New Opportunities for Enhanced RR Utilization through Networks and Coalitions

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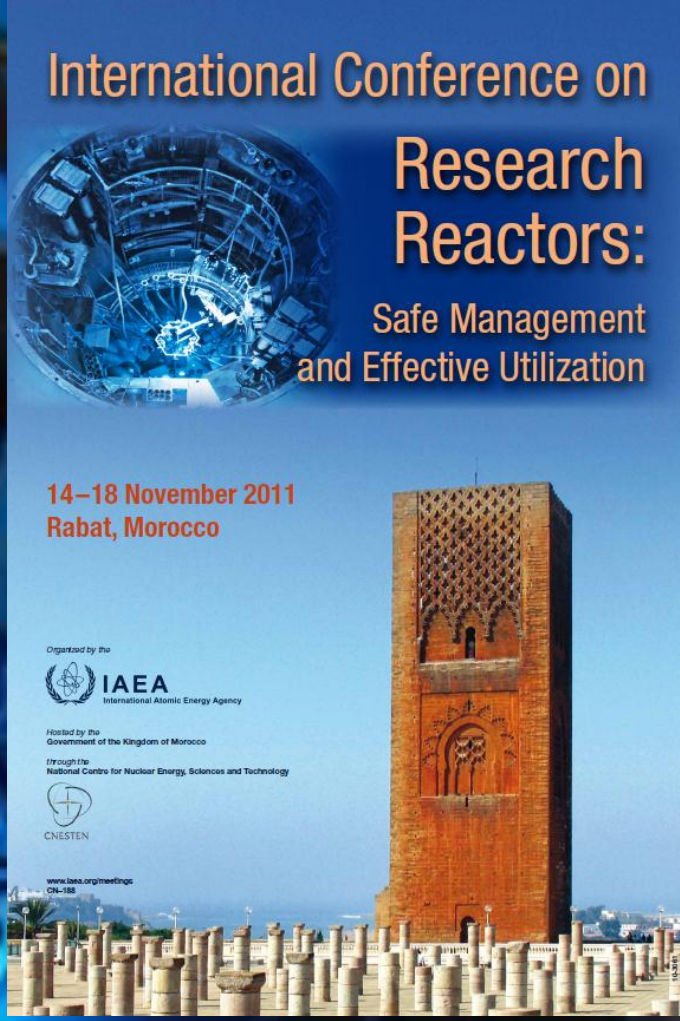
Outline

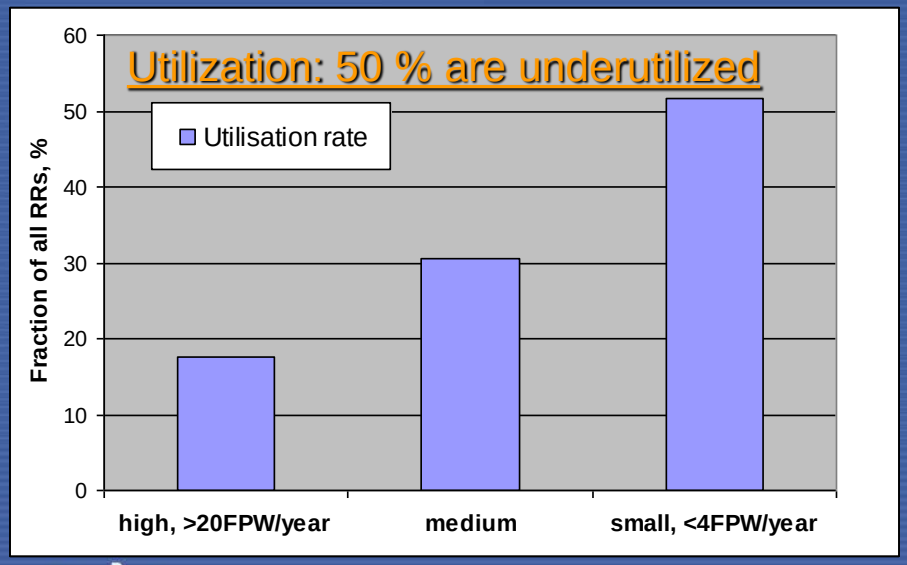
- Key Issues and challenges
- Reasons for RR underutilization
- Programmatic structure
- IAEA efforts to enhance RR utilization
  - IAEA RR Data Base (RRDB)
  - New RR projects
  - Networks and Coalitions
  - Coordinated Research Projects
  - Promotional and technical publications
  - …

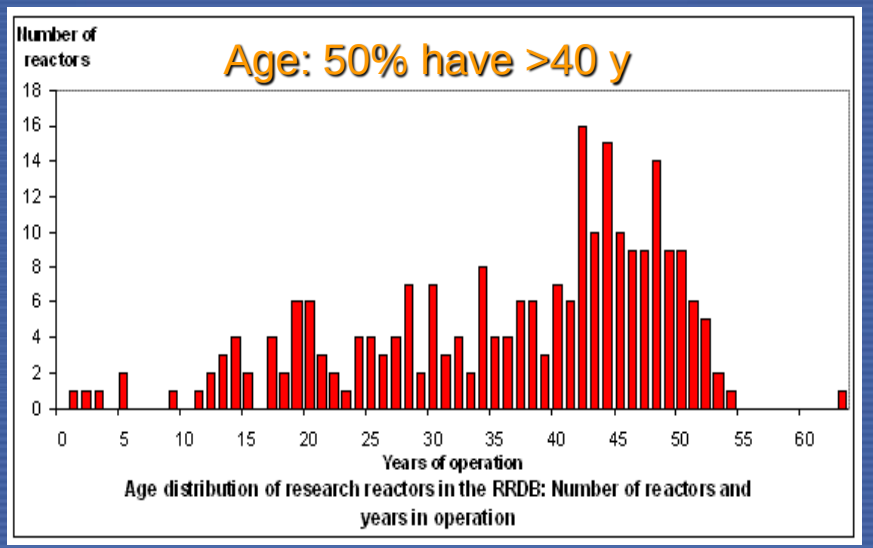


Contact: D.Ridikas@iaea.org

Key issues and challenges in RR utilization

- Number of operational RR is decreasing and will continue to decrease
- These are very old facilities and need urgent modernization/refurbishment
- 50% of RRs remain heavily underutilized
- "Paradox": requests by newcomers to assist in the first RR project





