

# Overview of Worldwide Nuclear Decommissioning

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International Atomic Energy Agency

12<sup>th</sup> December 2014

International Seminar

*Nuclear decommissioning : an opportunity  
for global and sustainable development*

Milan, Italy



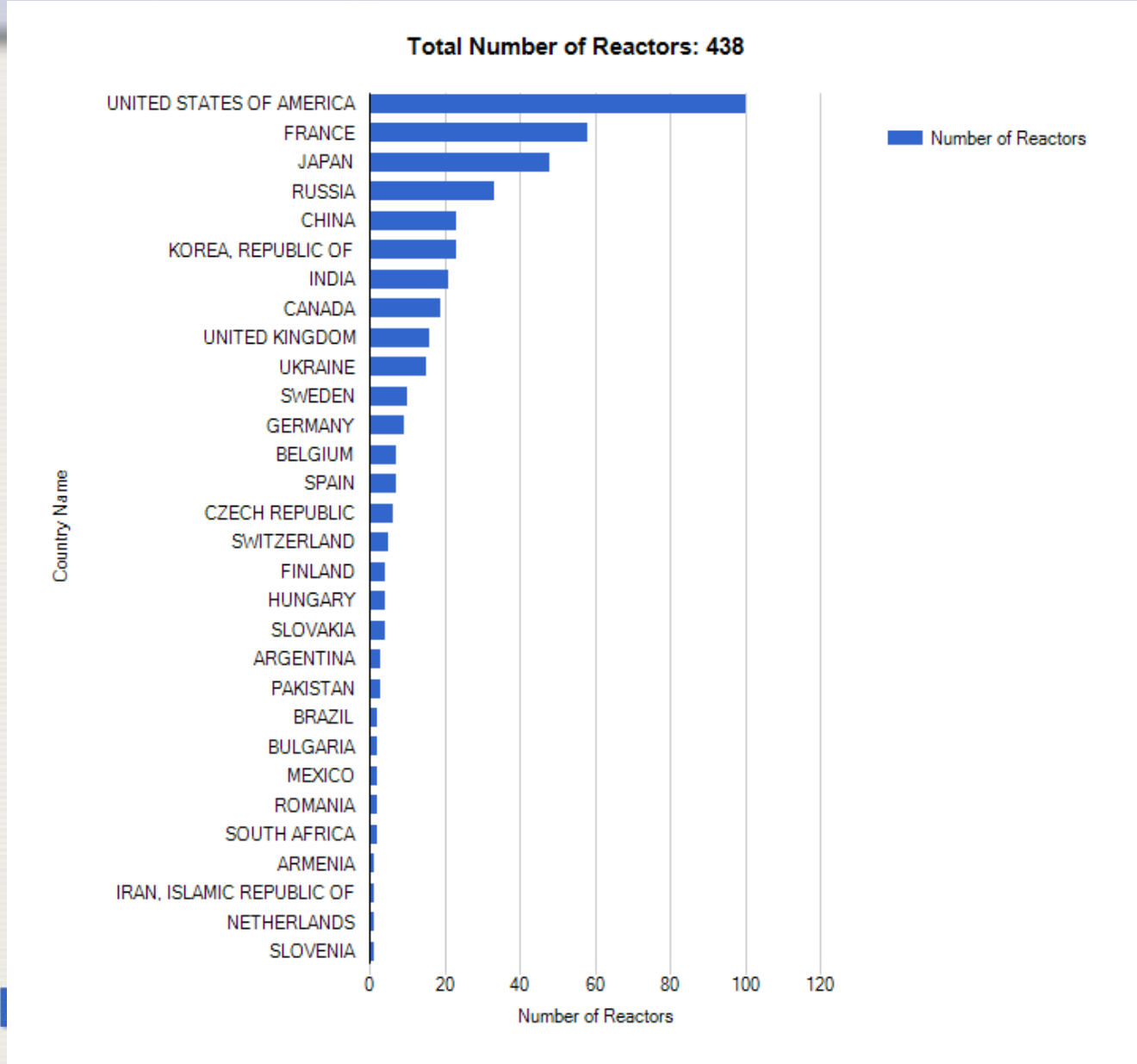
**IAEA**

International Atomic Energy Agency

# Agenda

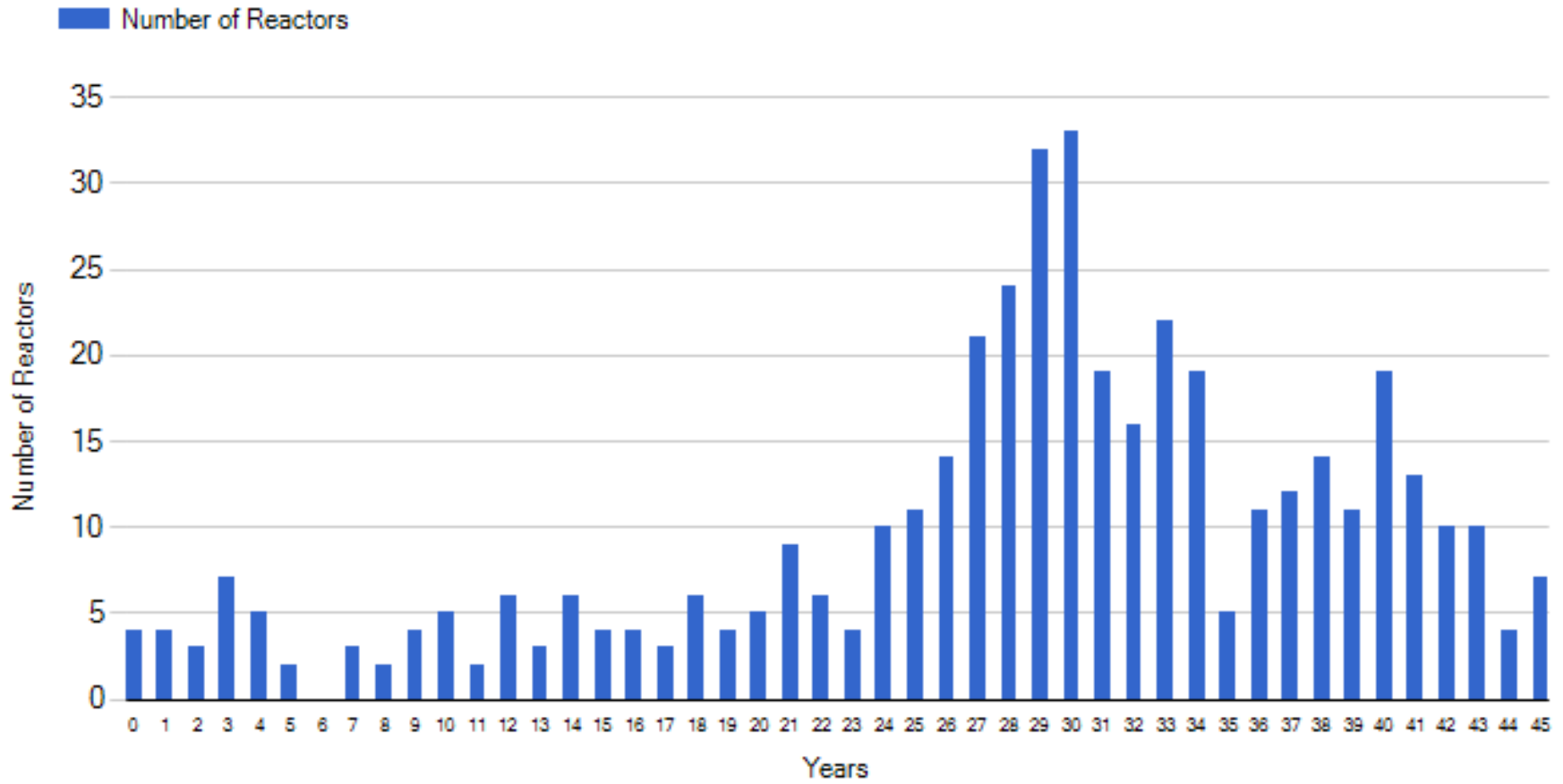
- ❑ Global Statistics on NPPs
- ❑ Some Examples of Good Progress in Europe
- ❑ IAEA Activities to Advance Decommissioning Programmes
  - ❑ CIDER Project
  - ❑ New International Project on Accident Damaged Facilities
  - ❑ International Conference on Decommissioning and Environmental Remediation

