Beyond 60 years operations

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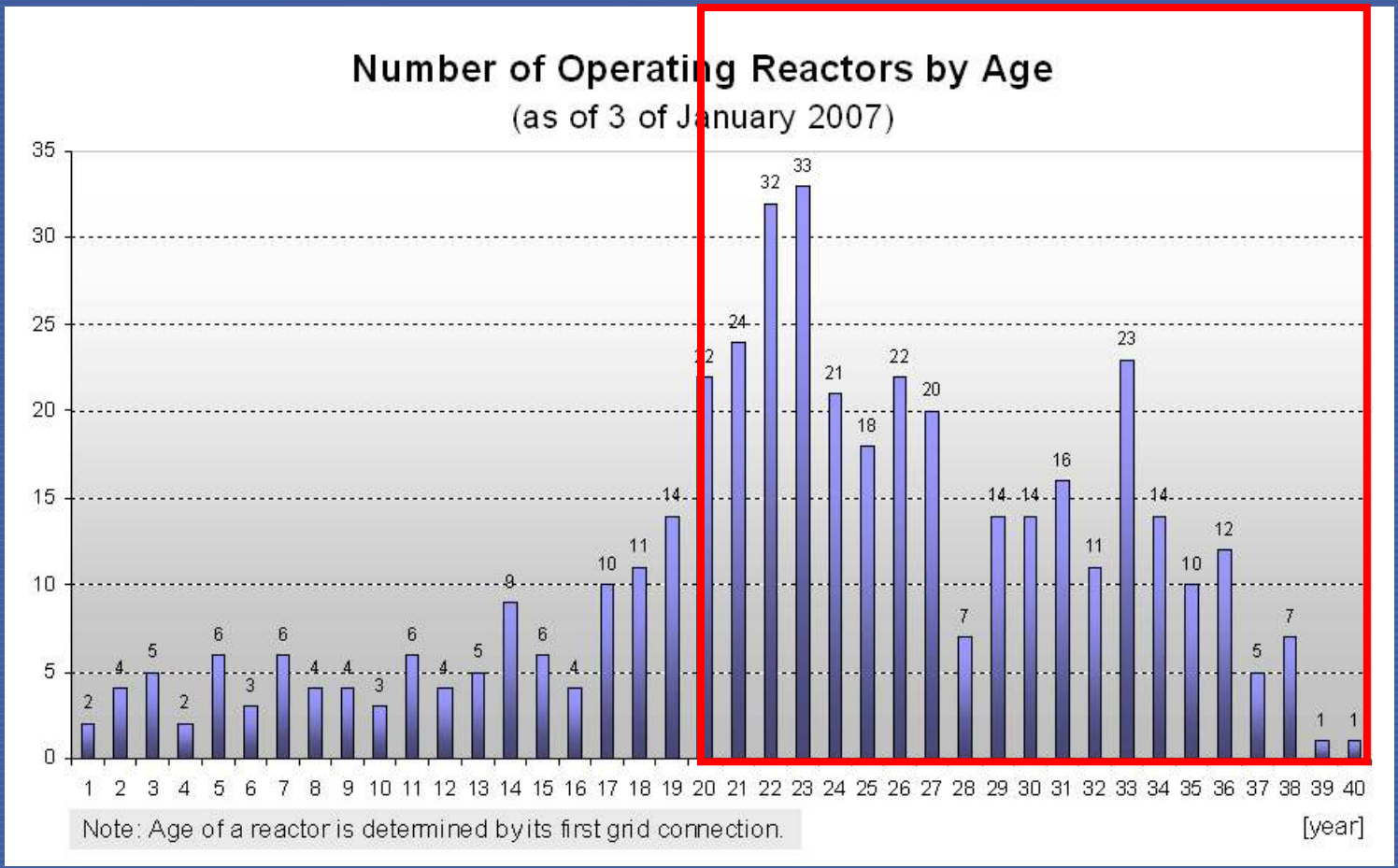
IAEA
International Atomic Energy Agency

Operating Reactor by age (as of June. 2007)



