The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

2067-10

Joint ICTP/IAEA Workshop on Irradiation-induced Embrittlement of Pressure Vessel Steels

23 - 27 November 2009

Effects of Mechanical Properties and Mechanisms Governing the Irradiation-induced Embrittlement of Pressure Vessel Steels

L. Kupca
IAEA
Vienna
AUSTRIA

Joint ICTP-IAEA Workshop on

Effects of Mechanical Properties and Mechanisms Governing the Irradiation-induced Embrittlement of Pressure Vessel Steels

hosted by the ICTP
Trieste, Italy, 23-27 November 2009

Ludovit KUPCA

IAEA/NENP/Nuclear Power Engineering Section

IAEA
International Atomic Energy Agency

International Atomic Energy Agency (IAEA)

Atoms for Peace (1953)
addressed by D.Eisenhower, to the 470th Plenary Meeting of the UN GA

- **Founded 1957**
- HQ in Vienna, Austria
- **146 Member States**
- 6 Divisions
- 2300 Staff
- About 300 MEuro Budget
- www.iaea.org

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The Nobel Peace Prize 2005

"for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way"

International Atomic Energy Agency (IAEA)

1/2 of the prize

Vienna, Austria

Founded in 1957

Mohamed ElBaradei

1/2 of the prize

Egypt

Director General of IAEA

b. 1942

IAEA

Pillars of the IAEA

- Promoting Science & Technology

  the world's focal point to mobilize peaceful applications of nuclear science and technology for critical needs in developing countries

- Promoting Safeguards & Verification:

  the world's nuclear inspectorate

- Promoting Safety and Security

  helps countries to upgrade nuclear safety and security

IAEA's 50 Years of Atoms for Peace (2007)

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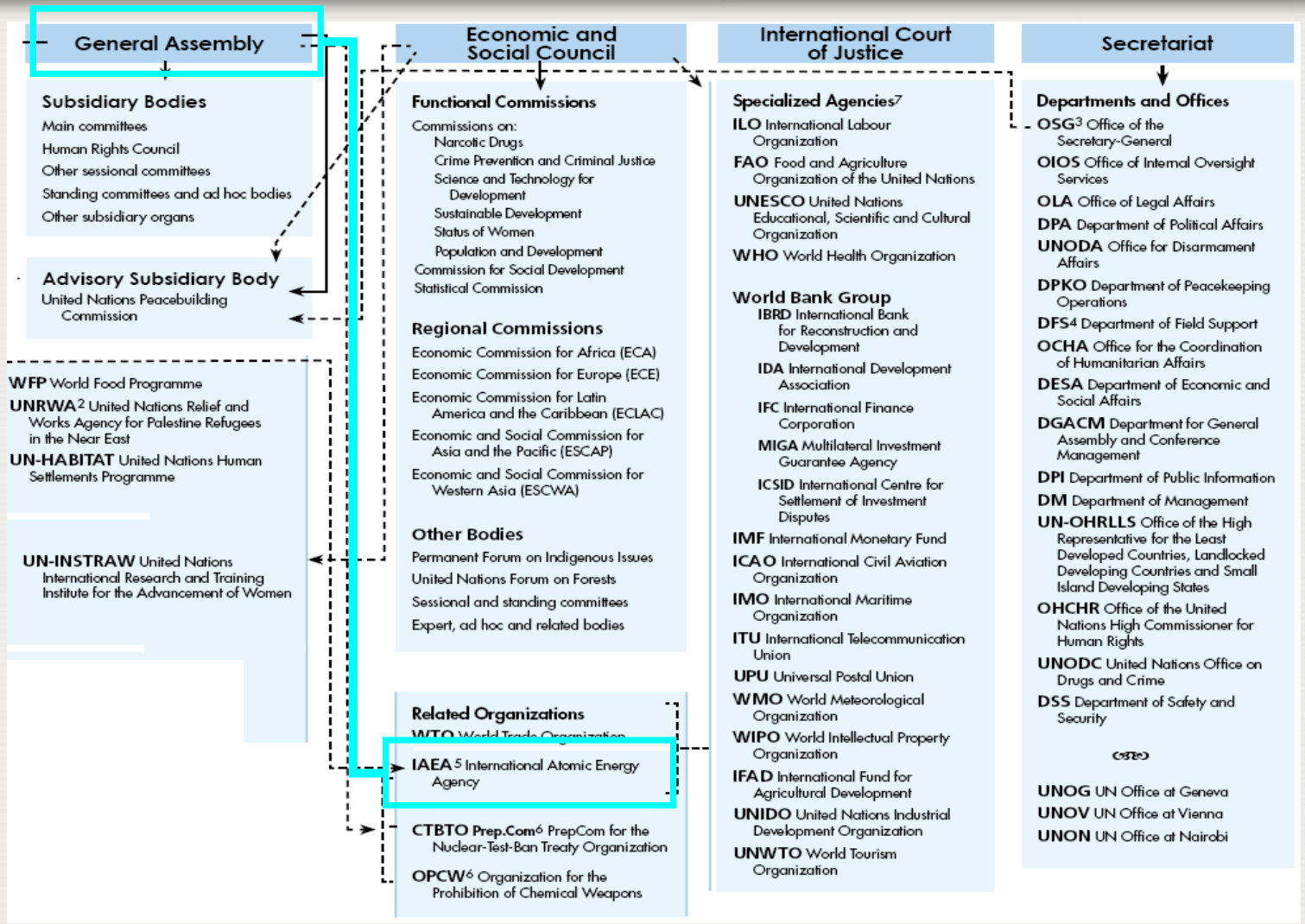
IAEA in UN system