# Operational Reactors Worldwide – by country

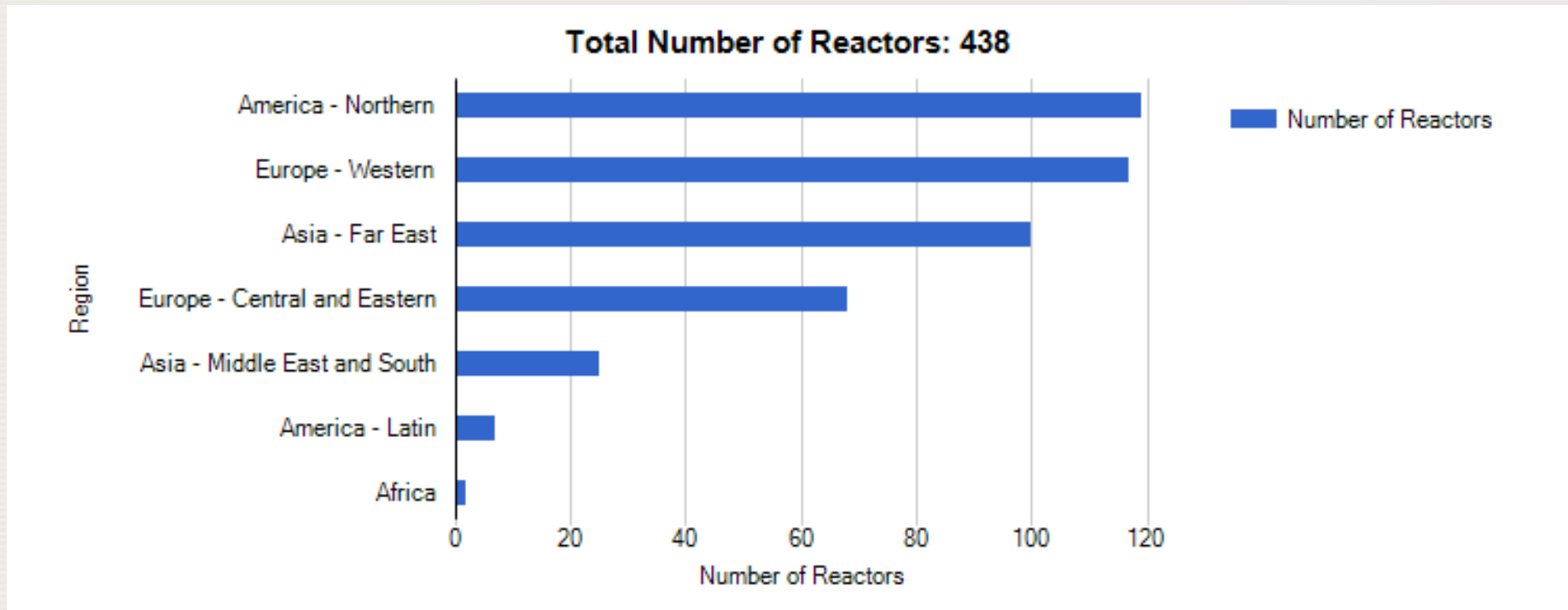


# Operational Reactors Worldwide – by age

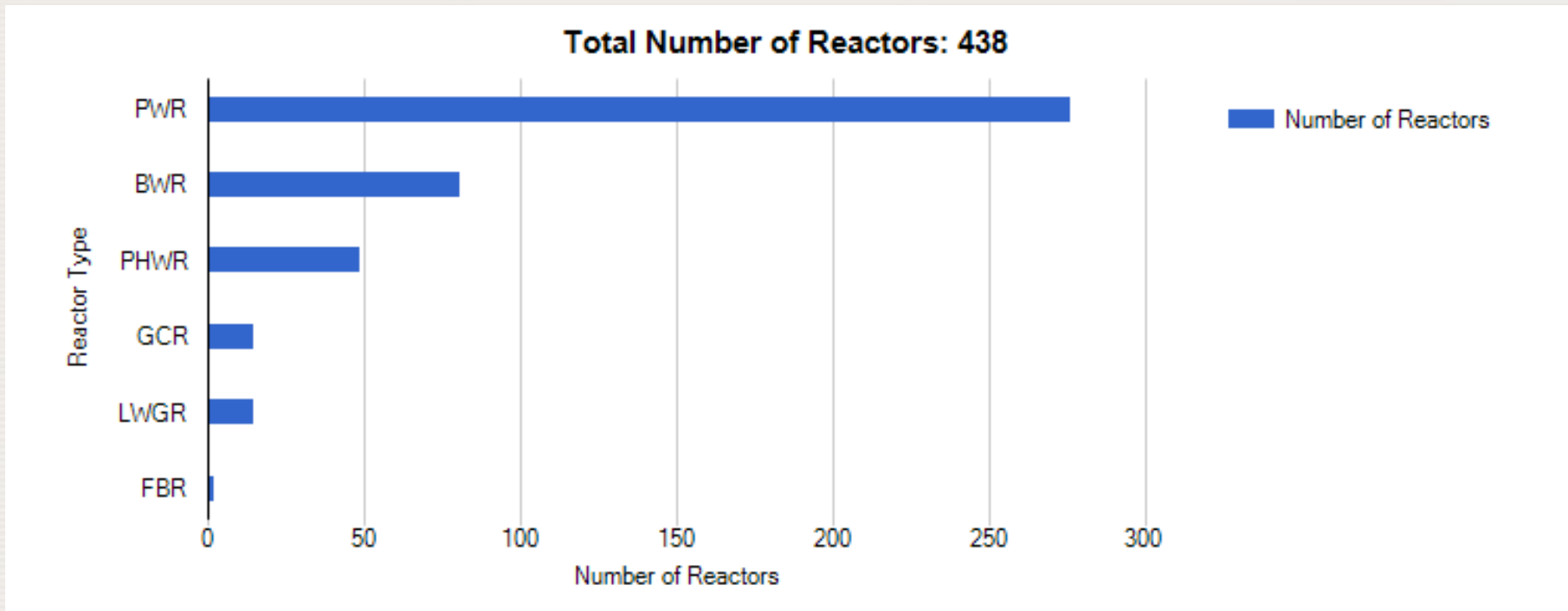
Total Number of Reactors: 438



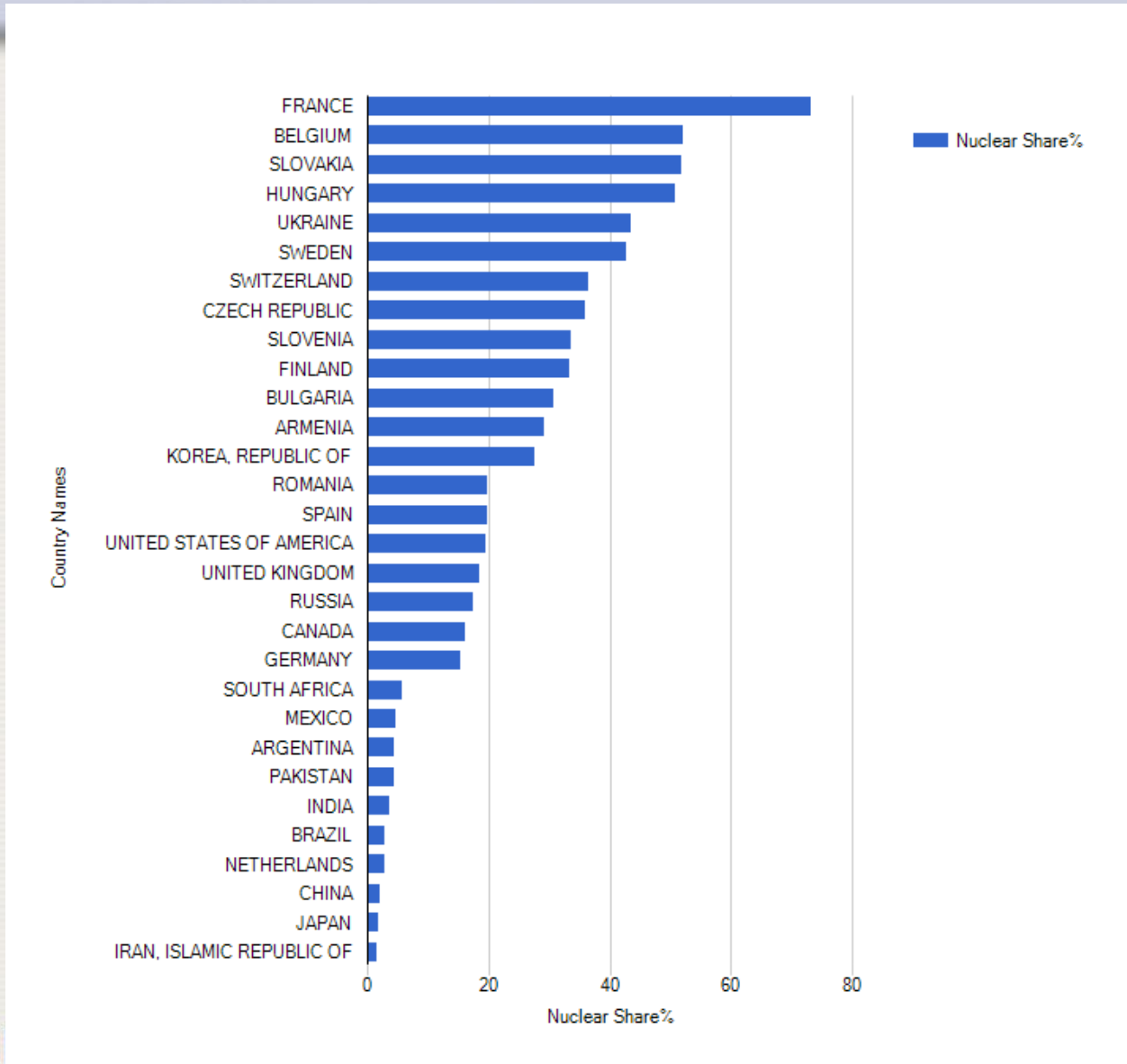
# Operational Reactors Worldwide – by region