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Source: IAEA RRDB, February 2011

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Major reasons for RR Underutilization

- **Lack of purpose** (and strategy) objectives formulated long time ago; no new/clear strategy available
- **Lack of budget** (and staff); prefer operate on “survival” level rather than shut-down and decommission; no plan/funds for decommissioning
- **Lack of pro-activity** (and motivation); no action to search for new users/clients; no action to analyse/penetrate the market for potential commercial products & services
- **Lack of QA/QC** (and Integrated Management System); decreased confidence from major stakeholders (funding and regulatory authorities); decreased chance to go commercial; no courage for re-organization

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RR related efforts within the IAEA programmes

→ Cross cutting activities on RRs: NA, NE, NS, TC, SG, …

Programme D: Nuclear Science

4 team members present at this Conference

Sub-programme D2: Research Reactors (RR)

Project D2.01:
Enhancement of utilization & applications of RRs

- Activity 1
- Activity 2
- Activity 3
- …

Project D2.02:
RR infrastructure, planning & innovation

- Activity 1
- Activity 2
- Activity 3
- …

Project D2.03:
Addressing RR fuel cycle issues

Project D2.04:
Research Reactor operation

RR utilization & application related issues addressed under two projects

See key note talks B01 by P. Adelfang on Tuesday &
D01 by H. Abou Yehia on Thursday

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Enhancement of RR utilization & applications

List of major activities:

- Research Reactor Data Base (RRDB)
- New RR projects
- RR coalitions & networks
- Coordinated Research Projects
- Technical Meetings (TM), Consultancy Meetings (CM), Schools
- International RR Conference, Workshops
- Support of national & regional TC projects
- Publications, technical reports, brochures

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In-house strategy for enhanced RR utilization

Today existing or planned RR facilities should concentrate on three major issues:

Strategic Planning & Performance Monitoring

International Cooperation & Networking

Sustainability through Provision of Products & Services

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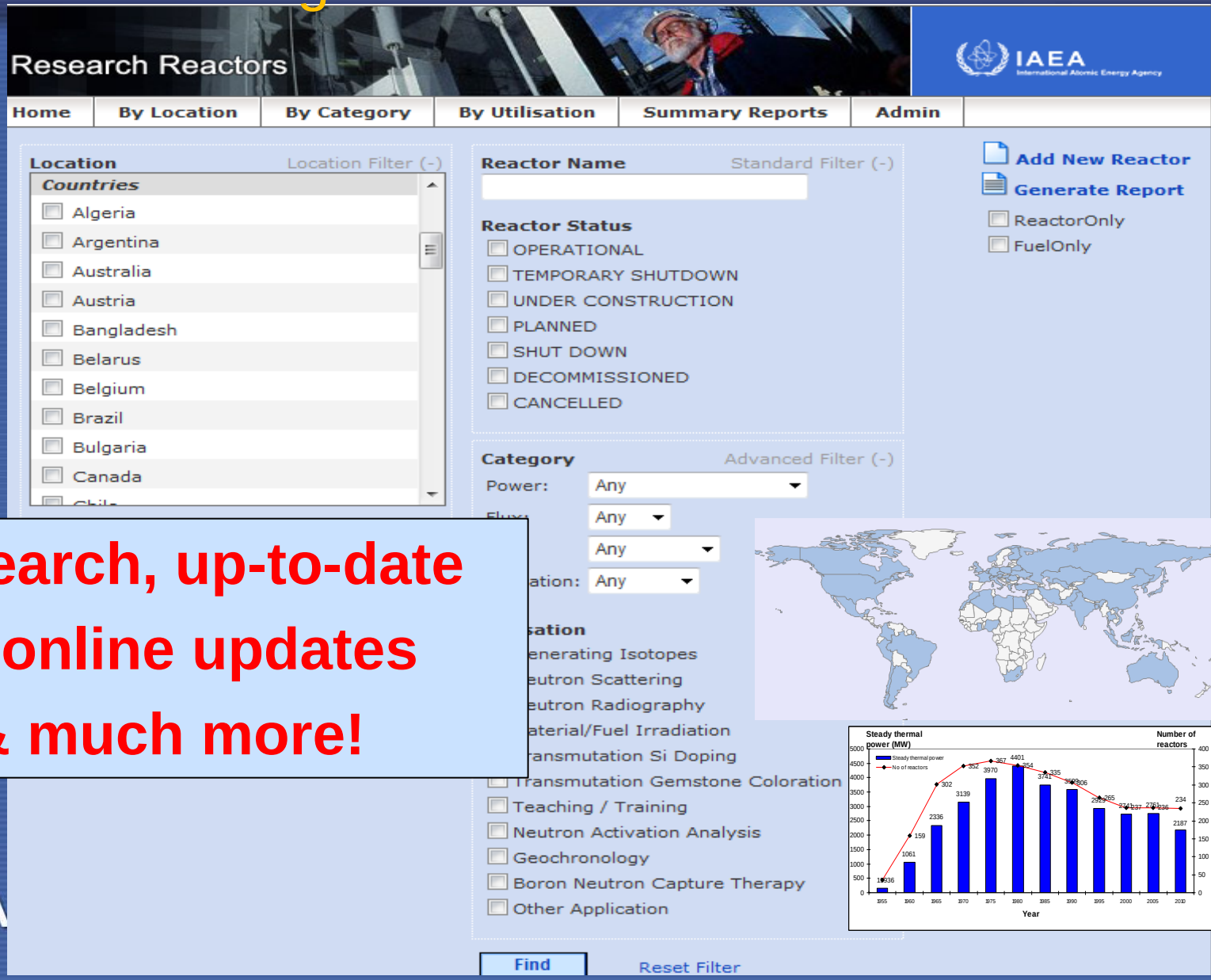
IAEA RRDB: improved release through

http://nucleus.iaea.org/RRDB/



Multiple search, up-to-date statistics, online updates possible & much more!