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Education & training activities

The Abdus Salam
International Centre for Theoretical Physics

TU Delft
Delft University of Technology

IAEA
International Atomic Energy Agency

Neutron probing for compositional and structural characterization of materials and biological samples

11 – 15 May 2009

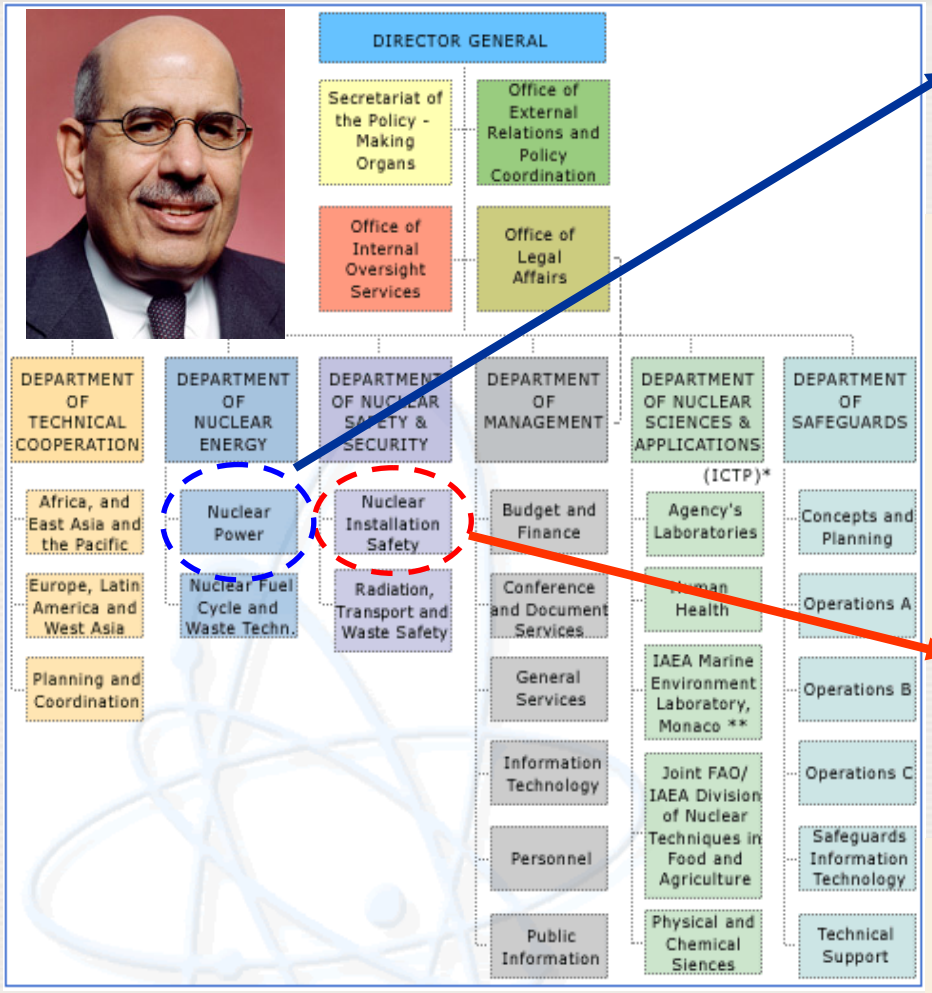
(TU Delft - Reactor Institute Delft, The Netherlands)