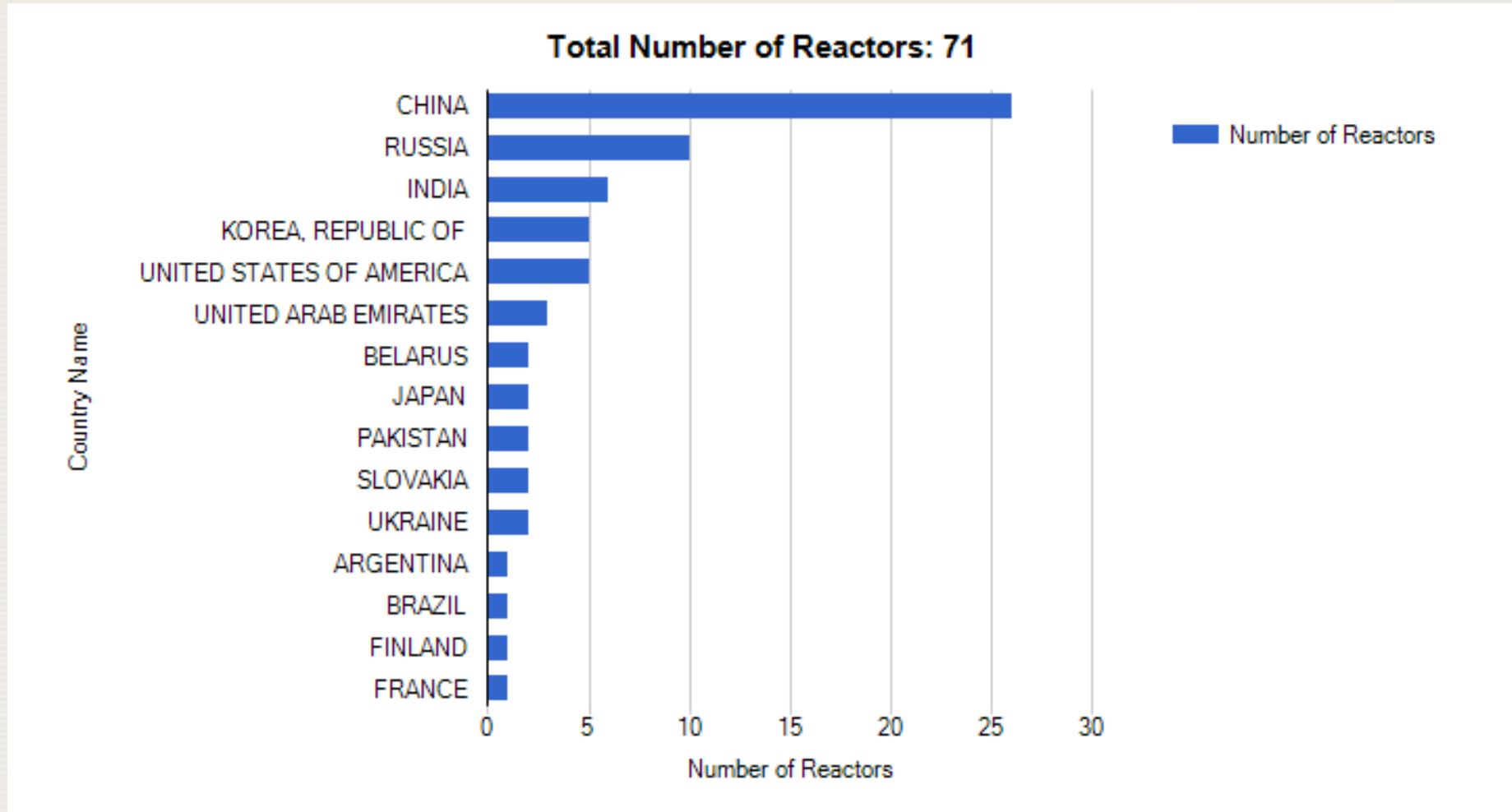
# Operational Reactors Worldwide - by type