Total : 439 + 20 years : 327 - 20 years : 112

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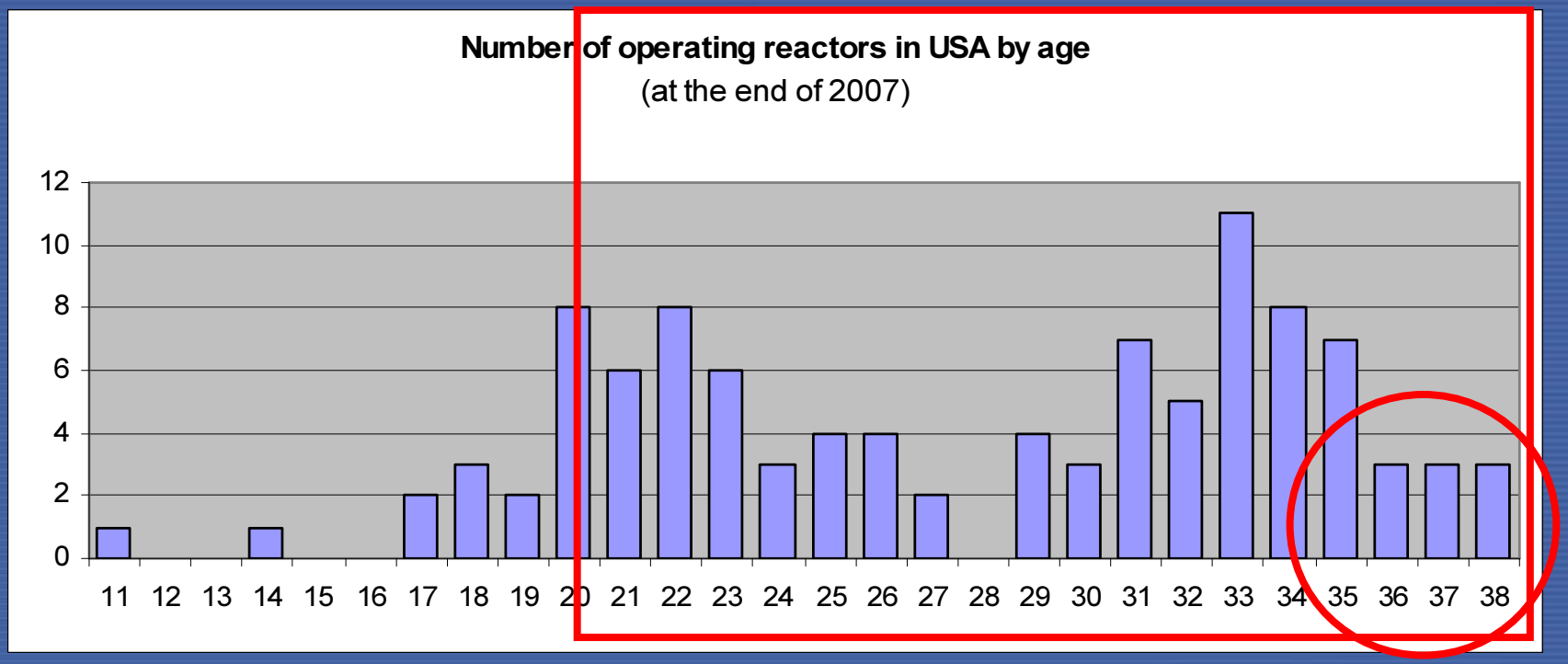
USA NPPs Operating Reactors



- More than 20 years : 95 Units
- More than 30 years : 50 Units

After 10 years

(2017)

40~ 48 years: 50 Units

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Looking back…

- The 1st PLiM symposium in 2002 in Hungary.
  - 138 participants from 30 countries and from 3 International organizations
- The 2nd PLiM symposium
  - 175 contributions, keynotes, papers and posters were submitted.
  - 270 participants, 3 observers from 35 Member States and 3 international organizations.
  - 30 non registration

This conference is far larger than the 2002 PLiM Symposium, a clear indication of the growing importance of this topic

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Main recommendations and findings

- Uncompromising safety culture
- Power plant units are improved continuously instead of one-time major investments
- Technical development is considered to meet latest safety requirements.
- Own and other plants operational experiences and best practises are utilized
- PSA, cost-benefit, and probabilistic availability analysis methods are applied
- Well-functioning contacts to vendor and consulting companies as well as to research institutes and to regulatory body

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Main recommendations and findings

- Need more proactive Ageing Management
  - Need clear requirements to cover full life
- Knowledge management :
  - Keep the valuable experiences from seniors specialists
  - Maintain the core knowledge that must be in place to operate existing plants safely and economically,
- Competition between operating Npps and new Npp

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Recurring management and leadership issues

- Management becomes over confident or complacent.
- Ineffective evaluation and use of operating experience.
  - Not establishing or enforcing management standards and expectations.