in co-operation with
Reactor Institute Delft
and
International Atomic Energy Agency

- **Support of international and regional education and training courses**
- **Cooperation with ICTP and other collaborating centres (ANSTO, RID, Elletra, etc.)**

IAEA
and the next fifty years

IAEA organizational chart



Division of Nuclear Power (NENP)

Activities from technical, performance and economical points of view

- Plant life management (PLiM)
- Ageing management
- Maintenance methodologies, optimisation
- I&C modernization, etc.

Division of Nuclear Installation Safety (NSNI)

Activities from safety point of view

- Safe Long Term Operation
- Ageing management
- Periodic safety review, etc.

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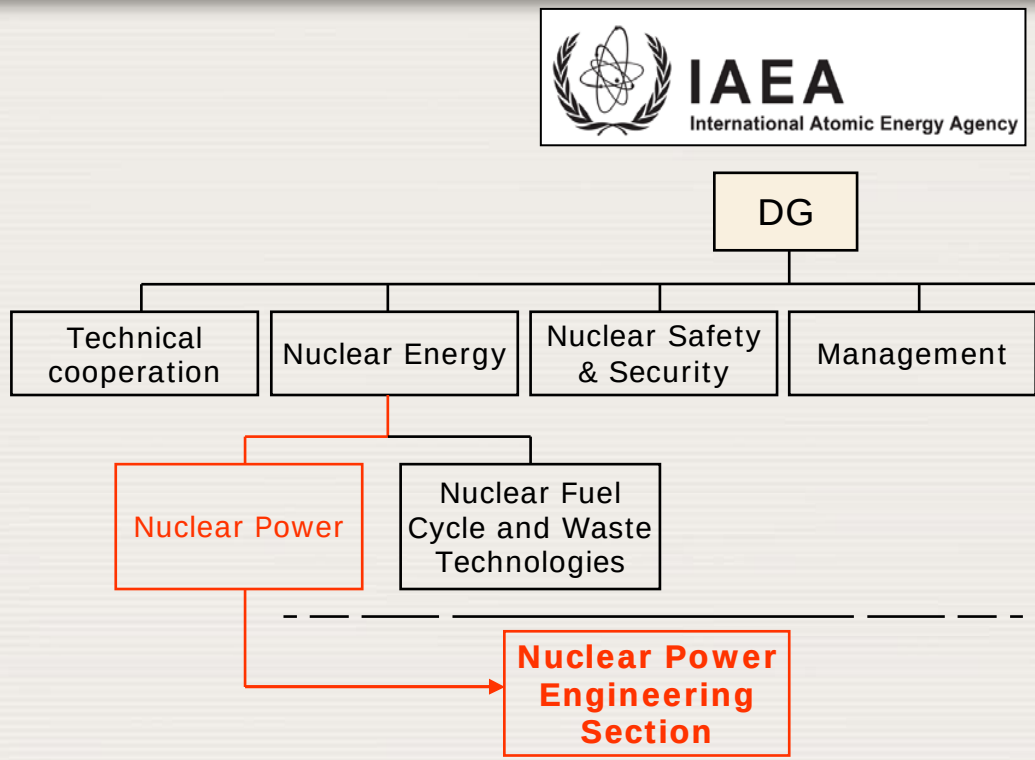
Nuclear Power Engineering Section



THE NUCLEAR POWER ENGINEERING SECTION is responsible for implementation of the Agency's sub-programme on Nuclear Power Plant Operating Performance and Life Cycle Management and Improving Organizational Performance.

