



Safety Aspects  
of Long Term  
Operation

SALTO

# Life After 60 – Long Term Operation of Nuclear Power

**IAEA support to Member  
States with respect to  
safe long term operation  
beyond 60 years**

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Gabor Petofi - [g.peofi@iaea.org](mailto:g.peofi@iaea.org)

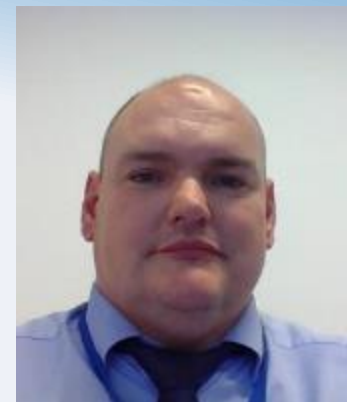
LTO Project Manager

IAEA Nuclear Installation Safety Division



# Introduction

- Name: Gábor Petőfi
- Position in IAEA
  - Senior Nuclear Safety Officer
  - Operational Safety Section
  - Division of Nuclear Installation Safety
- Current Main Activities in IAEA
  - LTO project leader
  - Team leader for SALTO Peer Review Services missions
  - IGALL Steering Committee and WGs 2, 4 scientific secretary
  - Since February 2018 with IAEA
- Originally: Hungarian, worked 18 years at regulator (HAEA)



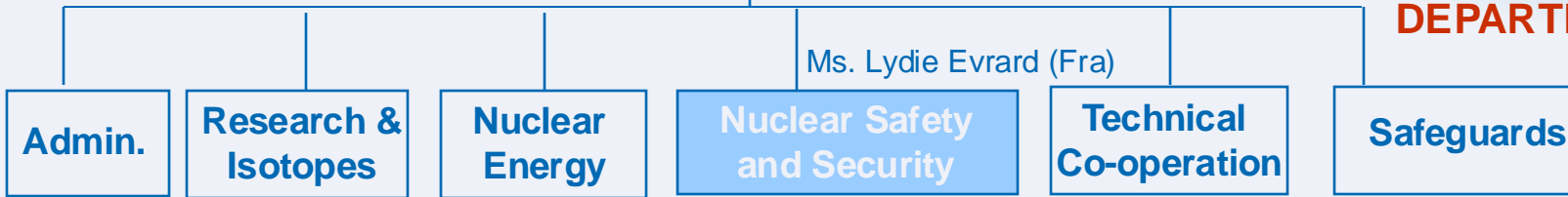
# IAEA Organizational Chart

Mr. Rafael Grossi (Arg)

**DIRECTOR GENERAL**

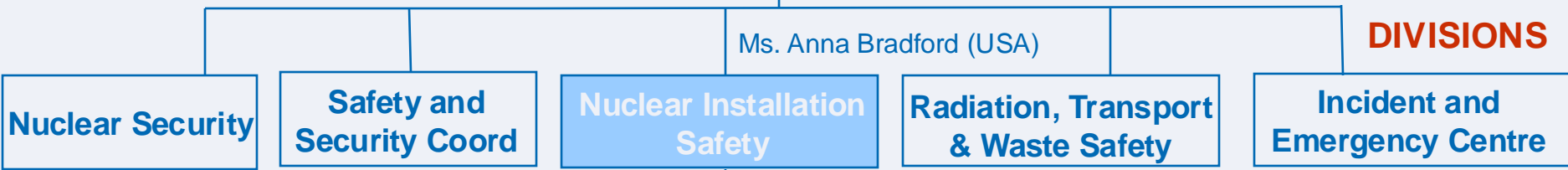
**DEPARTMENTS**

Ms. Lydie Evrard (Fra)