# Nuclear Share of Electricity – by country

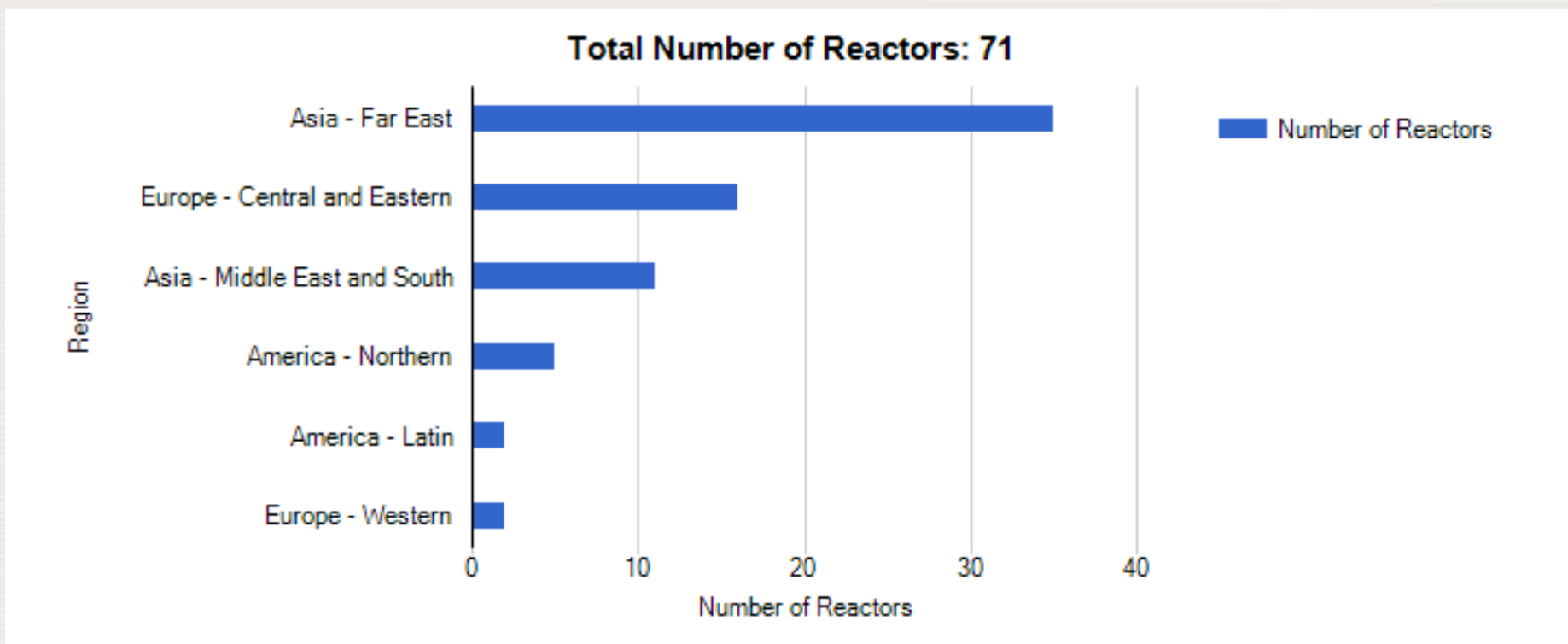


# Construction of Reactors Worldwide – by country

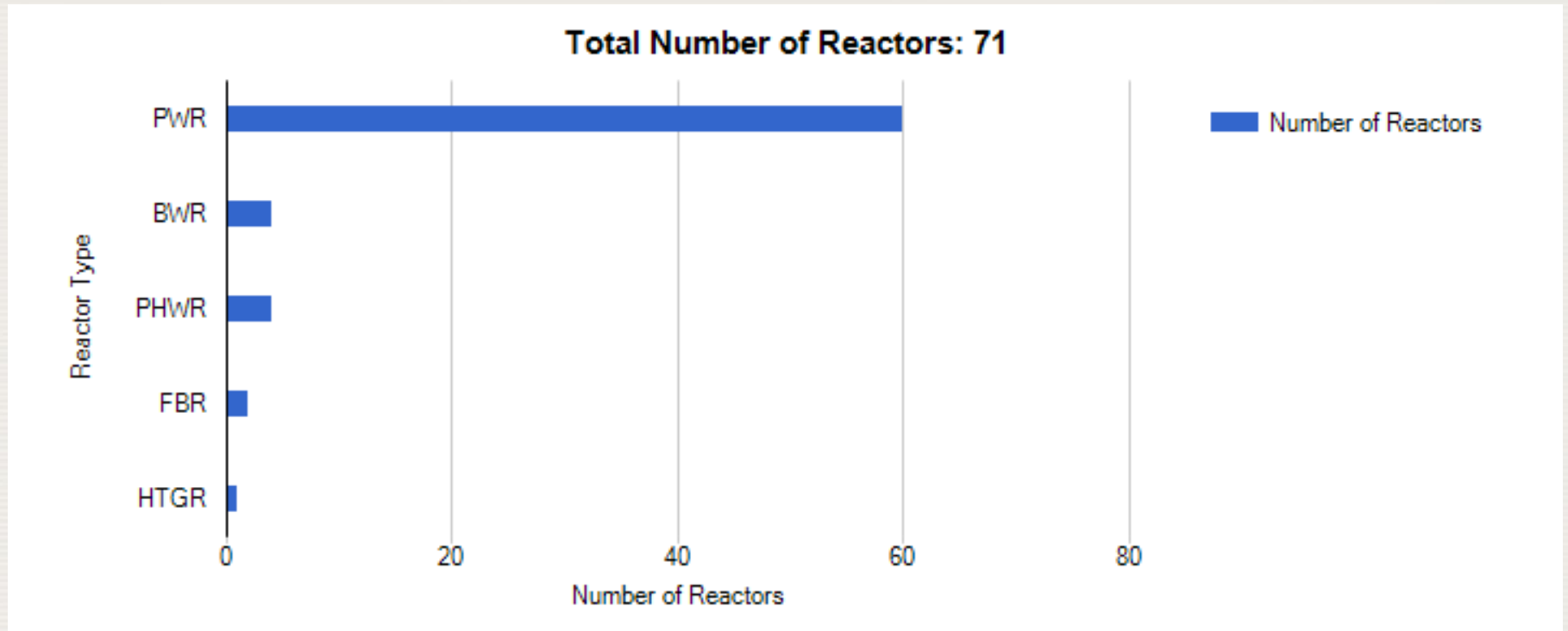




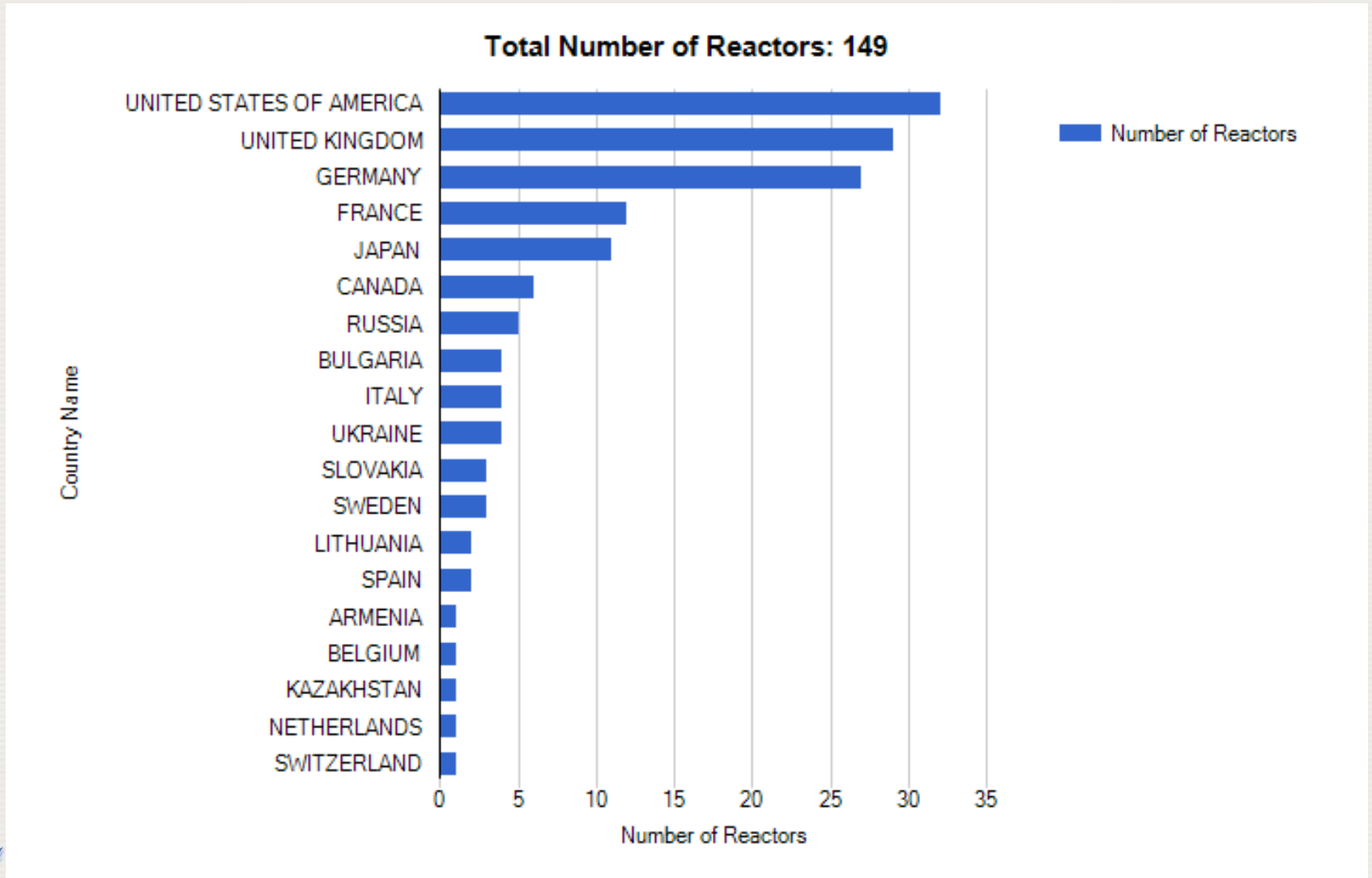
# Construction Reactors Worldwide – by region



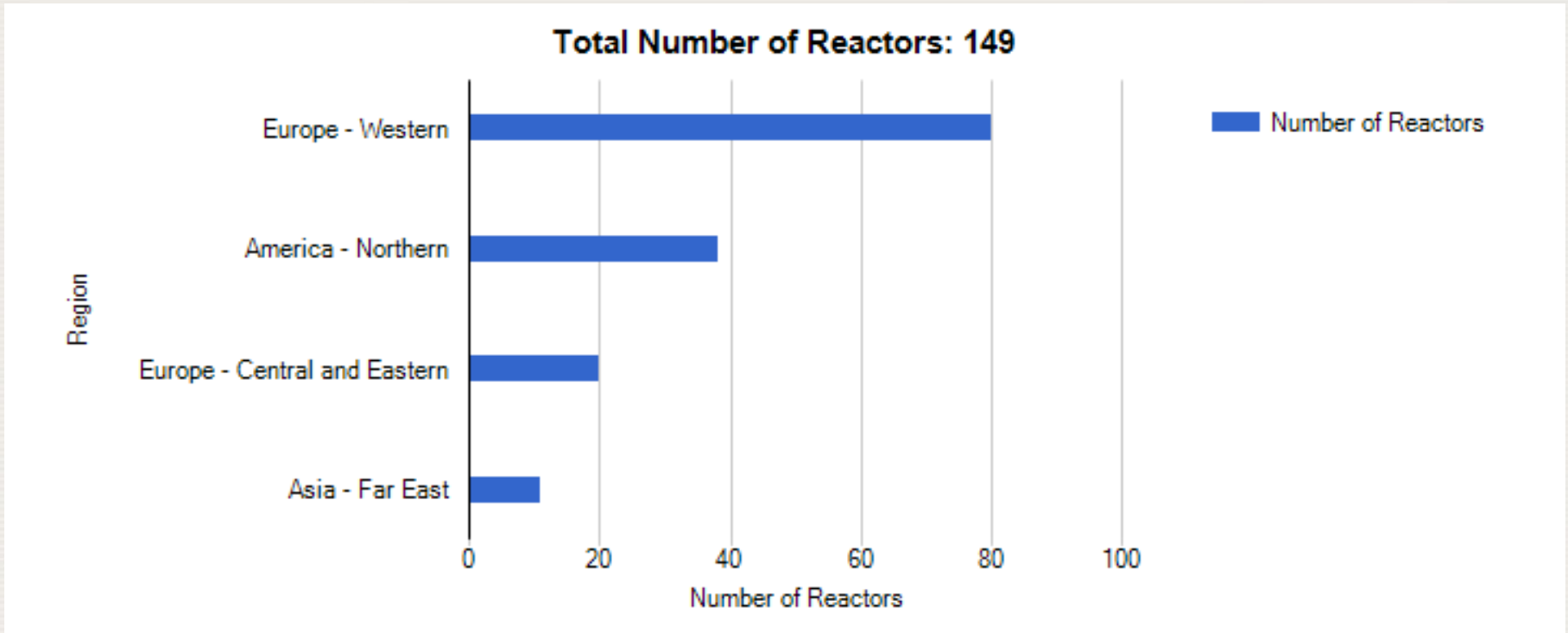
# Construction Reactors Worldwide – by type