1.1.1 Integrated Support for Operating Nuclear Facilities

1.1.1.1 Engineering support for design, operation, maintenance, and plant life management for safe long term operation:

- Integrated Plant Life Management/Long Term Operation of Nuclear Power Plants
- Ageing Management Programme
- Critical systems, structure, component integrity

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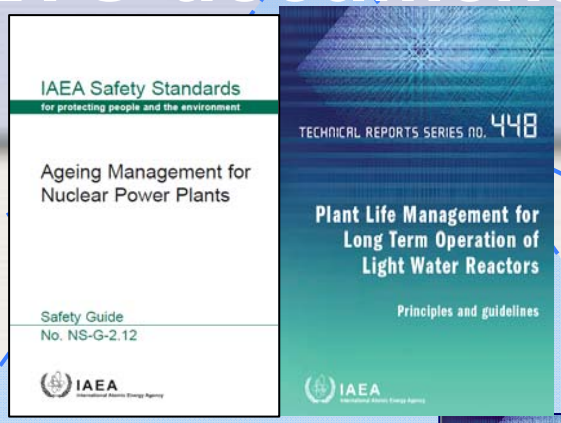
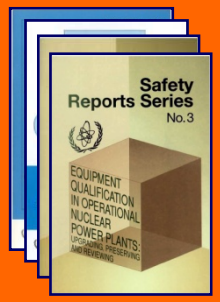
PLiM for LTO document Structure

Level 1
Basic Principles and Objectives



Course material for PLiM for LTO

Programmatic Guidelines (5)



Component Specific(13)

Review guideline

NSNI

RPV and PLiM (8)

Human Ageing Guideline (10)

Maintenance I&C (10)

NENP

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IAEA CRP History on RPV Structural integrity

- **Phase 1 : Irradiation Embrittlement of RPV Steels (1975): 9 Org. from 8 MS.**
- **Phase 2 : Analysis of the Behavior of RPV Steels under Neutron Irradiation (1986) : 10 Org from 9 MS.**
- **Phase 3 : Optimizing RPV Surveillance Programmes and Analyses (2001) 24 Org from 18 MS.**
- **Phase 4 : Assuring Structural Integrity of RPV (2002) : 24 Org. from 19 MS.**
- **Phase 5 : Surveillance Programme Results Application to RPV Integrity Assessment (1999-2003) : 24 Org. from 15 MS.**

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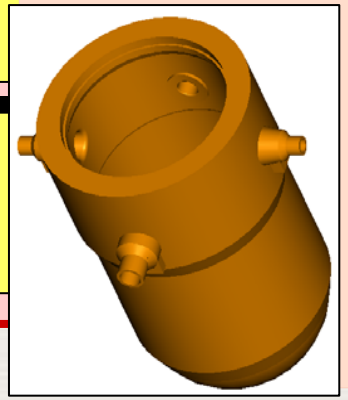
CRP- RPV Structural Integrity since 1975

- **CRP 5 : Surveillance Programme Results Application to Reactor Pressure Vessel Integrity Assessment (1999-2003)**
- **CRP 6 : Mechanism of Ni effect on radiation embrittlement of RPV materials (1999-2003)**
- **CRP 7 : Evaluation of Radiation damage of RPV using IAEA DB on RPV materials (2001 - 2004)**
- **CRP 8 : Master Curve Approach to monitor the Fracture Toughness of RPV in Npps (2005 – 2008)**
- **CRP 9 : Review and Benchmark of calculation methods for structural integrity assessment of RPVs during PTS (2005 - 2008)**



Closed relation with JRC-IE.
Over 100 organizations and institutes
TECDOC -1435, 1441 and 1442, TRS- 429