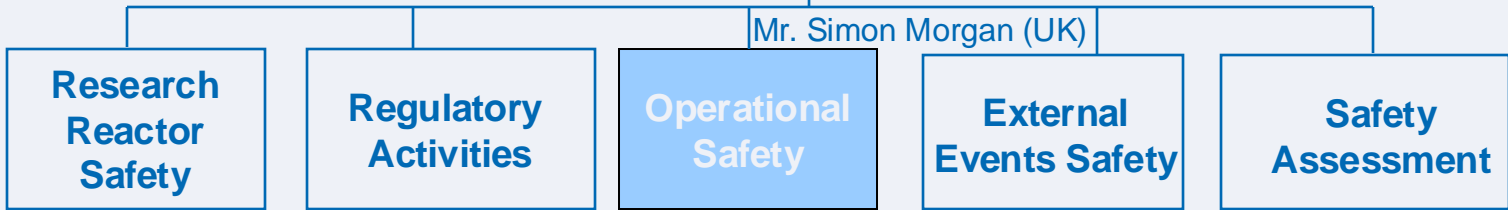


**DIVISIONS**

Ms. Anna Bradford (USA)



Mr. Simon Morgan (UK)



**SECTIONS**

**OSART**  
LTO  
PI  
L&M

Mr. Gabor Petofi (Hun)

**SAFETY SERVICES**

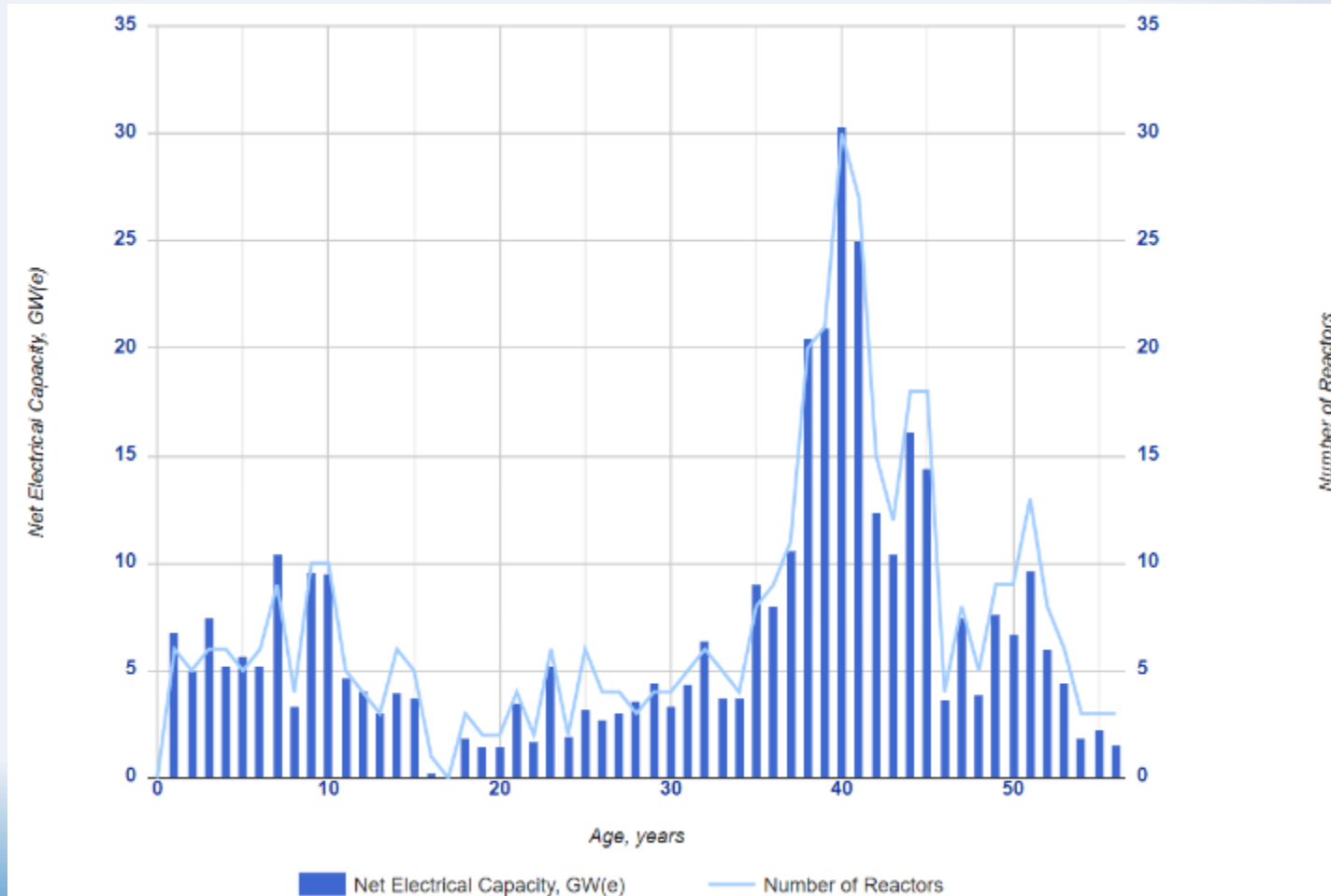
# Global ageing situation of NPP reactors

