



IAEA

International Atomic Energy Agency
Atoms for Peace and Development

Activities of the Research Reactor Section in support of ageing management, refurbishment and modernization of research reactors

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International Group on Research Reactors (IGORR) Conference and
IAEA Technical Meeting (TM) on Research Reactor Ageing Management, Refurbishment and Modernization
30 May - 4 June 2021 (Virtual Event)



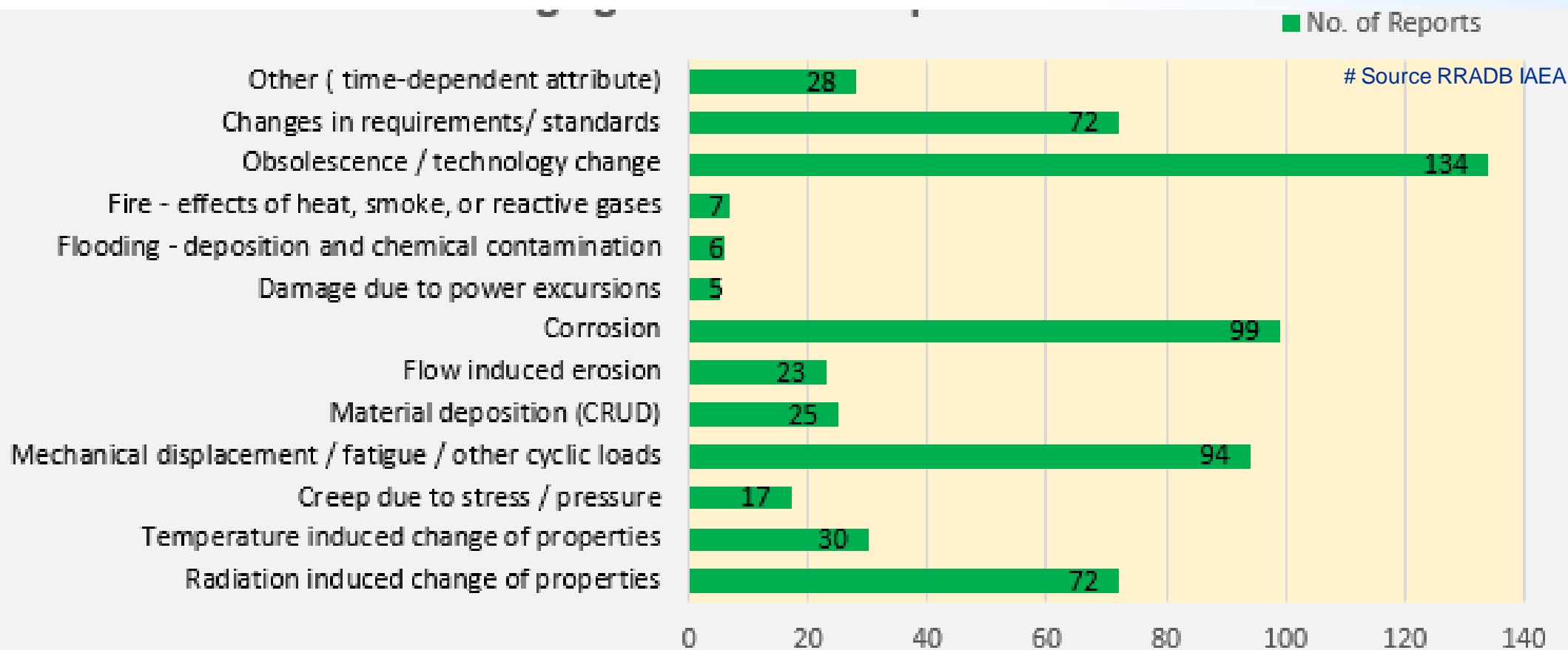
The rationale about Ageing Management

- The growing importance of Ageing Management in RR's Fleet worldwide is the consequence of two factors:
 1. More than 150, which accounts for 60% of total operating RR, are approaching or have gone beyond their design lifetime
 2. On the other side, only 27 New RR are planned or under construction
- The low rate for repositioning is due to:
 - the high cost and project time involved in building a new facility
 - New and more stringent regulations (+Cost + Risk)
 - Added Cost of Decommissioning

A cost effective shortcut is an AMRM Program
leading to a reliable and extended O&M



Ageing mechanism



IAEA's Project "RR operation and maintenance" (Leading goals)

To assist MS in developing and implementing O&M plans and establishing Integrated Management System

