

# Completion of Jordan Research and Training Reactor Construction Project



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# Talking Points

- ✓ Reporting the completion of JRTR construction
- ✓ Chronology of the project
- ✓ Focal points and issues at each construction stage

# 1. Overview

# JRTR Project at a glance

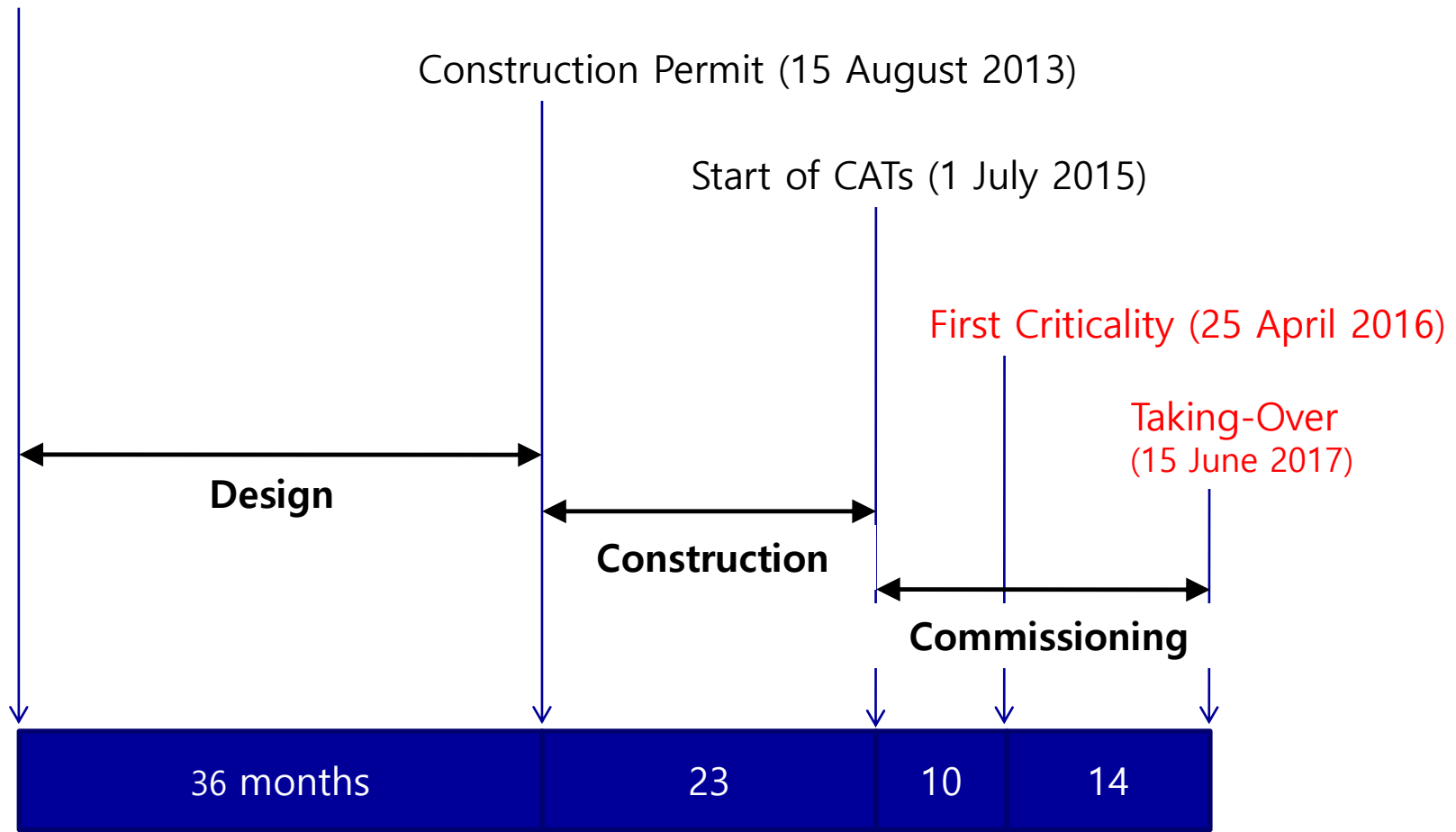
Project Name	Jordan Research and Training Reactor (JRTR) Project
Owner	Jordan Atomic Energy Commission (JAEC)
Contractor	Consortium of KAERI and Daewoo E&C (KDC)
Contract Type	Turnkey EPC Contract
Project Period	1 Aug. 2010 to 15 June 2017 (82.5 months)
Site	Campus of Jordan U of Science and Technology (Ramtha, Jordan)
Scope of Supply	<ul style="list-style-type: none"><li>▪ Design and Construction of JRTR (Reactor and buildings, RI Production Facility, Radwaste Treatment Facility, and Training Center)</li><li>▪ Education and Training of Jordanian Staff</li></ul>