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RRDB: application-oriented functions

Application	Number of RR involved	Involved / Operational, %	Number of countries
Education & Training	**161**	**67**	**51**
Neutron Activation Analysis	**122**	**51**	**54**
Radioisotope production	**90**	**37**	**44**
Neutron radiography	**68**	**28**	**40**
Material/fuel testing/irradiations	**60**	**25**	**25**
Neutron scattering	**48**	**21**	**32**
Nuclear Data Measurements	42	18	20
Gem coloration	36	15	22
Si doping	35	15	22
Geochronology	26	11	21
Neutron Therapy	20	8	13
Other	95	40	29

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Activity: TC projects and new RRs

Planned RRs as of today

- **Last TC cycle: more than 30 on-going IAEA TC projects related to RR utilization, safety, fuel cycle, refurbishment and modernization, etc.**

- **(2010-2011) 4 on-going projects to start the 1st RR in the country**
  1) Azerbaijan: Conducting a Feasibility Study for Planning and Establishing a RR
  2) Jordan: Establishing a RR
  3) Sudan: Sudan Nuclear RR Project
  4) GCC: Developing Regional Nucl. Training Centre for Capacity Building & Research

- **(2012-2013) similar number of all projects but already 7 new projects related to the 1st RR in the country**
  - **Jordan, Lebanon, Philippines, Saudi Arabia, Sudan, Tunisia, and Tanzania +**

  new RR projects in Argentina, Brazil, Korea, the Netherlands, South Africa, Vietnam…

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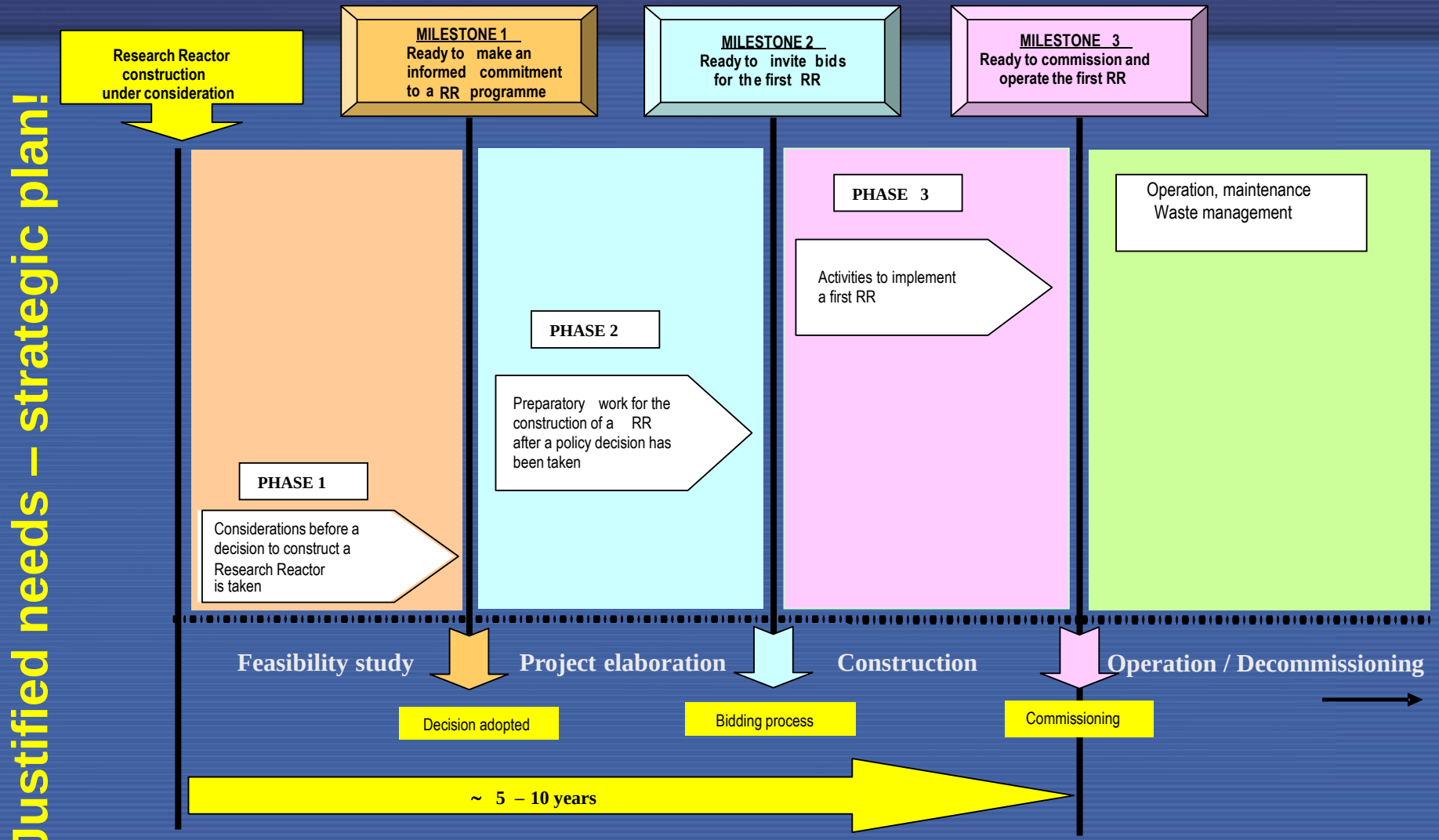
Activity: RR Milestones for Newcomer MS



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See key note talk C01 by A.M. Shokr on Wedensday

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Activity: RR strategic and business plans