To assist MS in developing and implementing Ageing Management, Refurbishment and Modernization programmes

To contribute to IAEA cross-cutting activities on research reactors' decommissioning

IAEA's Activities (RR)



- ❖ Technical Meetings
- ❖ Training Workshops



Coordinated Research Projects



Publications



Peer Review Missions



IAEA Research Reactor
Information Resources (Databases)



Cross-cutting Activity
on RRs Coordination Group



Technical Meetings / Training Workshop

(Coming Next)

| Type | Title | Schedule | Venue |
|------|--|----------------------|---------------|
| TM | Ageing Management, Refurbishment and Modernization | 31 May -4 June 2021 | Virtual Event |
| TW | Integrated Management Systems | 21–25 June 2021 | Virtual Event |
| TM | Good Practices for the Operation and Maintenance of RR | 2-6 Aug 2021 | Virtual Event |
| TM | Upgrades to Digital Instrumentation and Control Systems for RR | 23-27 Aug 2021 | Virtual Event |
| TM | Risk informed In-Service Inspection and Decision Making for RR | 4 to 8 October 2021 | Vienna |
| TW | Non-Destructive Examination (NDE), In-Service Inspection (ISI) and On Line Monitoring (OLM) Techniques | 29 Nov to 3 Dec 2021 | Vienna |
| TM | Decommissioning Planning for Research Reactors | TBD – 2022? | |



Coordinated Research Projects (CRP)

Recent

“Improved Instrumentation and Control Maintenance Techniques for Research Reactors” (2017)

“Material Properties Database for Irradiated Core Structural Components for Continued Safe Operation and Lifetime Extension of Ageing Research Reactors” (2019)

“Condition monitoring and incipient failure detection of rotating equipment at research reactors” (2020)

Planned

“Risk Based ISI and Decision Making for Long Term Operation of RRs” (Planned)



IAEA RR Information Resources



Research Reactor

<https://nucleus.iaea.org/RRDB/>

Data from +800 RR's worldwide
Renovated & Upgraded
ESPACE EVENT 65th GC



Ageing

<https://nucleus.iaea.org/sites/rramp/>

+300 reports +70 RR Systems - 13 Ageing Mechanism



Material Properties

<https://nucleus.iaea.org/sites/rrmpdb>

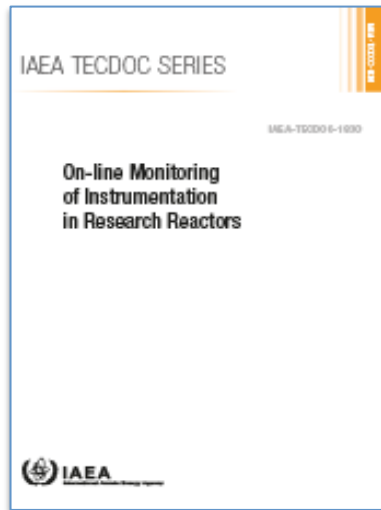
Irradiated Core, Structural Components
 5 groups of different meta data; 134 reports



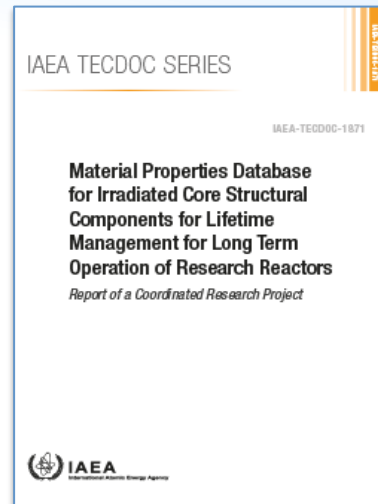
| Facility Name | Link to Facility | Affected system codes | Ageing Mechanism codes | Country | Date of Report | Name |
|---------------|----------------------------------|-----------------------|------------------------|-----------|----------------|------------------------------|
| RA-0 | Link to Facility | 4.5 | K | Argentina | 12/8/2017 | 21071208_ARG RA-0 fr_4.5 |
| RA-1 | Link to Facility | 1.9; 2.1 | D; K | Argentina | 12/8/2017 | 21071208_ARG RA-1 fu_1.9_2.1 |
| RA-3 | Link to Facility | 2.1 | D | Argentina | 12/8/2017 | 21071208_ARG RA-3 fc_2.1 |
| RA-4 (SUR100) | Link to Facility | 1.9; 3.2 | C; D; G | Argentina | 12/8/2017 | 21071208_ARG RA-4 fc_1.9_3.2 |
| RA-6 | Link to Facility | 2.1; 4.5 | F; G; K | Argentina | 12/8/2017 | 21071208_ARG RA-6 fu_2.1_4.5 |
| OPAL | Link to Facility | 8.5 | A; G | Australia | 12/8/2017 | 21071208_AUS OPAL Ageing |