- ✓ Philosophy in defining the scope of supply
  - At taking-over, JRTR would be operable by Jordanian operators and ready for NAA and production of I-131, Ir-192 and Mo-99.
  - JAEC was supposed to install later on the beam instruments, CNS, and so on.

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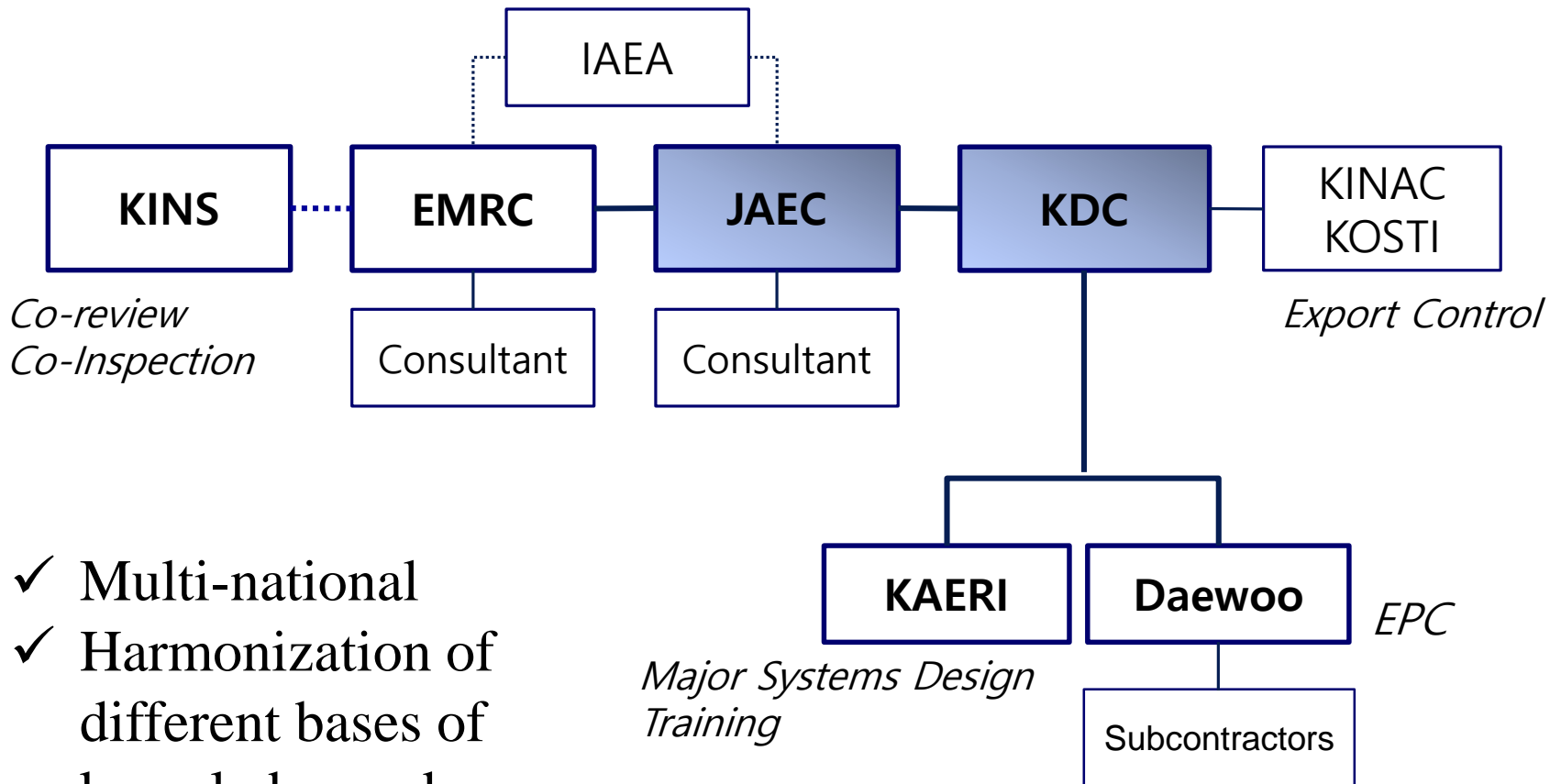
# Milestones