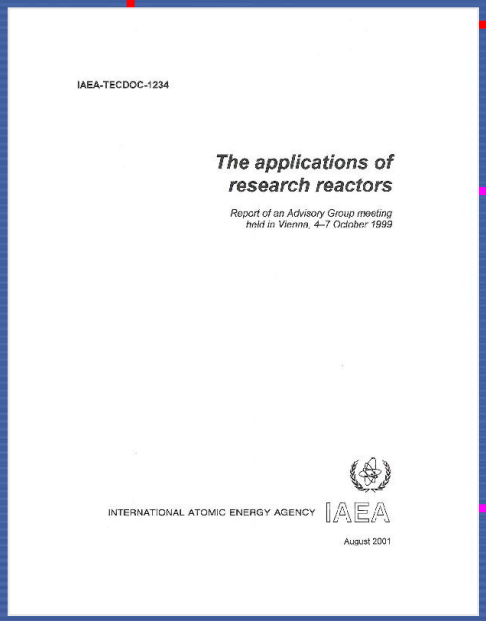
Preparation/revision of

→ Justification and Demonstrated Needs

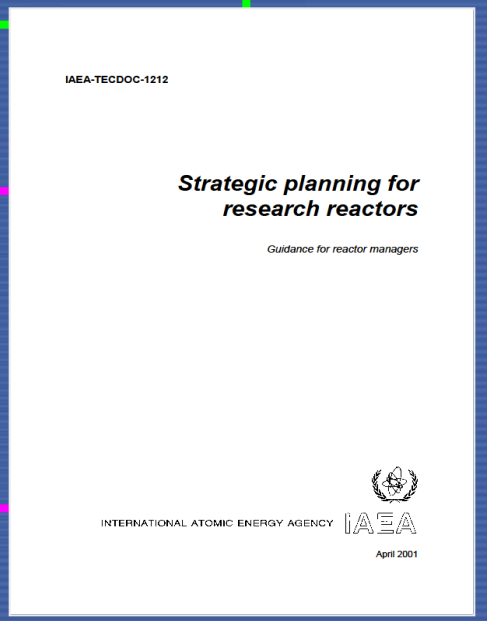
→ Strategic & Business Plans

Facility Status
Capabilities
What can I do?

Current Stakeholder
Requirements/Needs
What should I do?



Production of a strategic plan supports an increase in utilization by increasing capabilities and creating new requirements



Support/assistance from the IAEA is dependent on having a demonstrated need, i.e. … a strategic plan

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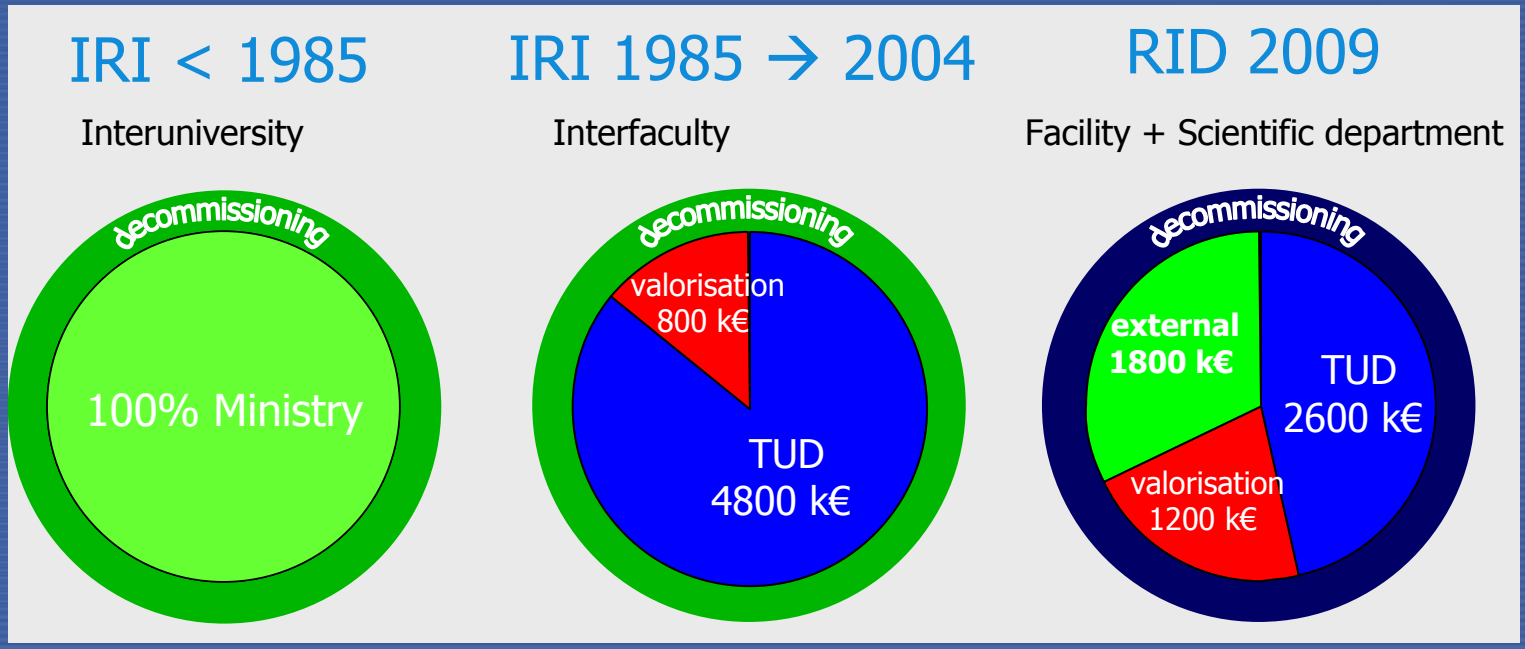
Example: 2MW RR: HOR of TU Delft

Today:

- **It is a partially self sustained RR (operational costs ~$M6)**
- **Multipurpose RR**
- **NAA, neutron beams, positron source, E&T, isotope production**
- **Special efforts on QA/QM, accreditation, recognition, etc.**



Future:

- **New applications, advanced R&D, search for specific niche…**

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- See presentation A17 on Tuesday by P. Bode

Activity: RR strategic & business plans

1) Dedicated **template/guidelines** prepared; available on request
2) Dedicated **questionnaire** prepared; available on request

3) Entire **strategic plans revised** for:
   - → Egypt
   - → Ghana
   - → Morocco
   - → EurAsia RR Coalition