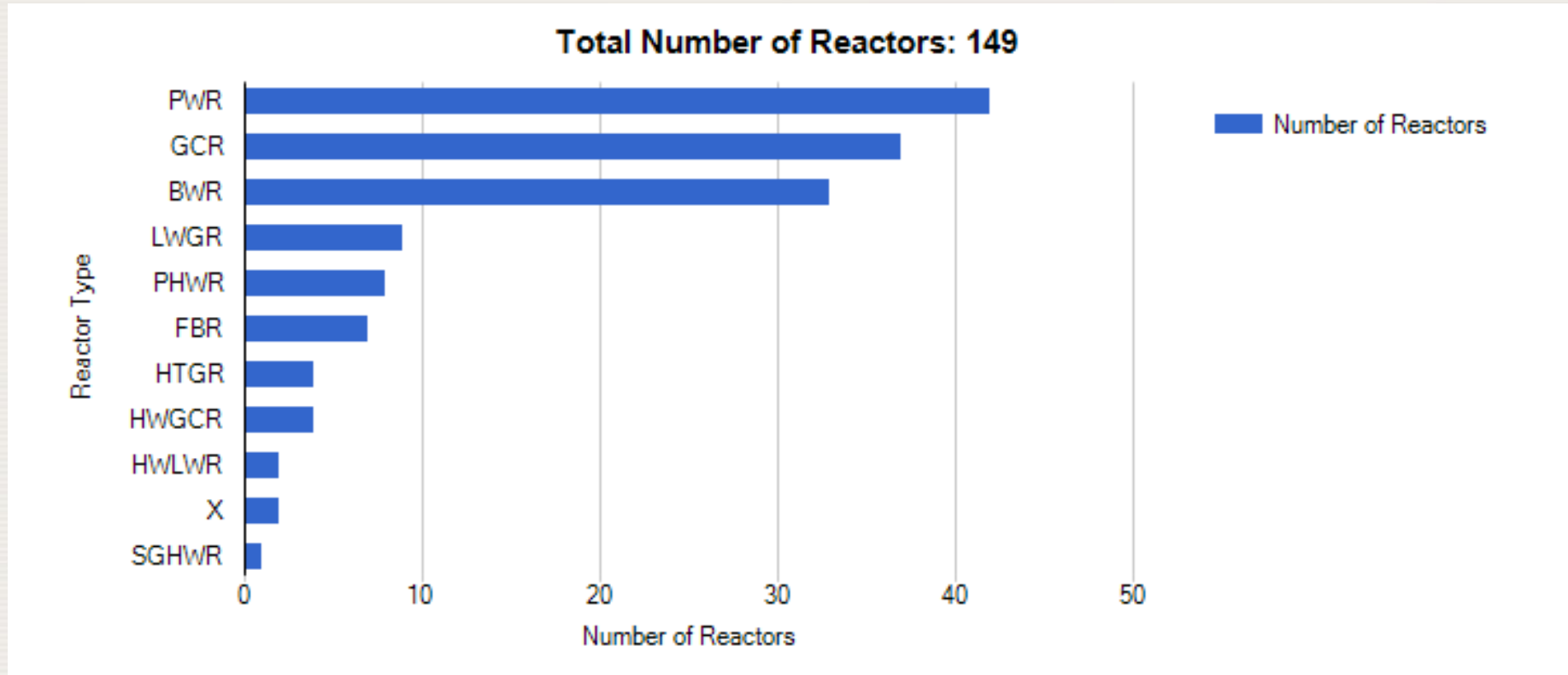
# Permanently Shutdown Reactors Worldwide – by country



# Permanently Shutdown Reactors Worldwide – by region



# Permanently Shutdown Reactors Worldwide – by type

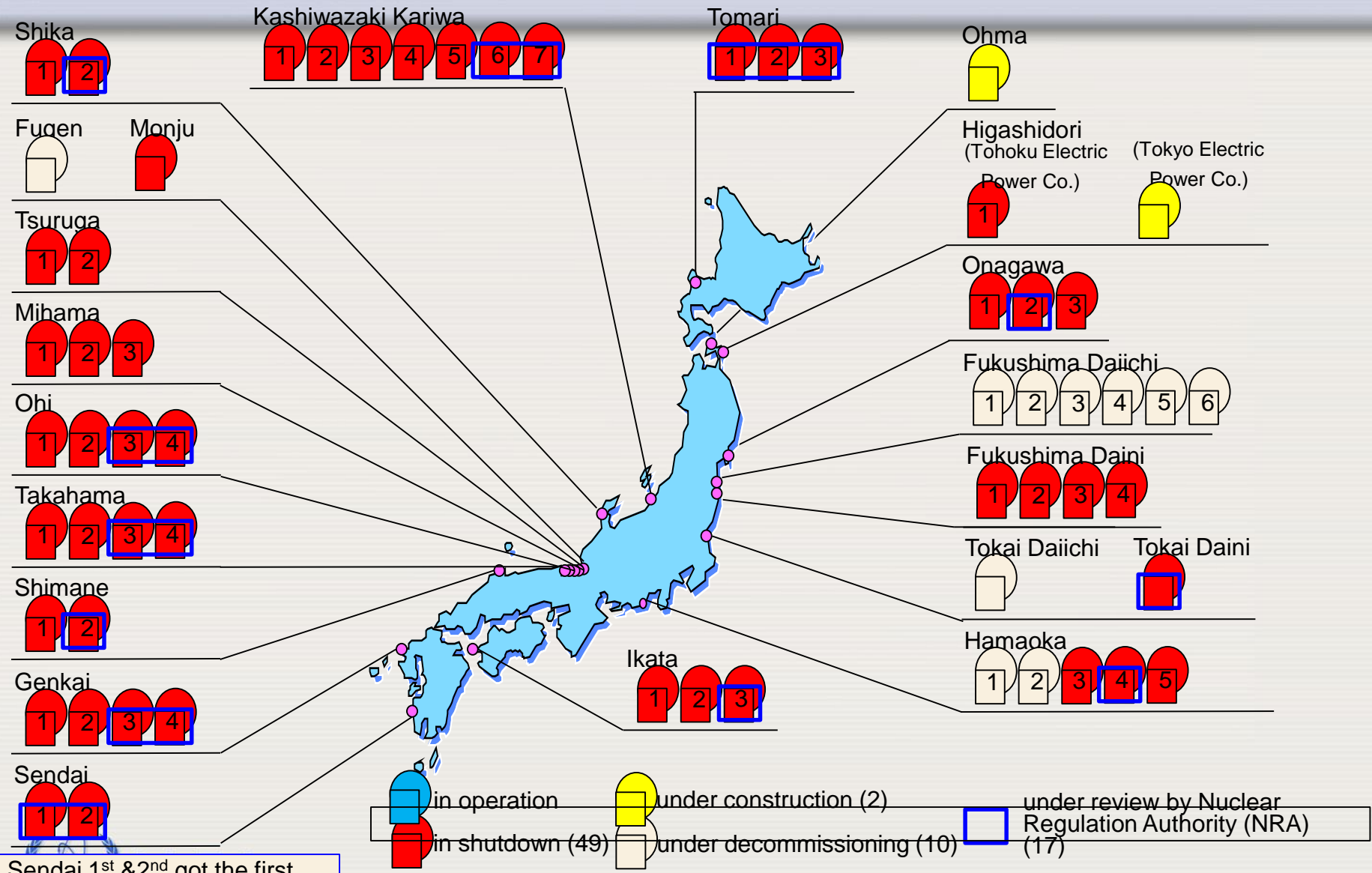


# Research Reactors Worldwide

Status	Developed Countries	Developing Countries	All Countries
Operational	159	88	247
Temporary Shutdown	13	6	19
Under Construction	3	3	6
Planned	4	8	12
Shutdown	121	21	142
Decommissioned	314	25	339