- Management becomes over focused on production, sometimes at the expense of safety.
- Public and other stakeholders lost trust.

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Where are we now for beyond 60 years operation?

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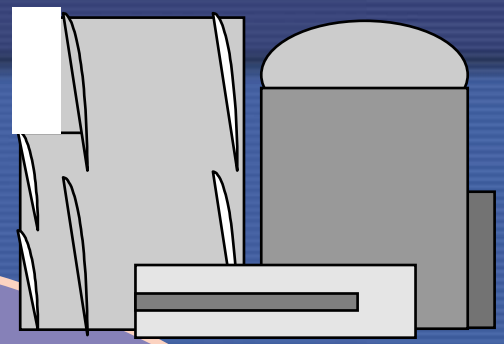
Technical Documents Matrix

Structural, system and component (SSC) integrity is at the core of NPP management



Monitoring, Diagnosis and Prognosis Technologies for Optimization of Maintenance

IAEA Safety Standards and Guidance Documents on Plant Life Management and AM Programme

Safety Requirement

Safety of NPP Design NS R-1 (to be revised)

Safety of NPP Operation NS R-2 (being revised incorporating AM)

Safety Guide

DS 382
under developing

Safety Guide on AM

Safety Guide on PSR (to be revised)

Safety Guide on MSI

Safety Guide on Personal Qualification

Tech. Guidelines

Programmatic Guidelines (5)

Component Specific Guidelines (13)

AMP Review guideline (1)

Keep updating

NSNI

RPV and PLiM (8)

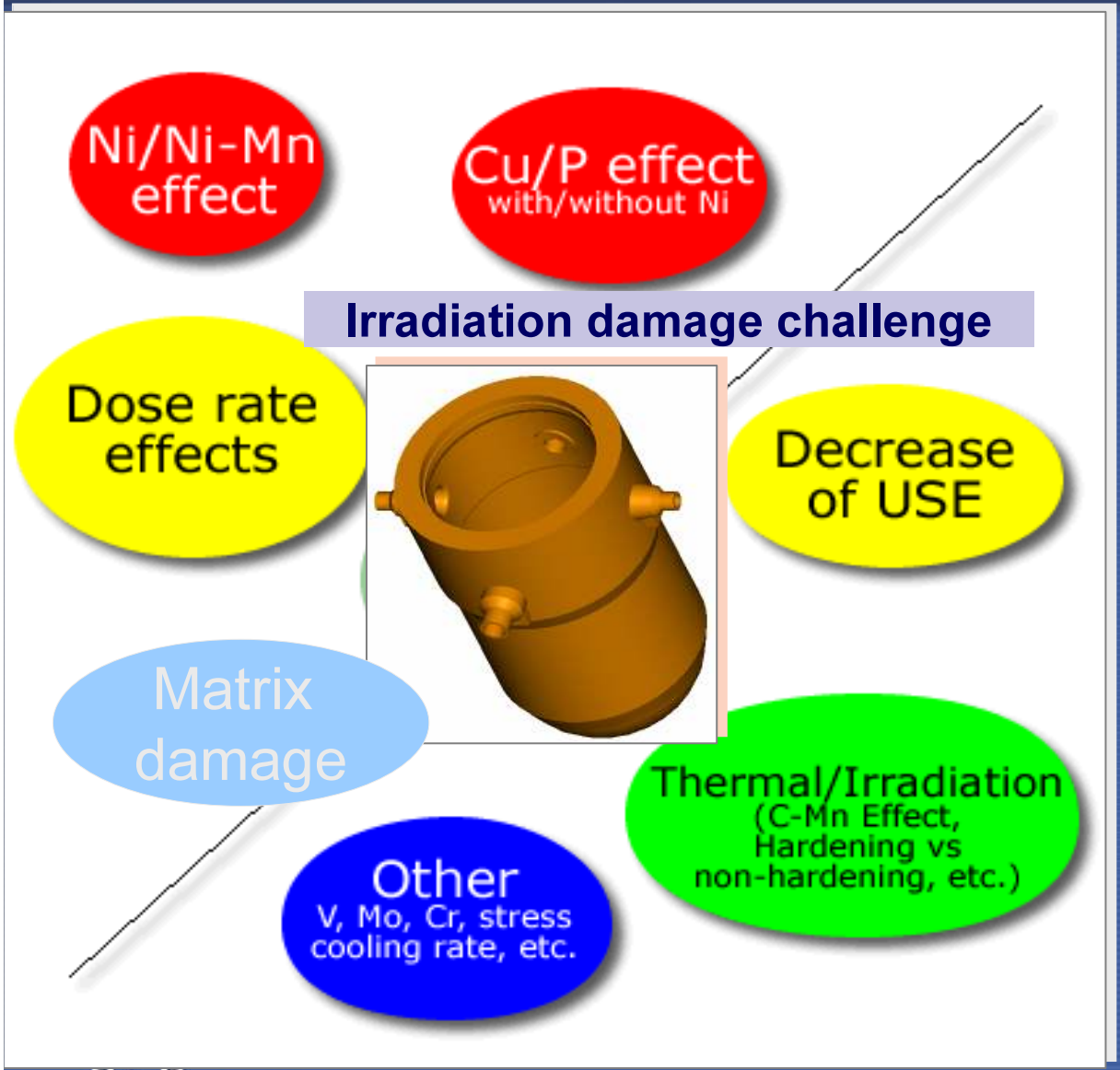
Human Ageing Guideline (10)