3) **Expert missions/workshops** held on strategic planning:
   - → Azerbaijan (+ questionnaires)
   - → 6 GCC states (+ questionnaires)
   - → Bulgaria
   - → Ukraine
   - → Sudan (+ questionnaires)
   - → Portugal
   - → Greece and Turkey (scheduled in 2012)

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Activity: RR Performance Indicators

Research Reactor Performance Variables, Page 1

Draft: 01/07/2010, D.Ridikas@iaea.org

General RR Data	
Country	Enter country name
RR name	Enter RR name
RR IAEA code	Enter RR IAEA code
RR Power, kW	Enter RR power
Administrator/Manager	
E-mail	
Phone	
Address	

Evolution of Personnel	
Number of Operating Staff	
Total Number of Facility Personnel	

A) Operation Data	
A100	Total hours/day in operation
A200	Total days/week in operation
A300	Total weeks/year in operation
A123	Total hours in operation per year
A321	Total planned hours in operation per year
A1	Neutron flux monitoring/depth-profiling operation hours
A2	In-Core irradiation (rigs, loops, etc.) operation hours
A3	Pool-side irradiation operation hours
A4	Pneumatic irradiation operation hours
A5	Material irradiation hours
A6	Radioisotope production operation hours
A7	Neutron scattering operation hours
A8	Neutron radiography operation hours
A9	Neutron activation analysis operation hours
A10	NTD of Si irradiation operation hours
A11	Gemstones irradiation operation hours
A12	Students training/experiments operation hours
A13	Operators training operation hours
A14	General guided tours/visits operation hours

B) Operation Results	
B1	Neutron flux monitoring/depth-profiling, number of experiments
B2	In-Core irradiation, number of experiments
B3	Pool-side irradiation, number of experiments
B4	Pneumatic irradiation, number of samples
B5	Material irradiation, number of experiments
B6	Radioisotope production, total activity in GBq
B7	Neutron scattering, number of experiments
B8	Neutron radiography, number of experiments
B9	Neutron activation analysis, number of samples
B10	NTD of Si irradiation, mass in kg
B11	Gemstones irradiation, mass in kg
B12	Students training/experiments, number of students trained
B13	Operators training, number of operators trained
B14	General guided tours/visits, number of events
B15	Number of internal users
B16	Number of external users

C) Shutdown and Maintenance Data	
C1	Number of scheduled shutdowns
C2	Scheduled shutdown hours
C3	Number of unscheduled shutdowns
C4	Unscheduled shutdown hours
C5	Number of work permits issued
C6	Number of preventative maintenance events
C7	Number of failures detected during preventive maintenance
C8	Number of corrective maintenance events
C9	Operation hours lost due to corrective maintenance

Research Reactor Performance Variables, Page 2

Draft: 01/07/2010, D.Ridikas@iaea.org

General RR Data	
Country	Enter country name
RR name	Enter RR name
RR IAEA code	Enter RR IAEA code
RR Power, kW	Enter RR power

	D) Quality and Safety Control	Year 2009	2010	2011
D1	Number of peer reviews			
D2	Number of QA audits			
D3	RR strategic plan update (yes=1, no=0)			
D4	Pubication of annual progress report (yes=1, no=0)			
D5	Number of internal publications (technical notes)			
D6	Number of publications in peer reviewed journals			
D7	Number of facility periodic safety inspections			
D8	Number of regulatory-lisencing inspections			
D9	Number of issued LA's restrictive resolutions			
D10	Number of revoked LA's restrictive resolutions			
D11	Number of non conformity in terms of documentation			
D12	Number on non conformity in terms of safety critical systems			
D13	Number of issued inspection recommendations			
D14	Number of inspection recommendations implemented			
D15	Number of RR staff re-/certified			
D16	Number of reportable events to licensing authority			

	E) Radioactive Dose Records (in mSv)	Year 2009	2010	2011
E1	Collective radioactive dose to operating staff			
E2	Average dose per staff member			
E3	Collective radioactive dose to facility personnel			
E4	Average dose per facility personnel member			
E5	Maximum individual dose among facility personnel			
E6	Medical checks of rad workers			

	F) Radioactive Discharge Records	Year 2009	2010	2011
F1	Noble gas (Ar-41) released to atmosphere (GBq)			
F2	Iodine isotopes released to atmosphere (GBq)			
F3	Liquid effluent discharged from reactor system (m3)			
F4	Radioactivity of reactor discharged effluent (MBq)			
F5	Liquid effluent discharged from laboratories (m3)			
F6	Radioactivity of lab discharged effluent (MBq)			
F7	Solid radioactive waste generated, minus spent fuel (m3)			
F8	Spent fuel removed from reactor (kg)			
F9	Fresh fuel inventory (kg)			

	G) Financial Records ($US)	Year 2009	2010	2011
G1	Total annual budget			
G2	Operational costs including salaries			
G3	Operational costs excluding salaries			
G4	Revenue generated from NAA			
G5	Revenue generated from RI production			
G6	Revenue generated from other irradiation services			
G7	Revenue generated from R&D with industry/other stakeholders			
G8	Revenue generated from education & training programs			
G9	Total fiscal year generated revenue			
G10	Support received from IAEA			

from self-evaluation to self-monitoring

within 2 pages, ~80 variables

* General information

* Evolution of personnel

A) Operation Data, 14 var.

B) Operation Results, 16 var.

C) Shutdown & Maintenance Data, 9 var.

D) Quality and Safety Control, 16 var.

E) Radioactive Dose Records, 6 var.

F) Radioactive Discharge Records, 9 var.

G) Financial Records, 10 var.

Goal: comparative analysis over the period of 3-5 years!