# Current Status of Nuclear Power Plants in Japan

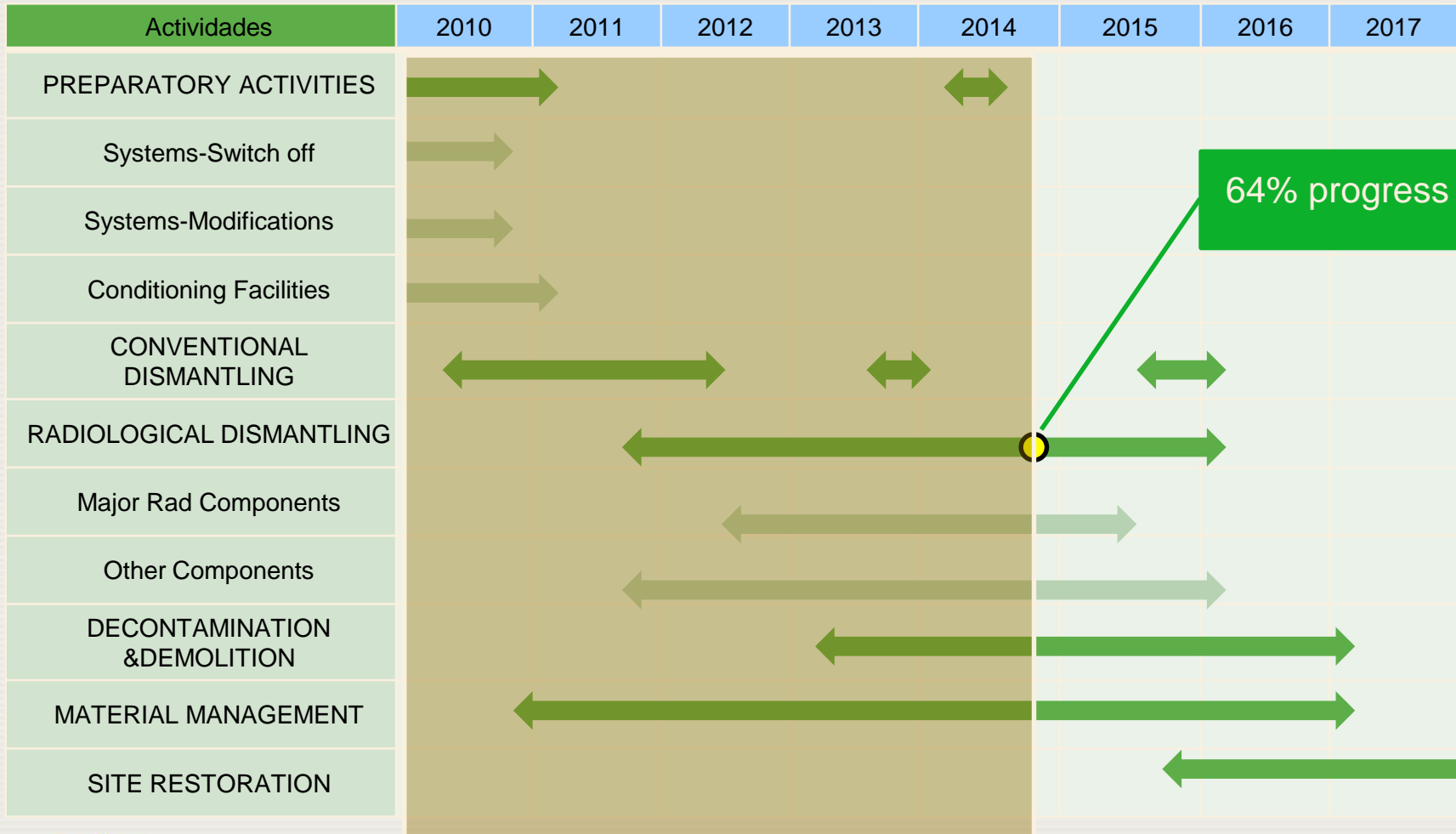
[from K. Takahashi, JAEA, IDN-2014, Vienna]



Sendai 1<sup>st</sup> & 2<sup>nd</sup> got the first permission in September.

# Schedule (José Cabrera NPP Decommissioning)

[from E. Garcia Neri, ENRESA, IDN-2014, Vienna]





# Work Areas

[from E. Garcia Neri,  
IDN-2014, Vienna]

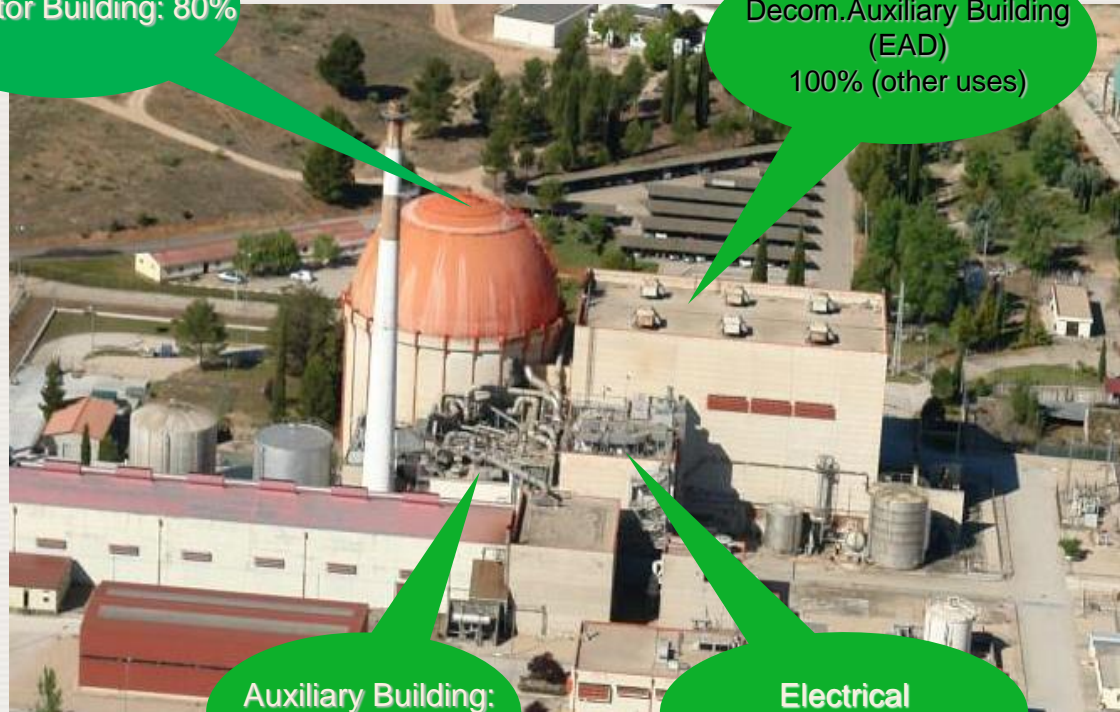


Reactor Building: 80%

Decom.Auxiliary Building (EAD) 100% (other uses)



JOSÉ CABRERA NPP



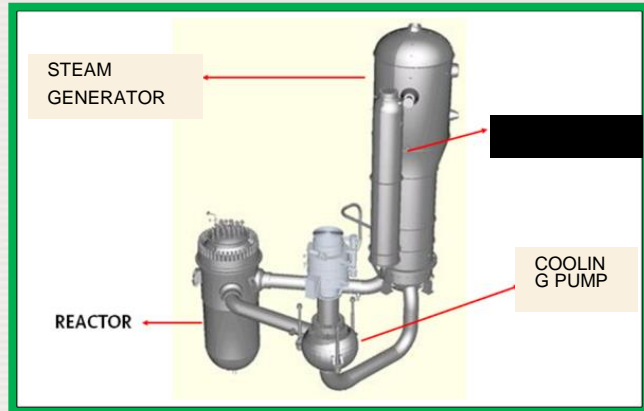
Auxiliary Building: 75%

Electrical Building: 100%



# Major Primary Circuit Components

[from E. Garcia Neri, ENRESA, IDN-2014, Vienna]



PRIMARY CIRCUIT



→ Finished



PRESSURIZER



→ Finished



COOLING PUMP



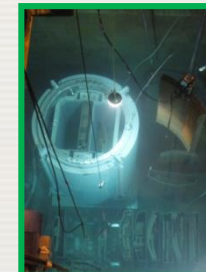
→ In progress (80%)



STEAM GENERATOR



→ Finished



REACTOR INTERNALS



In progress (50%)



REACTOR VESSEL

# CEA's Grenoble Nuclear Facilities

[from J-G Nokhamzon, CEA, IDN-2014, Vienna]