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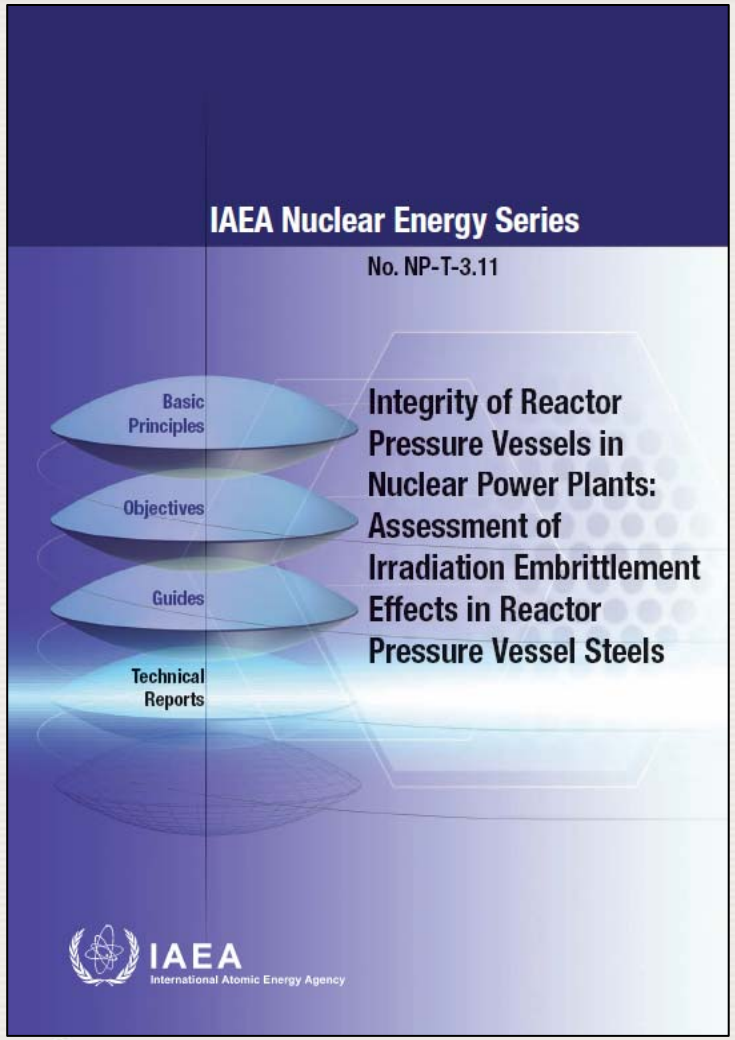
Integrity of Reactor Pressure Vessel In NPPs:
Assessment of irradiation embrittlement effect in RPV steels



- Description of reactor pressure vessels
- Effect of irradiation of mechanical properties
- Mechanisms governing the irradiation induced embrittlement of LWR RPV
- Assessment of the mechanical properties of operating RPVs
- Effects of irradiation on RPV Operation