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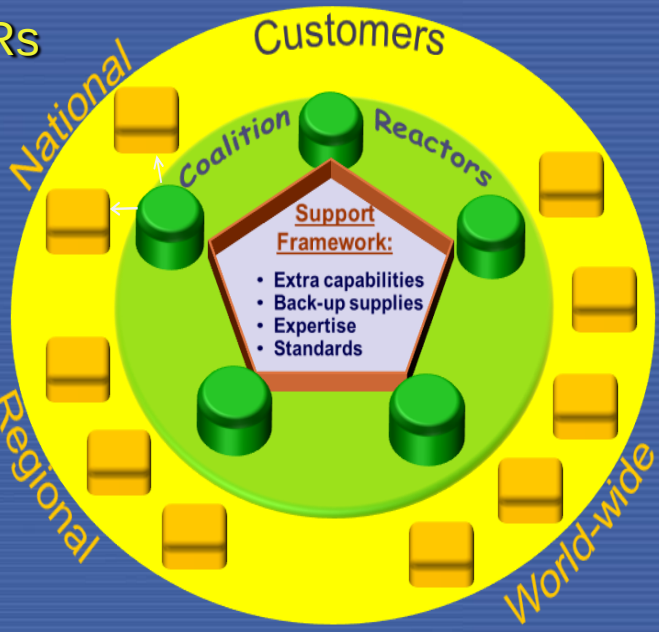
Activity: RR Networks and Coalitions, background

Objectives:

→ increase utilization and sustainability
→ promote regional/international cooperation
→ access to RRs from Member States without RRs

Role of the IAEA

→ Catalyst and facilitator towards self-reliance
→ Preparation of strategic and business plans
→ Initial support via regional TC projects



Performance indicators:

- Number of RR facilities forming networks
- Number of non-RR countries forming networks
- Number of RRs with new/updated strategic plans
- Number of RRs with increased utilization/revenues

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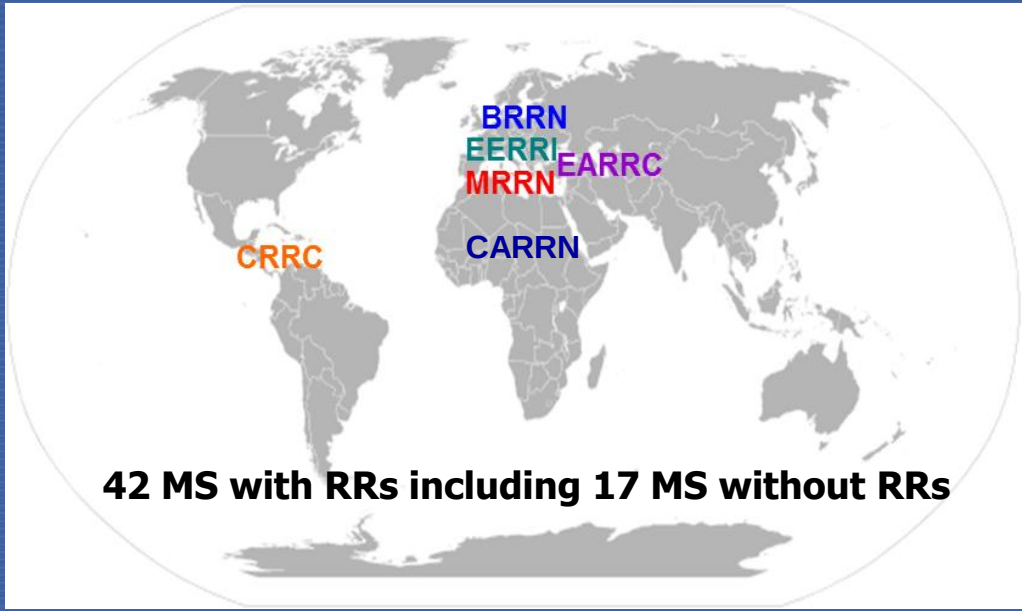
Activity: RR Networks and Coalitions, status

1.	BRRN – Baltic Research Reactor Network,	multipurpose,	10MS
2.	EARRC – Eurasian RR Coalition,	isotope production,	5MS
3.	EERRI – Eastern European RR Initiative,	multipurpose,	6MS
4.	CRRC – Caribbean RR Coalition,	mainly NAA,	3 MS
5.	MRRN – Mediterranean RR Network,	multipurpose,	12 MS
6.	CARRN – Central Africa RR Network,	multipurpose,	9 MS



Future:

- Strengthen & consolidate the existing 6 RR coalitions
- Assist in developing common strategic & business plans
- Provide support towards maturation, self-reliance and sustainability
- Ensure access to countries without RRs

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Activity: RR Networks and Coalitions, highlight

RR Group Fellowship Training Course (6 weeks):

- **EERRI:** organized by partners in Austria, Czech Republic, Hungary, & Slovenia
- **IAEA:** implementation and financial support through TC projects
- **Contents:** theoretical courses, hands on training, IAEA lectures, evaluations
- **Participants:** ~40 fellows trained during 4 courses
- **Future:** 5th course is taking place right now; **similar initiatives in other regions**

See today's talk A04 by L. Sklenka

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Activity: Networks and Coalitions, new initiative

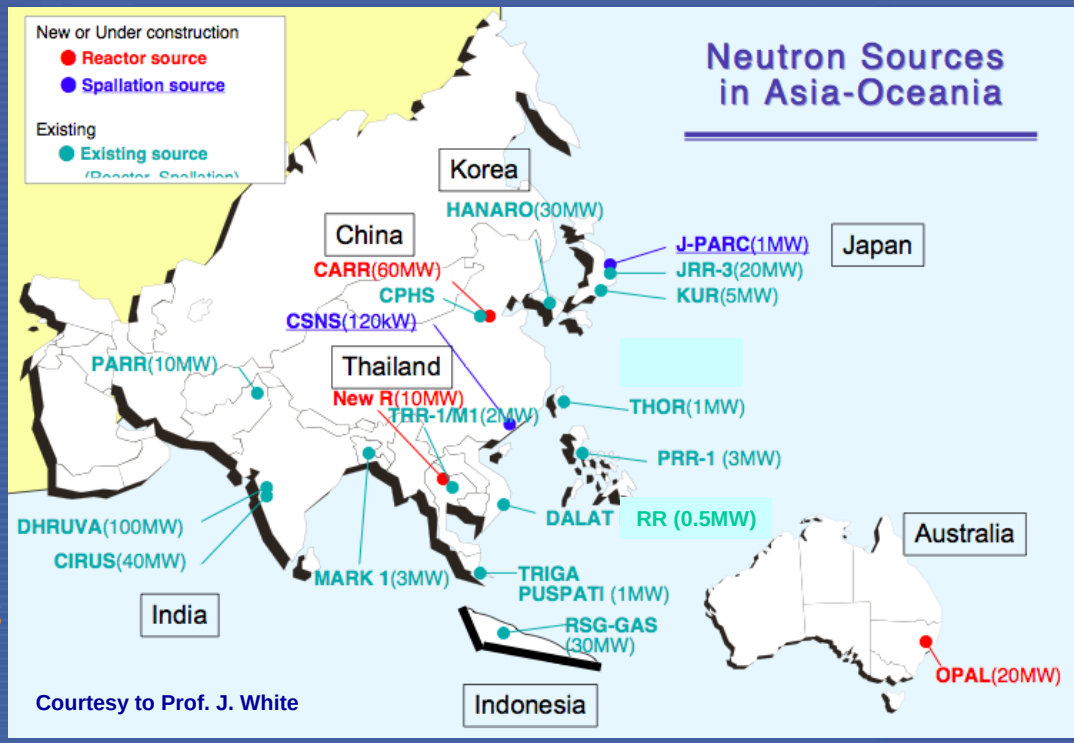
Asia-Pacific RR Users' Network, neutron beams, 11 MS