Commencement (1 August 2010)



# 1. Overview

# Involved Entities



- ✓ Multi-national
- ✓ Harmonization of different bases of knowledge and experiences was important.

- ✓ Licensing in two steps
  - Construction Permit (CP) & Operating License (OL)
  - Temporal permits such as Limited Work Authorization (LWA) for excavation before CP
  
- ✓ Regulatory bases
  - Laws and decrees of Jordan if available
  - IAEA, "Safety of RRs" (NS-R-4)
  - NUREG 1537 of US NRC
  - Korean regulatory practices including NSSC Notices

- ✓ Classification of SSCs
  - Kinds of classification: Safety Class, Seismic Categories, Quality Class, and classification of electrical and I&C systems
  - ANSI/ANS-51.1 for criteria on Safety Class
- ✓ Validation of computer codes and design concept
  - Benchmark tests of neutronics code,
  - Experiments on CHF, siphon breaker,
  - Factory Acceptance Tests as usual; Special attention to the performance tests of CRDMs

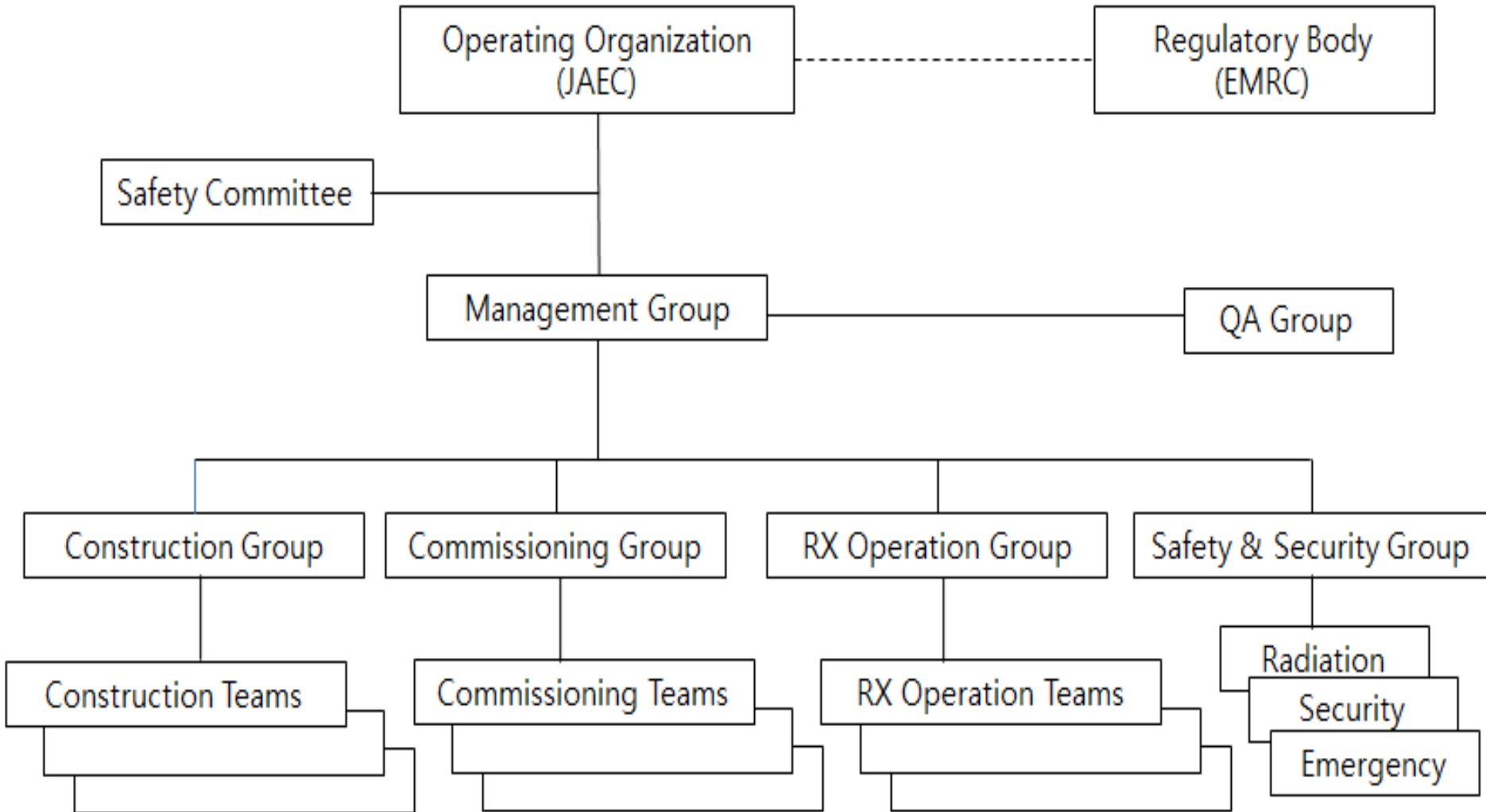


- ✓ Upgradability from 5 to 10 MW
  - 10 MW was assumed for permanent SSCs such as radiation shielding structures, pipes of cooling systems, and decay tank
  - Core reserves space for extra fuel assemblies.
  - Relatively light equipment such as pumps and HXs will be replaced.
  
- ✓ Impact of Fukushima accident
  - New systems such as Automatic Seismic Trip System and Air Discharge System
  - Upgrade of Quality Class of some systems

- ✓ Well-staffed site office
  - 50 Engineers and 500 workers
  - Headquarters of KAERI and Daewoo dispatched engineers and supervisors.
- ✓ Safety First: Human-Safety-Environment Program
  - No accident recorded for 4.8 million man-hours by the end of 2016.