| Type Name | Title | Author | Material | Material Type | Component | Properties |
|------------------------|--|--|-----------|-----------------|--|--------------------|
| 1_Chang ORNL CP-95192 | FRACTURE PROBABILITY AND LEAK BEFORE BREAK ANALYSIS FOR THE COLD NEUTRON SOURCE MODERATOR VESSEL | S. J. Chang | Aluminium | Al 6061 | Core box/vessel | Fracture toughness |
| 10_Kapusta AI5754 2005 | Mechanical characteristics of 5754-NET-O Aluminium alloy irradiated up to high fluences: Neutron spectrum and temperature effects. | Kapusta, B., et al., | Aluminium | Al 5754 (AlMg3) | Core box/vessel | |
| 11260-43942-1-PB | Fretting fatigue analysis on nuclear fuel cladding tubes | Lichen Tang, Shurong Ding, Yongzhong Huo | Zirconium | Zr-4 | Core box/vessel, Core support structures | |

Publications recently released



TECDOC 1830
Dec 2017



TECDOC 1871
May 2019



NR-G-5.1
June 2020



Service Series 44
Nov 2020



TECDOC 1920
April 2021



Ageing's related Publications under preparation

| Title | Type | Status |
|---|--------------------|--|
| Considerations on Decommissioning in the Design and Operation of Research Reactors. | N.A. | In preparation |
| Post-Irradiation Examination for Research Reactor Fuels | N.A. | In preparation TBI 2021 |
| Guidelines for an Ageing Management, Modernization and Refurbishment Programme for a Research Reactor | NR-G-?? | to be reviewed at this TM (Jun 4 th , 2021 12:00 CET) |
| Optimization of Reliability and Availability of RRs | NP-T-5.4 (2008) | Revision pending |
| Application of non-destructive testing and in-service inspection to research reactors | TECDOC 1263 (2001) | Revision pending |

Peer Review Missions (OMARR)

Assistance for:

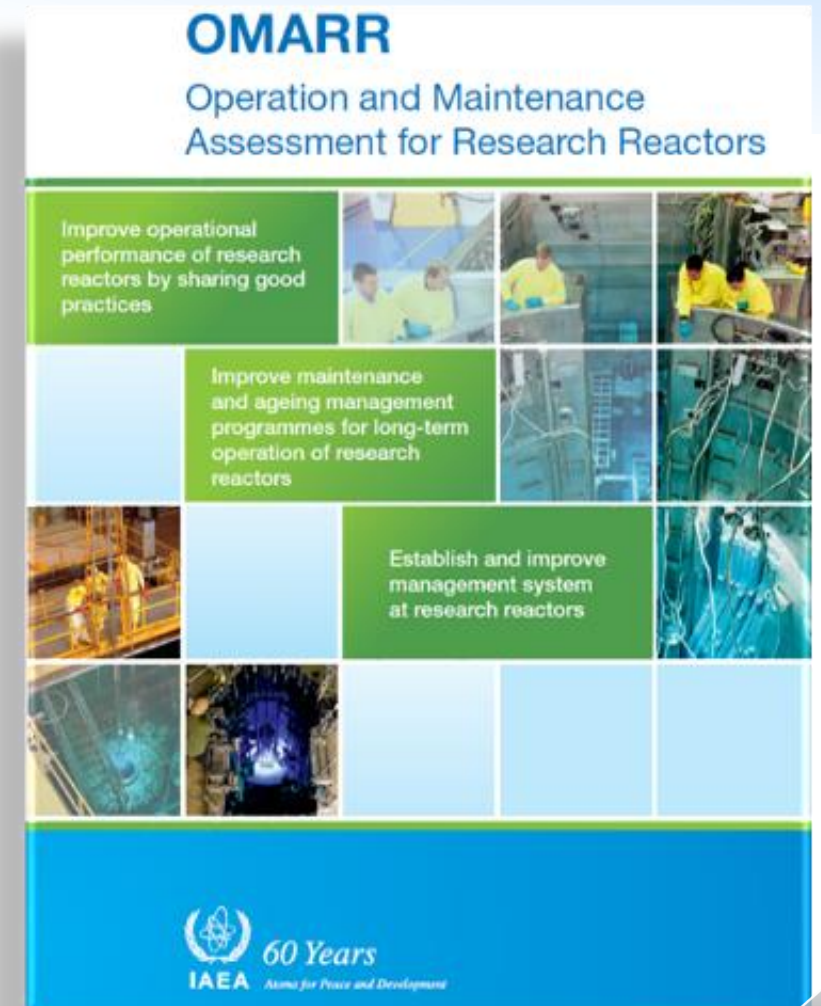
- Enhancing availability, reliability and performance in RR O&M
- Identifying opportunities for upgrades and improvement