Status:

- Discussed in August 2009, ANSTO
- Initiated in October 2010, KAERI
- Annual AONSA neutron schools

Activities:

- **ANSTO as an IAEA CC**
- Collaboration with AONSA
- Joint meetings with facility directors



Future:

- Dedicated web portal
- "Yellow book" of neutron instruments
- Design of a new regional IAEA TC project

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Activity: IAEA Collaborating Centres

"Designation as a CC is a public recognition of the work that the institution is doing for the IAEA. It can be regarded as an acknowledgement of being an internationally recognised player in the specified field, and as an expression of thanks by the IAEA."

ANSTO: Neutron Scattering Applications (since 2007)

- See today's presentation A07 by S. Kennedy

TU Delft: NAA Based Methodologies (since 2009)

- See presentation A17 on Tuesday by P. Bode

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Activity: Coordinated Research Projects (1)

Active CRP 1496 (2008-2012), jointly coordinated and supported by NA, NE and NS:

Innovative methods in **RR Analysis: Benchmark against Experimental Data** on Neutronics and Thermalhydraulic Computational Methods & Tools for Operation & Safety Analysis of RRs

Objectives:

encourage cooperation and exchange of information in the area of RR related numerical analysis

facilitate and support RR design, operation, and safety

benchmark against experimental data existing neutronics and thermalhydraulic computational methods and tools that are routinely utilized for operation and safety analysis of RRs

9 Research Contracts + 8 Research Agreements + 2 Observers

1. Algeria
2. Argentina
3. Australia
4. Bangladesh
5. Canada
6. Egypt
7. France
8. Germany
9. Ghana
10. Italy
11. Nigeria
12. Pakistan
13. Romania
14. South Africa
15. Syrian Arab Republic
16. USA
17. Uzbekistan

Expected output:

report on comparison of experimental and theoretical results

data base of RR characteristics, experiments and data used for benchmarks

recommendations on open issues for future R&D activities involving RRs

increased cooperation in RR related experiments and modelling

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Activity: Coordinated Research Projects (2)

Active CRP 1575 (2009-2012):

- Development, Characterization and **Testing of Materials of Relevance to Nuclear Energy Sector Using Neutron Beams** (SANS, diffraction and neutron radiography)

Objectives:

- investigation and characterization of materials relevant to nuclear energy applications
- optimization and validation of experimental and modelling methods
- creation of a database of reference data for nuclear materials research
- enhancement of the capacity of research reactors for nuclear materials research

10 Research Contracts + 9 Research Agreements

1. Argentina
2. Australia
3. Brazil
4. China
5. Czech Republic
6. France
7. Germany
8. Hungary
9. Indonesia
10. Italy
11. Japan
12. Korea
13. The Netherlands
14. Romania
15. Russian Federation (2)
16. South Africa
17. Switzerland
18. USA

Expected output:

- Creation of multilateral network in the field of advanced nuclear materials research
- Creation of an experimental reference database for models and calculations
- Final project publication

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Activity: Coordinated Research Projects – planned

Enhanced utilization & sustainability

→ 1.4.2.1/11 CRP on Development and Implementation of Routine Automation in Advanced NAA Laboratories (2012-2015)

Neutron Beams

→ 1.4.2.1/11 CRP on advanced neutron imaging and tomography (2012-2015)

Radioisotopes, Mo-99

→ 1.4.2.1/04 CRP on the Feasibility of Low-specific-activity, Non-HEU, Mo-99 Production, Separation and Distribution (2011-2014)