- ✓ Fostering Jordanian operators and engineers
  - More than 10 engineers received Master degrees in Nuclear Eng. in Korea since 2011.
  - More than 20 operator-candidates trained in Korea in 2014-2105 and on the site later.

# 4. Commissioning

# Organization



## 4. Commissioning

# Work Flow

Stage	Test Category (No of procedures)
A1	Construction Acceptance Tests (67)
A2.1	Flushing (15)
A2.2	System Performance Tests (44)
A3	Integrated System Tests (3)
B1	Fuel Loading and Initial Criticality (11)
B2	Low Power Tests (10)
C	Power Ascension and Full Power Tests (17)

- ✓ First criticality on 25<sup>th</sup> April 2016
- ✓ Full power on 15<sup>th</sup> September 2016

## 4. Commissioning **Initial Operation Tests**

- ✓ IOT is very unique in JRTR.
  - Right after all the commissioning tests
  - Re-do most of the tests in Stages B and C for six months; completed in Oct 2017
  - By Jordanians
  - In order to provide Jordanian operators with intensive on-the-job training and re-confirm the results of commissioning tests
  - Resulted in satisfactory qualification of operators

## 5. Collaboration after Hand-over

- ✓ JAEC and KAERI made an Agreement in Oct. 2017.
  - To strengthen technical cooperation for safe and confident operation as well as full utilization of JRTR
  - In the areas of RI production, material irradiation including NTD, fuel management, emergency planning, radiation protection, maintenance, etc.
  - Will be further developed towards two sister centers, Jordan Nuclear Research Center and HANARO

# Remarks

- ✓ The goals of JAEC and KDC were the same.
- ✓ Supply on Time, Support Forever!