Three stages approach:

- Pre-OMARR
- OMARR (Main Mission)
- Follow-up

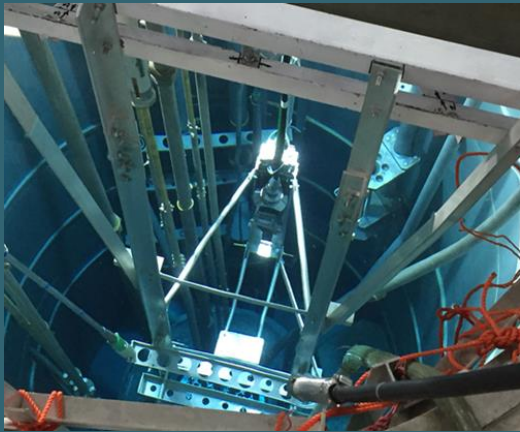
Outcome:

- Self assessment
- Peer Review Expert Report (R, S and GP)



ISI and NDE Missions

Supporting MS in the assessment of the operating conditions:
Reactor Tank, Auxiliary Pool, Internals, Supporting structures, Core Grid, Fuels, Pumps, Piping, Heat Exchangers, Cooling Towers, etc. With participations of experts if requested.



ISI and NDE Missions

Equipment available (free to MS) :

- Radiation Resistant Underwater, HD Digital cameras (B/W & Color)
- Videoscope
- Ultrasonic tester



VISUAL INSPECTION SYSTEM «PROTON»



ADVANTAGES

- RESOLUTIONS 1920 × 1080
- COLOR IMAGE
- RADIATION TOLERANCE UP TO 10⁵ RAD
- REMOTE PAN & TILT
- AUTO / MANUAL FOCUSING
- EASY MAINTENANCE AND REPLACING OF CAMERA MODULE
- 10X ZOOM
- HEAVY DUTY WATERPROOF DESIGN
- LOAD-CARRYING CABLE