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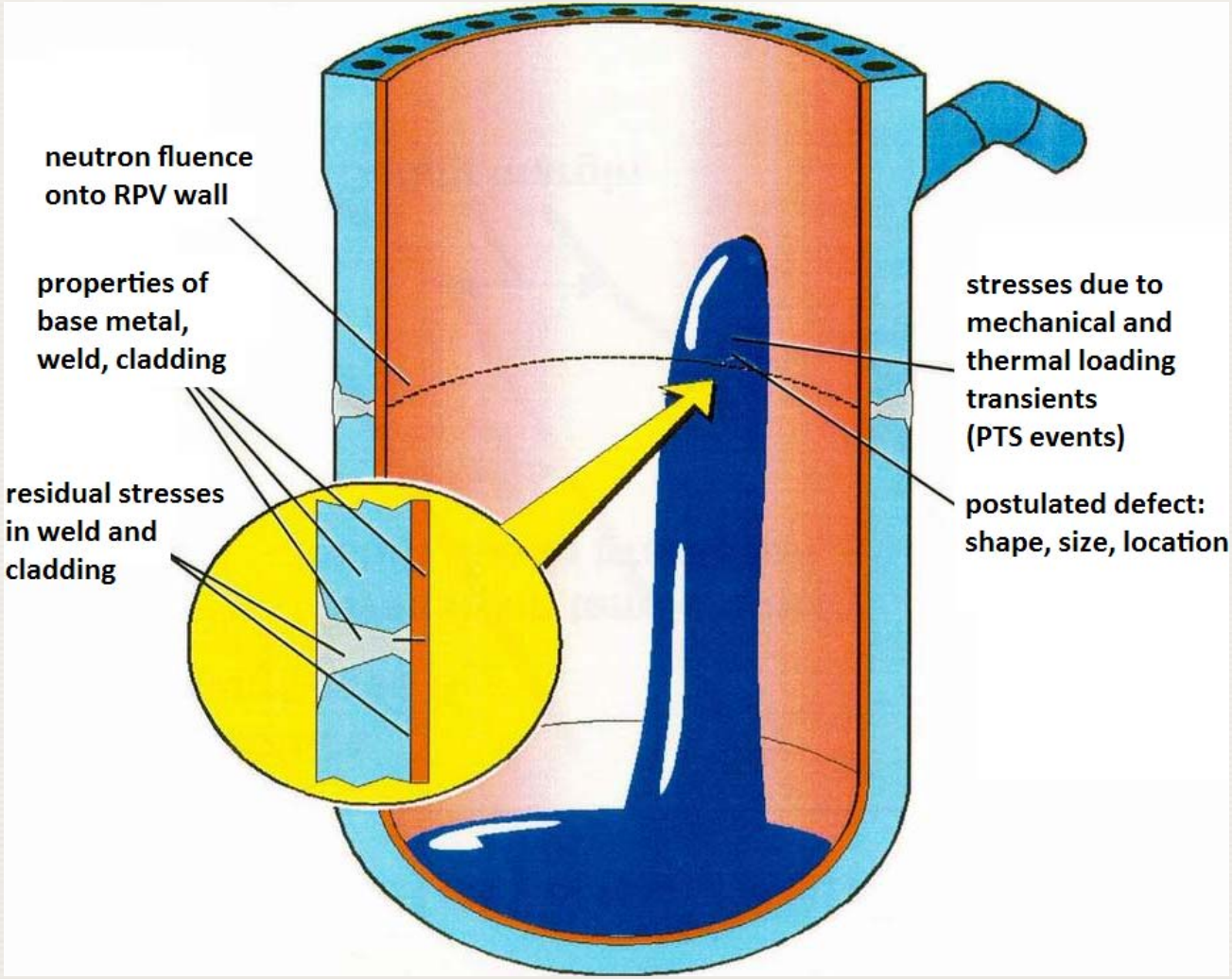
Key elements of RPV integrity