## 6 Basic Nuclear Installations



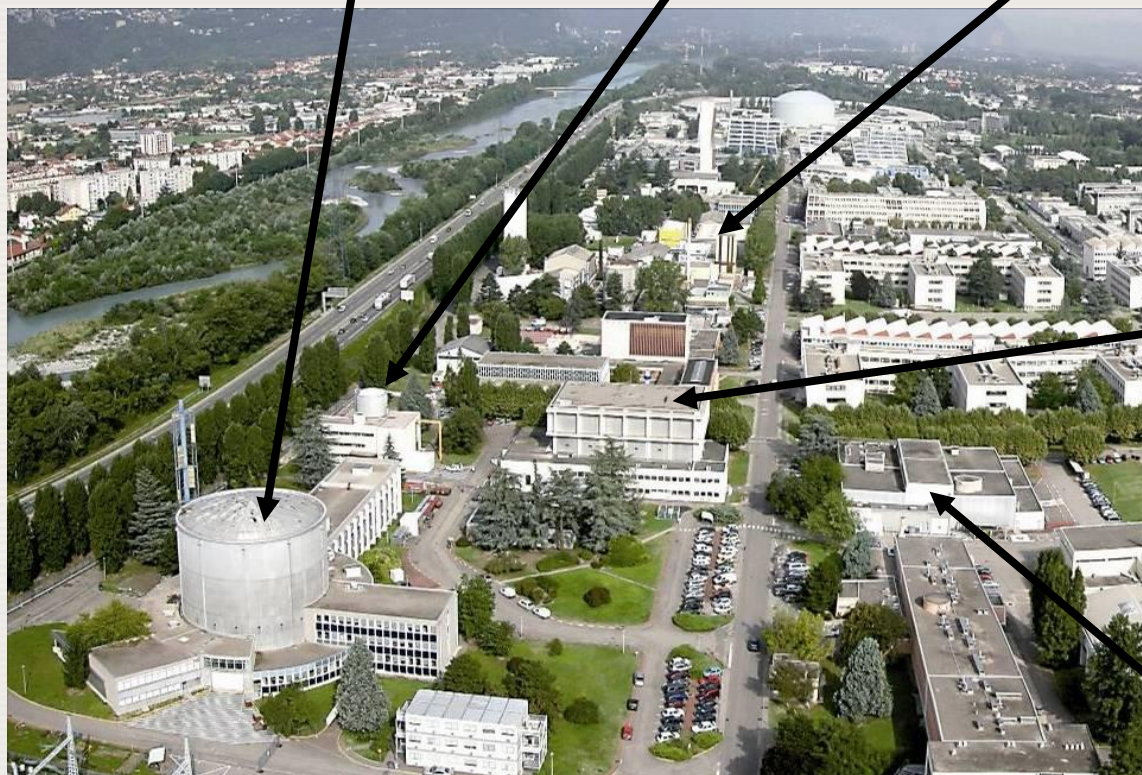
**Siloé**  
1963-1997



**Siloëtte**  
1964-2002  
Delicensing mi 2007



**STED (2BNI)**  
1964 & 1972 - 2002



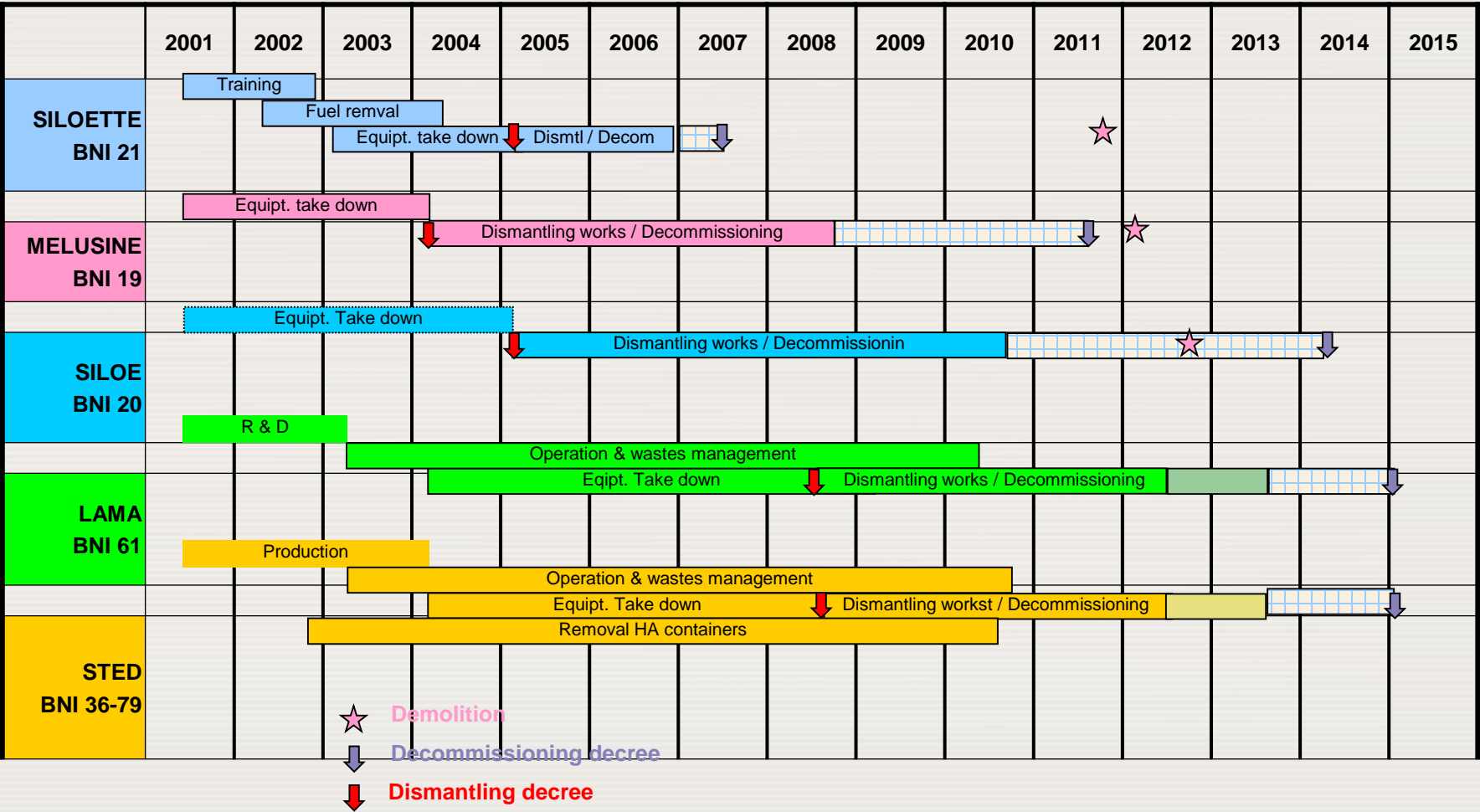
**Mélusine**  
1958-1988  
Delicensing  
end 2011



**LAMA**  
1961-2002

# Schedule Management–Grenoble Research Facilities

[from J-G Nokhamzon, CEA, IDN-2014, Vienna]