APPLICATIONS

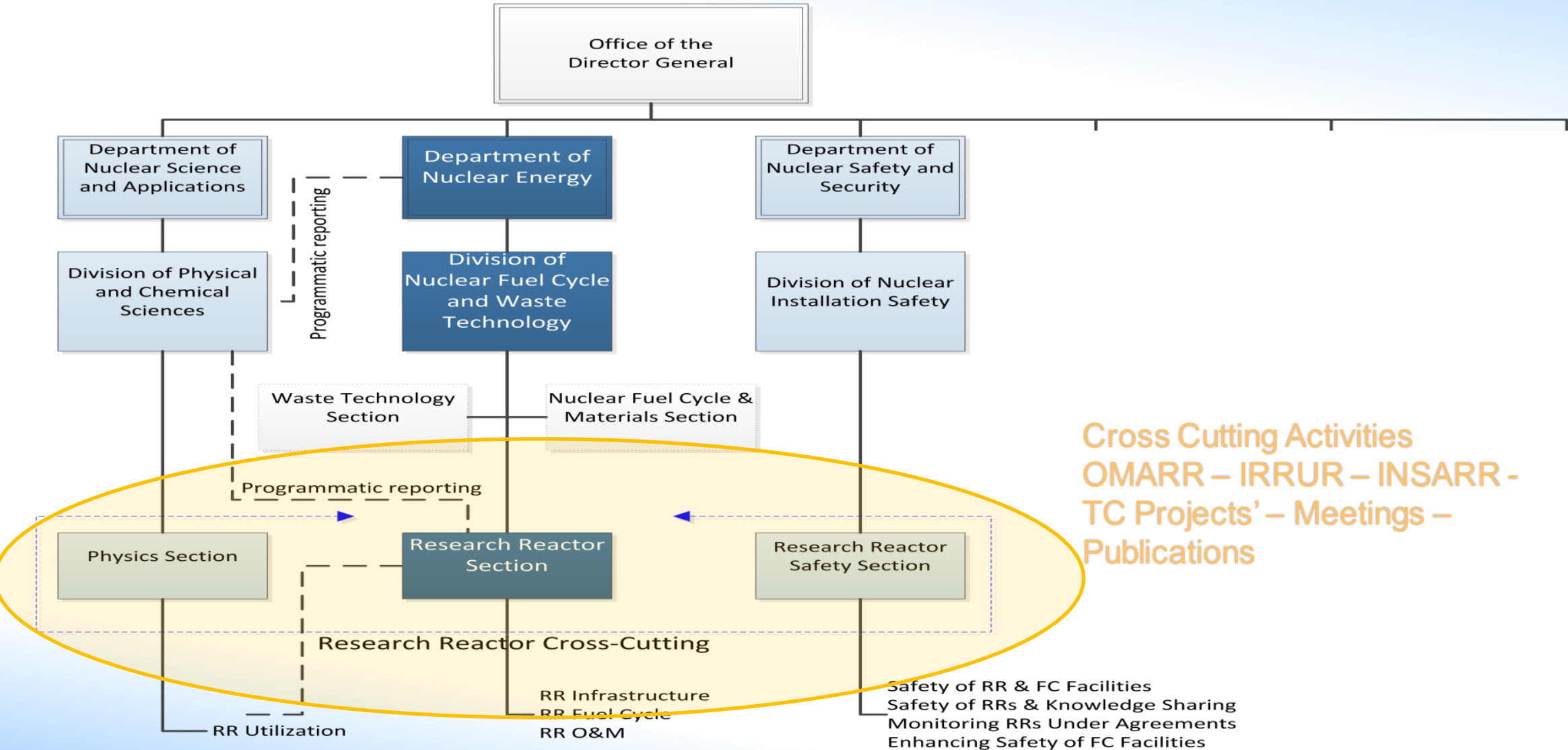
- VISUAL INSPECTION IN A HOT CELL
- REMOTE MONITORING OF CONTAMINATED AREAS
- INSPECTION STORAGE CAPACITIES FOR NUCLEAR WASTE
- STEAM GENERATORS MONITORING
- IDENTIFICATION THE SERIAL NUMBERS OF PRODUCTS
- FOREIGN OBJECT SEARCH
- OTHER TV MONITORING AND INSPECTION TASKS IN NUCLEAR POWER INDUSTRY



Peer Review Missions

| Type | | Completed/Ongoing | Requested/Planned |
|----------------|--|--|---|
| Pre- OMARR | Pre- Operation and Maintenance Assessment of Research Reactors | 2012 USA (NIST) 2012 Italy (Lena) 2017 Portugal (RPI) 2018 Bangladesh (BTRR) 2018 Uzbekistan (WWR-SM) 2018 DRC (Trico II) 2019 Indonesia (Bandung) 2019 Thailand (TRR-1/M1) | 2021 Chile (RECH-1) TBD Poland (MARIA) TBD Iran (TRR) |
| OMARR | Operation and Maintenance Assessment of Research Reactors | 2012 USA 2012 Italy 2018 Bangladesh 2018 Uzbekistan 2019 Indonesia | 2021 Chile TBD Poland TBD Iran TBD Thailand |
| NDE & ISI | Non-Destructive Examination and In Service Inspection | 2014 Venezuela (RV-1) 2017 Portugal 2018 Bangladesh 2019 DRC | 2021 Uzbekistan 2021 DRC 2022 Venezuela TBD Chile |
| Expert Mission | (Jointly with RRSS) | 2021 Philippines (PRR-1 SATER) | |

Cross-cutting Activity on RRs Coordination Group



Cross Cutting Activities
 OMARR – IRRUR – INSARR -
 TC Projects' – Meetings –
 Publications

Final Remarks

- IAEA is conducting several activities aimed at supporting MS in aspects related to Ageing Management, Refurbishment and Modernization.
- Good feedback was received from MS that have conducted OMARR/ISI/NDE missions. And new missions are requested/planned.
- These activities are effective tools to face successfully the technical challenges for Long-Term / Extended Reactor O&M
- We encourage the participation of Operating Staff to share experiences with other colleagues of the RR Community at these events and provide technical information to increase the use of IAEA's databases.



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THANK YOU

Questions/Comments/Ideas?