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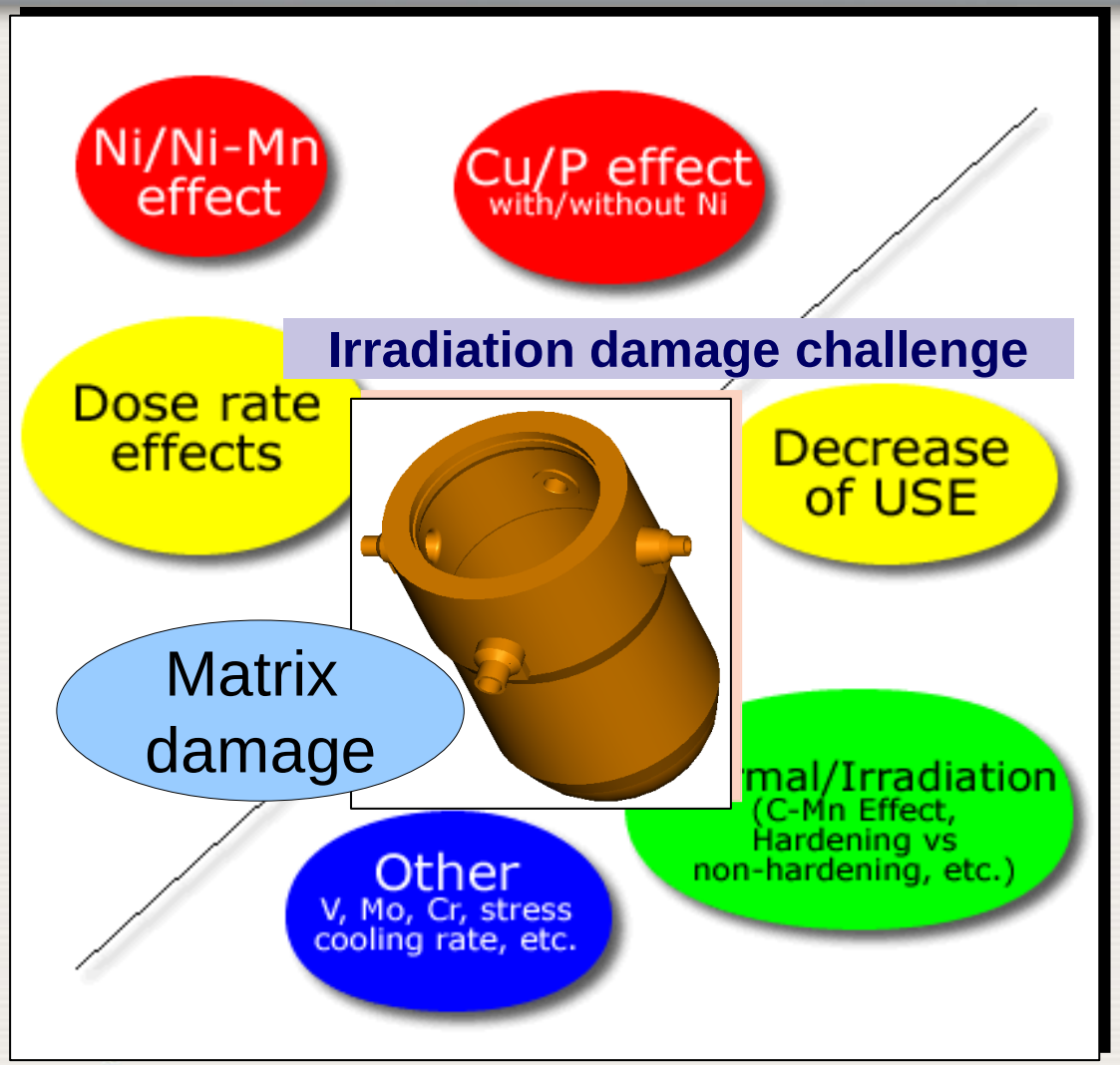
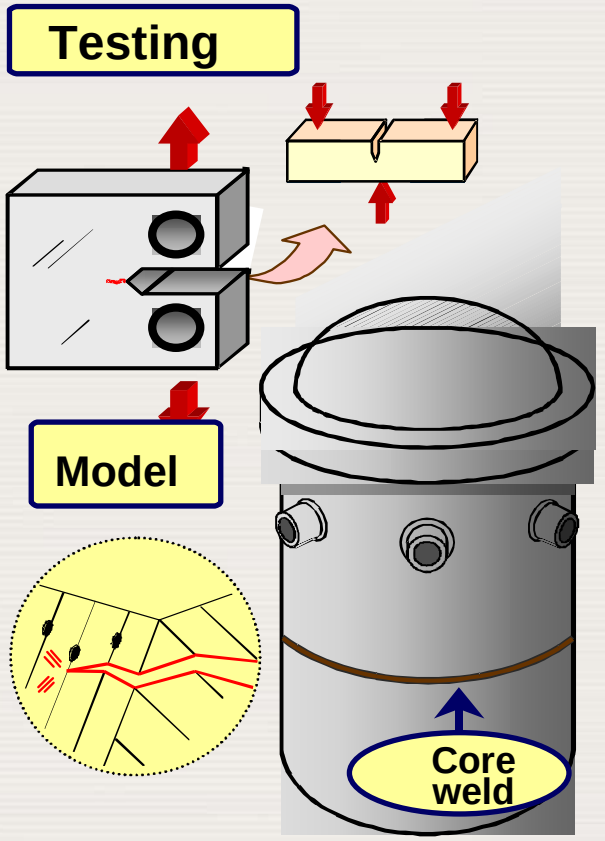
RPV integrity under irradiation damage





ICTP-IAEA Workshop

Main purpose:

- Provide state-of-the-art information about modern nuclear research reactor based techniques used for simulation and studies of radiation damage in reactor core structural materials
- Overview of advanced physical models and computational codes developed for prediction of high-dose radiation effects.

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ICTP-IAEA Workshop

This event provides unique opportunity to get consistent information on basic physical processes of radiation damage as well as related R&D activities.

- 20 lectures by 4 experts
- Poster session for participants
- Selected attendees can give short oral presentation
- Participants will get official CERTIFICATE however full presence during the workshop is required

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Thank your for your attention!