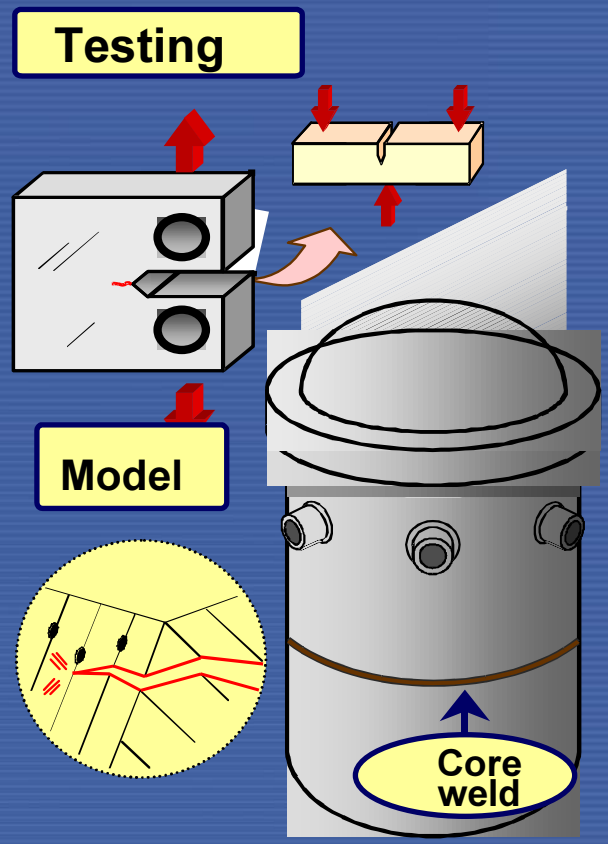
Maintenance I&C (10)

Keep updating

NENP

RPV integrity under irradiation damage





Major concerns issues for more 20 years

- Safety and performance Improvements (Plant Modifications, Ageing, Periodic Safety Review etc.)
- Integrity of SSCs
- Ageing Management

- Safety impact of further reductions in safety margins.
- Optimization of O&M
- Advanced Surveillance, Diagnosis and Prognosis Techniques for System Health monitoring in NPPs
- Advanced I&C