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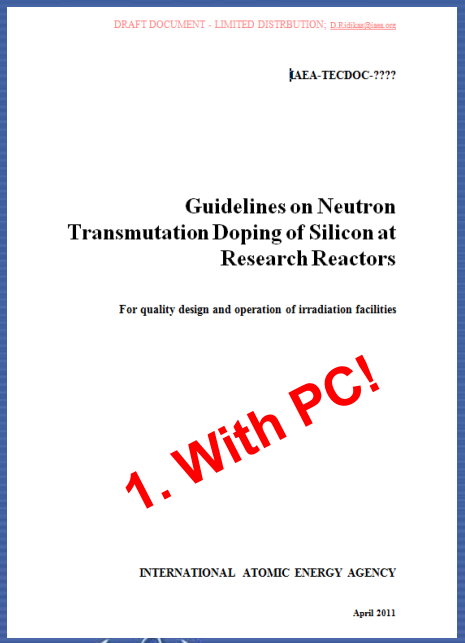
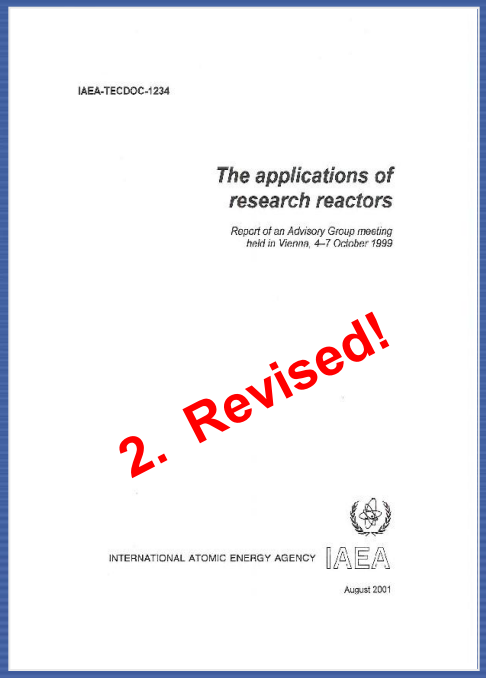
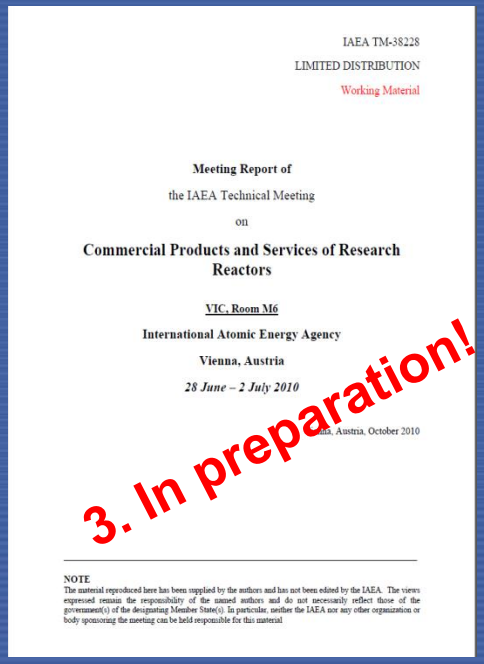
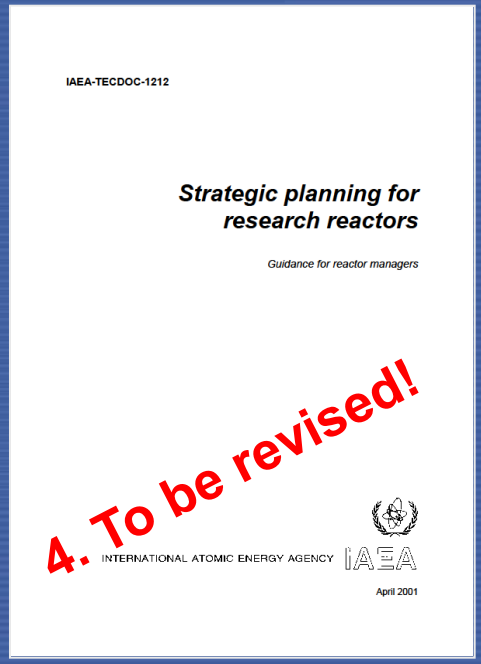
Update on Technical Publications (Utilization/Applications related)

1. TECDOC on “Guidelines on NTD of Si at RRs” has been finalized; PC comments were addressed
2. IAEA TECDOC1234 “Applications of RRs”; fully revised and will go to the PC shortly; will remain reference document describing RR capabilities
3. Complementary to TECDOC 1234, new IAEA TECDOC on “Catalogue of Commercial Products and Services of RRs” is in preparation as a result of TMs held in 2010-2011.
4. IAEA TECDOC 1212 “Strategic Planning for RRs” to be revised/complemented; will include “business strategic planning”









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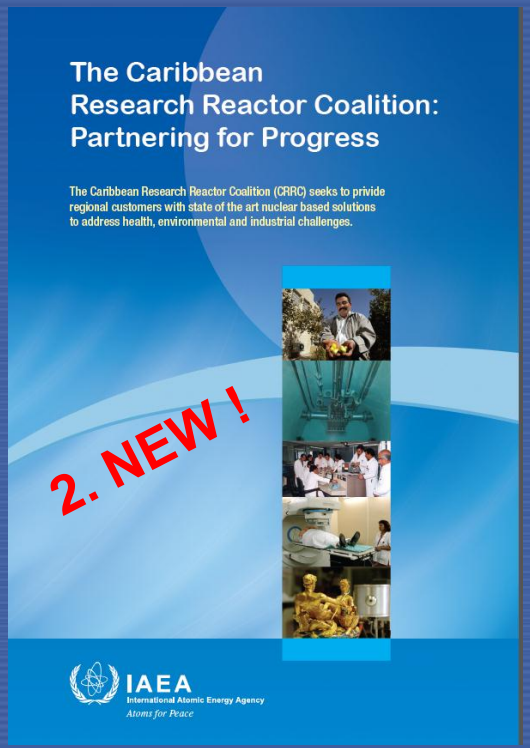
Promotional publications

1. Dedicated brochure on “Research Reactors: purpose and future” has been published in late 2010; ~300 copies distributed during GC 2010
2. Dedicated brochure on “The Caribbean RR Coalition: Partnering for Progress”
3. Dedicated brochure on “Research Reactors in Africa” is in print; to be distributed during RR Conference 2011 in Rabat



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Other Efforts Supporting Enhanced Utilization

- Concept of Centres of Excellence and International User-shared facilities; focus on new high-power high-flux facilities
- Applications and enhanced utilization of small RRs; focus on MNSRs and other RRs with power ~1kW-100kW
- Regional NAA proficiency tests: in Africa 7/11 laboratories performed very poorly; exercise will is extended to Europe (11), Latin-America (7) and will be repeated in Africa (11)
- Regional standardization experiments for neutron imaging: scheduled in Europe, Africa, Asia-Pacific and Latin America (~20 laboratories)
- Enhanced/revised role of RRs in NPP programme development; focus on countries planning NPP and already operating RRs + newcomer Member States
- Periodic RR related lectures at IAEA/ICTP Nuclear Energy Management Schools …

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Thanks for your attention and...

...I wish you a successful Conference!

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