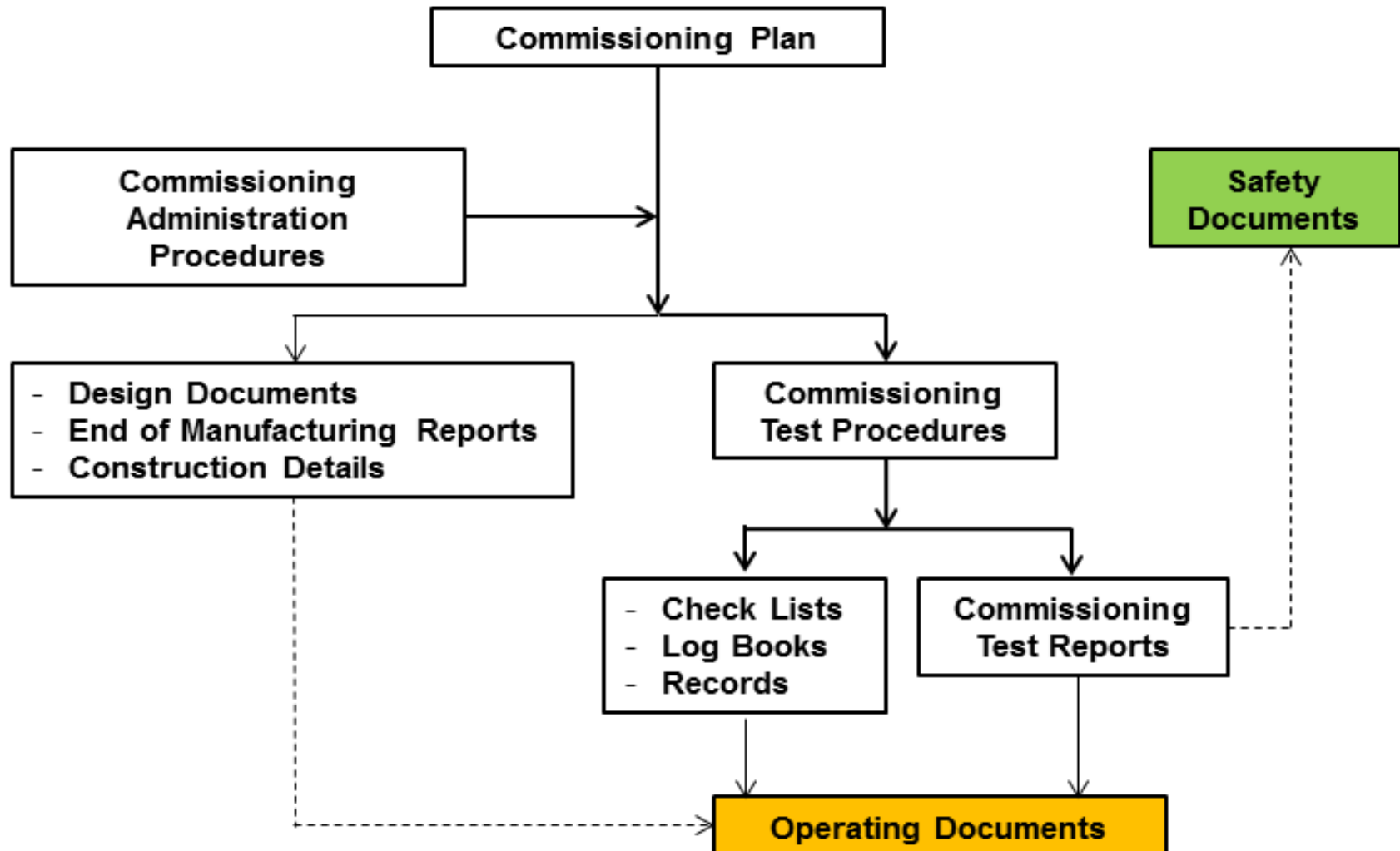


## Responsibility of Reactor Operation Group

- ❑ **Participate in Commissioning Activities**
  - ❖ **Gain Experience in System Operation & Maintenance**
  - ❖ **Ensure Compliance with Design Requirements, Performance & Safety**
- ❑ **Reactor and Facility Operation**
  - ❖ **Operation Procedures & Direction of Commissioning Group**
- ❑ **Implement Radiation Protection Plan & Procedures**
- ❑ **Enforce Emergency Plan & Procedures**
- ❑ **Secure Facility & Materials**



## Commissioning Documentation





## JRTR QA Program/Management System

### Objectives:

- Ensure requirements & expectations are met
- Comply with applicable regulations & requirements
- Provide confidence in achieved results



# Thank You