- Lack of Industry capabilities

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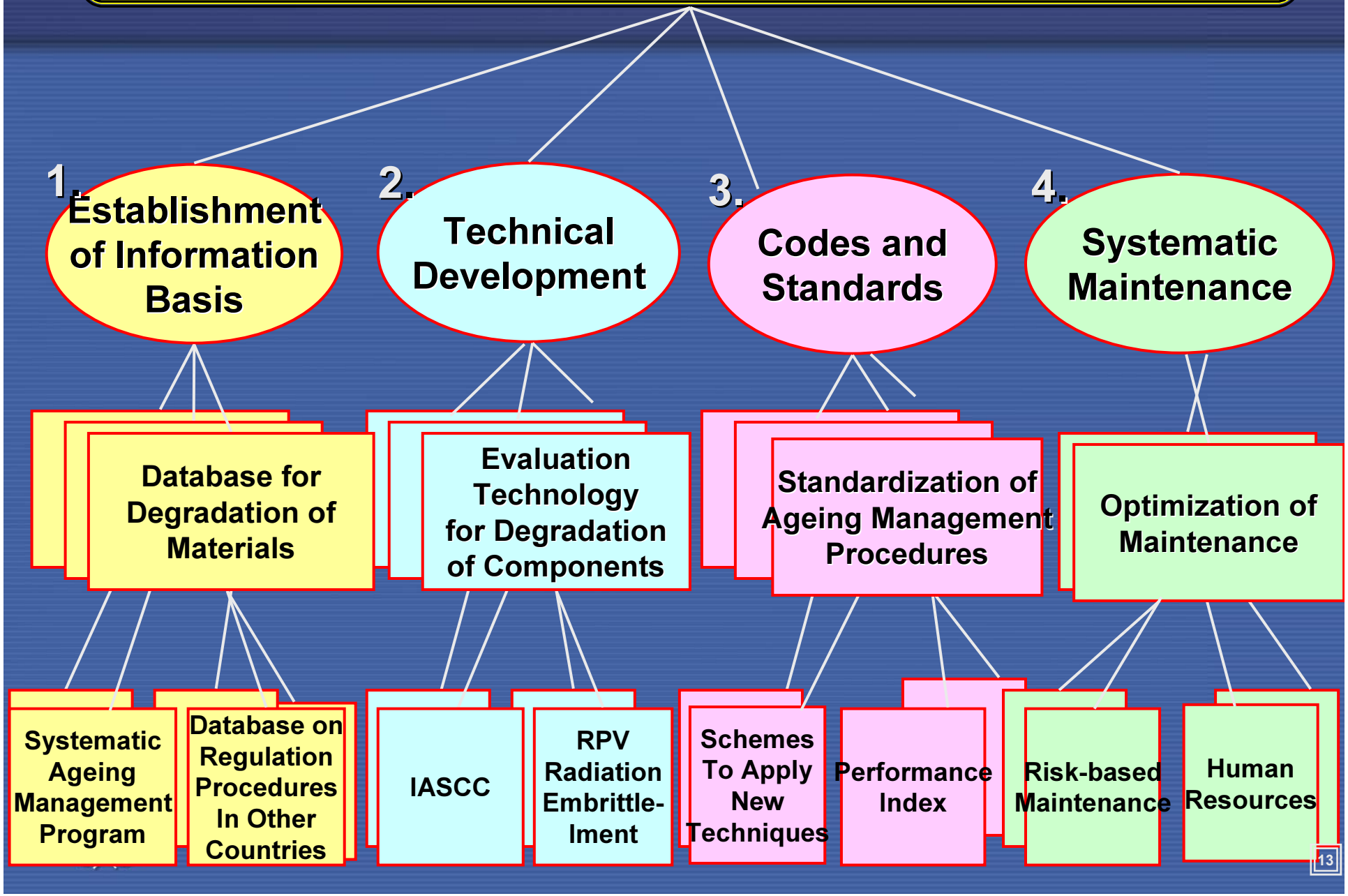
To Keep Safety and Reliability of Nuclear Power Plants for Long Term Operation



Strategy Maps for Ageing Management

4. Systematic Maintenance

3. Establishment of Information Basis

2. Establishment of Codes and Standards

1. Safety Research to Solve Ageing Issues

Aging phenomenon	Current Status	40th to 50th year	Long-life, next-generation reactor
Irradiation embrittlement	* Countermeasures are being taken by rule of thumb based on plant data.	* Predication methods and monitoring technology will be upgraded.	* Advanced designs will be developed based on past operating experience.
Stress corrosion crack	* Countermeasures suited to materials in use are being taken. * Database is being constructed.	* Use of SCC-resistant materials will be ensured. * Database will be constructed.	* Simulation methods will be established. * ISI technology will be upgraded.
Fatigue	* Countermeasures suited to materials in use or environment are being taken, and database is being constructed.	* Countermeasures suited to materials in use or environment will be taken, and database will be constructed.	* Countermeasures suited to materials in use or environment will be taken, and database will be constructed.
Wall thinning	* Countermeasures suited to materials in use are being taken, and database is being constructed.	* Mechanism-based predication methods will be established. * Risk-based maintenance methods will be established.	* Monitoring technology will be upgraded.
Deteriorated cable insulation	* Countermeasures suited to materials in use are being taken. * Database is being constructed.	Deterioration diagnosis technology will be upgraded.	* Monitoring technology will be upgraded.
Decreased strength of concrete	Intensive study is being made on scarcely known fields.	The reliability of integrity evaluation methods will be improved or enhanced. CCV integrity evaluation methods will be established.	* Past records of performance will be reflected in the maintenance technology and durability designs for new plants. * Recycling methods will be established for replaced structures and materials.