# Siloé Research Reactor Decommissioning

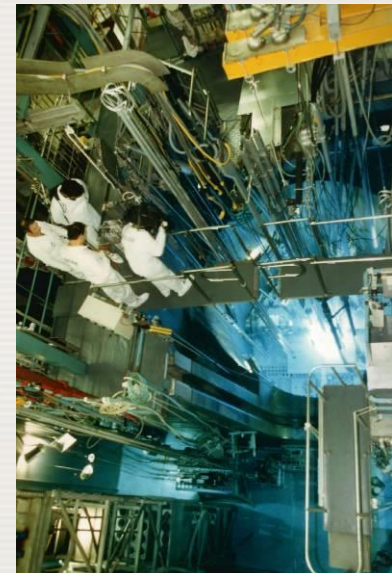
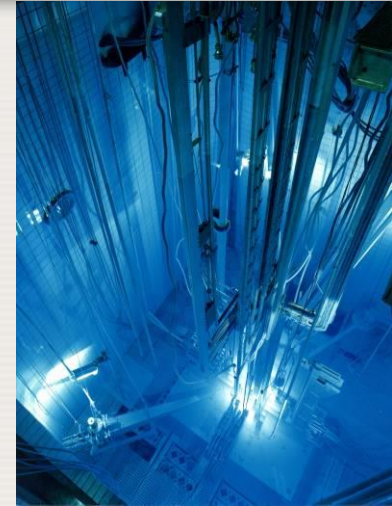
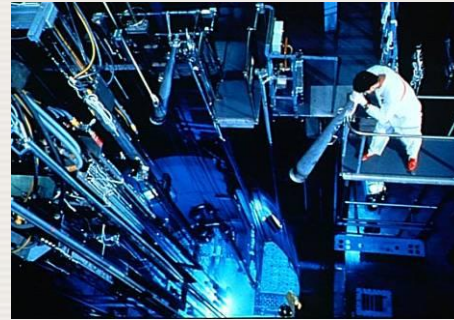
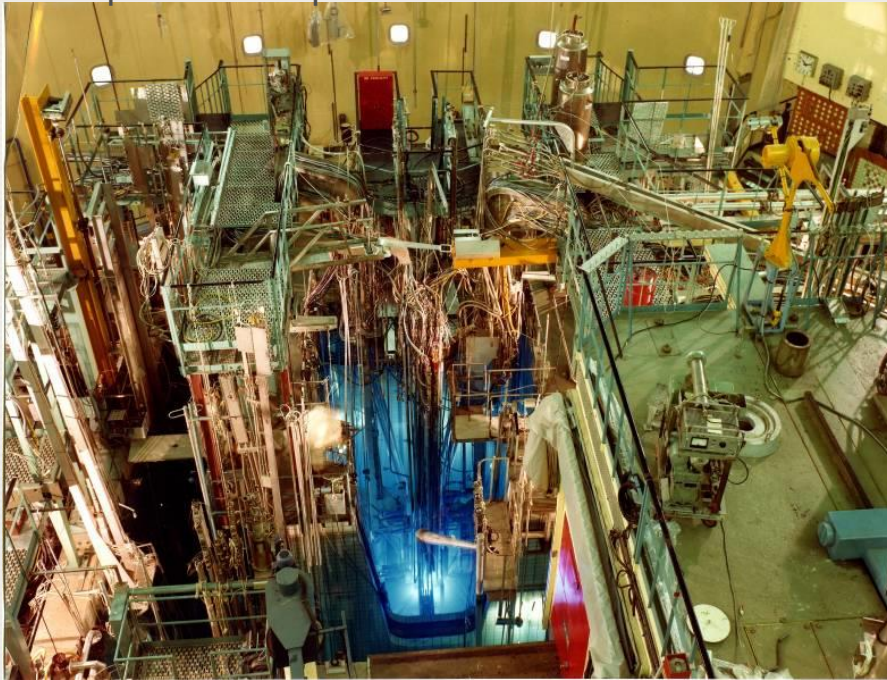
[from J-G Nokhamzon, CEA, IDN-2014, Vienna]

## 34 years operation (1963 to 1997)

Nominal power 35 MW<sub>th</sub>

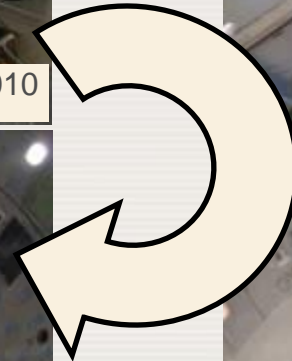
Wide range of activities :

- ❖ research on crystalline structures using neutron beams,
- ❖ scientific support to French nuclear fleet,
- ❖ behaviour studies on future nuclear fuels,
- ❖ radionuclide production for medical purposes,
- ❖ doped silicium production for micro electronics industries.



# Siloé building internal structures demolition (2010)

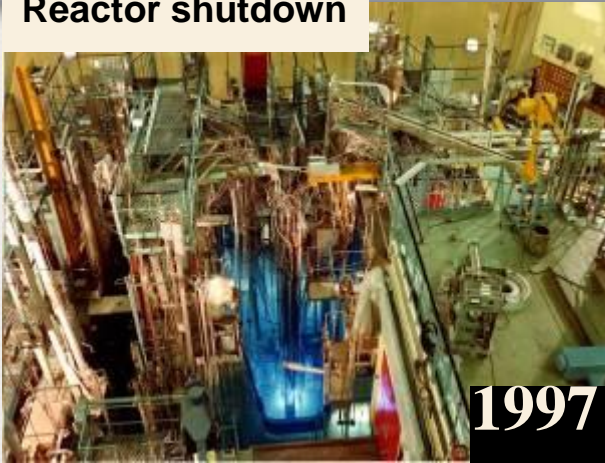
[from J-G Nokhamzon, CEA, IDN-2014, Vienna]



# Siloé: Summary of Main Stages

[from J-G Nokhamzon, CEA, IDN-2014, Vienna]

Reactor shutdown

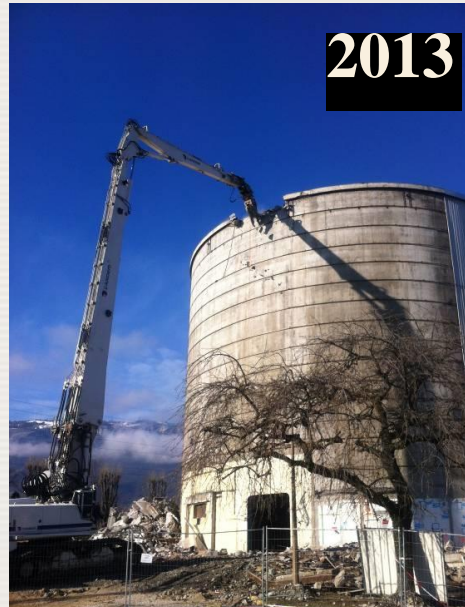


Pond emptied



Liner removal remotely

2013



Reactor hall demolition

2014



Final end state

2010



Big internal structures demolished

# IAEA Responsibilities re. Decommissioning

## IAEA Statute:

1. Develop safety standards
2. To (support) practical development and practical application of atomic energy
3. To foster the exchange of scientific and technical information on peaceful uses of atomic energy
4. To encourage the exchange and training of scientists and experts



Nuclear safety  
Radiation Safety  
Waste Safety  
Transport Safety



Peer reviews  
Technical cooperation  
Research and development  
Training  
Exchange of information (networks)



# CIDER Project (Launched April 2013)

The overarching objective of the CIDER project is **to improve current levels of performance on decommissioning and environmental remediation projects**, by

- **Raising awareness** at a policy level and **promoting greater cooperation** amongst IAEA Member States dealing with the decommissioning and remediation of disused nuclear facilities and sites, and with national and international organizations involved in the development of aspects pertaining to their management, decommissioning and remediation and regulatory oversight;
- **Developing a baseline report** for use by policy makers and other involved parties
- **Establishing a plan of action** that proposes specific actions and associated timeframes to address constraints to progress.

# Objectives of the Baseline Report (CIDER)

- Discusses specific barriers impeding implementation (Phase 1, 2013-15)
- Provides recommendations on how these barriers might be overcome (Phase 1)
- Provides a detailed overview of global liabilities for decommissioning and remediation (Phase 2, 2015-)

# Overcoming Barriers to Implementing Decommissioning and Environmental Remediation Projects

- ❑ **Barriers to Implementation**
  - ❑ National policy and legal & regulatory framework
  - ❑ Finance
  - ❑ Technology and infrastructure constraints (esp. for waste management())
  - ❑ Stakeholder and political challenges

# Overcoming Barriers to Implementing Decommissioning and Environmental Remediation Projects

## ❑ Strategies for Overcoming Barriers

- ❑ Lifecycle planning, project management & risk management (role of characterization)
- ❑ Funding sources (primary and complementary sources)
- ❑ Management and organizational culture change ('project' rather than 'process')
- ❑ Using an affordable and graded approach (infrastructure commensurate to the liability)
- ❑ Risk-based prioritization (efficient allocation of resources)
- ❑ Clear identification of roles (government, regulator, implementer)
- ❑ Value of independent review (sharing good practice)
- ❑ Communication and stakeholder engagement (ownership/sustainability of the solution)
- ❑ Management of political influences (risk of political changes)

# International Project on Decommissioning of Accident Damaged Facilities – 19-23 January 2015

- Purpose : Learn and benefit from the experiences derived from the challenges associated with D&ER of these facilities, in particular relating to: regulatory issues; technical issues and strategic planning (three working groups)
  
- Case Studies
  - Fukushima
  - Three Mile Island
  - Chernobyl
  - A1 (Slovakia)
  - Kyshtym (Russian Federation)
  - Windscale (UK)

# Future International Conference on Advancing Decommissioning & Environmental Remediation

- ❑ Planned date: 23-27 May 2016
- ❑ Successor Conference to Athens 2006 (D&D) and Astana 2009 (ER)
- ❑ Mainly technical but also aimed at political decision makers
- ❑ Invited papers with contributed posters

# Future International Conference on Advancing Decommissioning & Environmental Remediation

- ❑ Lifecycle planning and risk management at different stages of the lifecycle;
- ❑ Regulatory frameworks for D&ER;
- ❑ Societal considerations/ decision making end selection;
- ❑ Characterization techniques and development of inventory databases;
- ❑ Optimization of the waste management strategies associated with the decommissioning or remediation work;
- ❑ Project management costing and financing of D&ER projects / contracting strategies and supply chain management;
- ❑ Technology selection and deployment for D&ER, including new technology developments following the Fukushima accident.