PLiM Approaches for Long Term Operation

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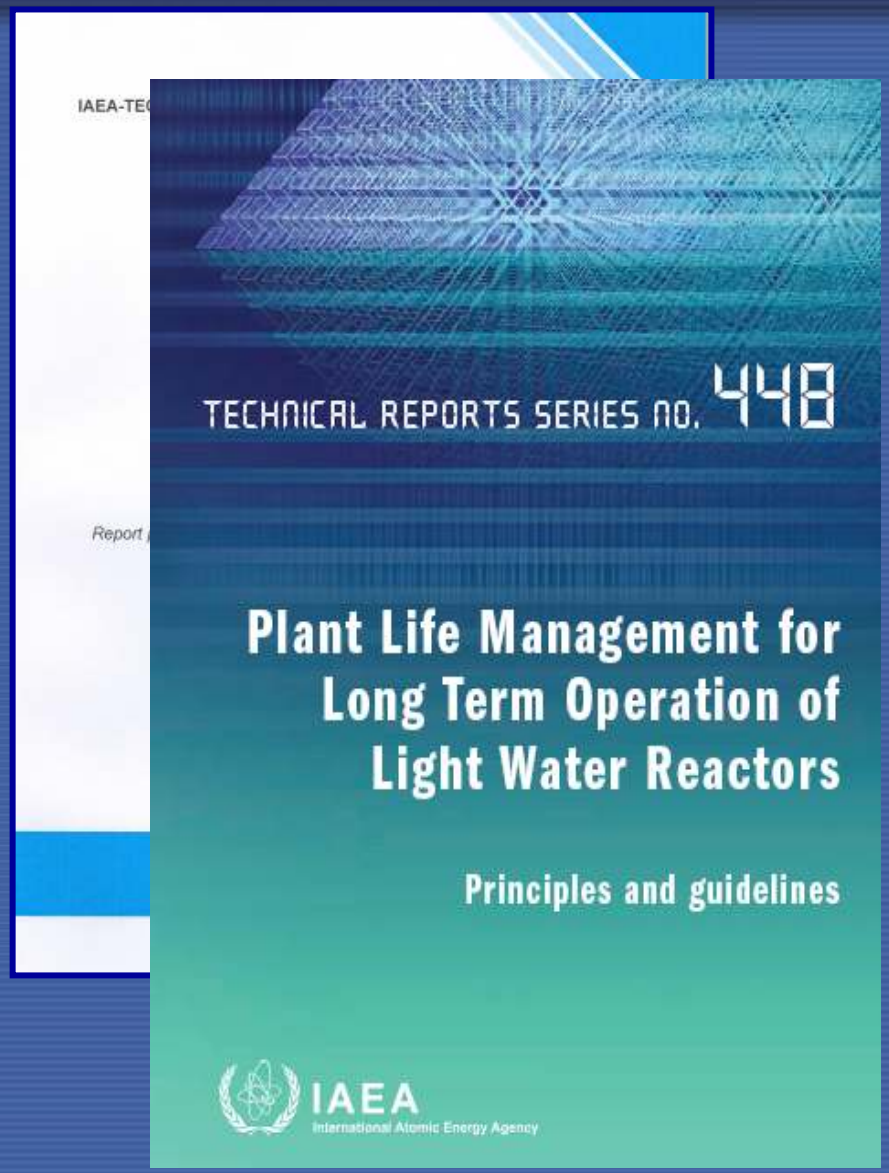
- **Country Reports :**
  - For LWR : Belgium, Bulgaria, Czech, Hungary, Japan, Germany, France, Korea, Russia, Slovakia, Spain, Switzerland, USA
  - For PHWR: Argentina, Canada, India, Korea, Pakistan, Romania