(<https://pris.iaea.org>, 02-12-2024)

417 reactors

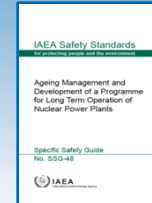
284 above 30y

191 above 40y



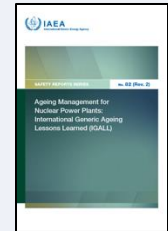
# How does IAEA support AM and safe LTO of NPPs?

## 1. Establishment of **related IAEA Safety Standards**



## 2. Fostering **information exchange** and establishing **databases**

- 1) IGALL Programme
- 2) AM and LTO workshops
- 3) SALTO methodology and experience transfer workshops



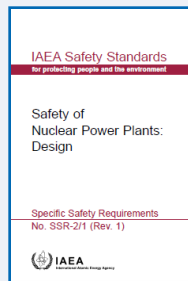
## 3. Provision of **peer review service** to assist Member States in application of related Safety Standards

### Safety **Aspect** of **Long Term Operation** (**SALTO**)



# 1. LTO and AM related IAEA guidance

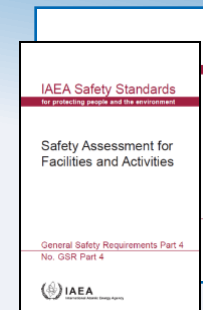
## SAFETY REQUIREMENTS



**SSR-2/1**  
Safety of NPPs: Design

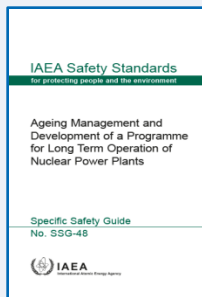


**SSR-2/2**  
Safety of NPPs: Commissioning and Operation

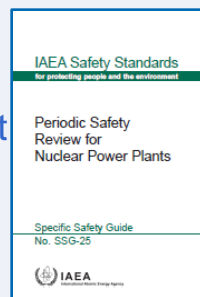


**GSR part 2**  
Leadership and Management for Safety  
**GSR part 4**  
Safety assessment for facilities and activities

## SAFETY GUIDES

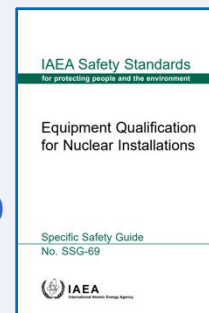


**SSG-48**  
Ageing Management and LTO



**SSG-25**  
PSR

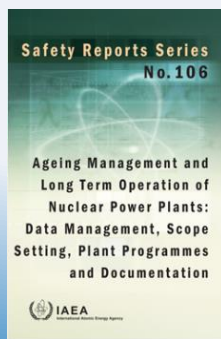
**SSG-69**  
EQ



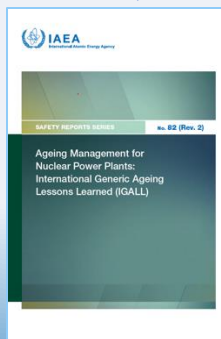
**Other important Safety Guides:**  
GS-G-3.1 Management System...  
SSG-71 Modifications  
SSG-72 Operating Organization  
SSG-74 Maintenance, Testing, Etc.  
SSG-13 Chemistry Programme...

## SAFETY REPORTS

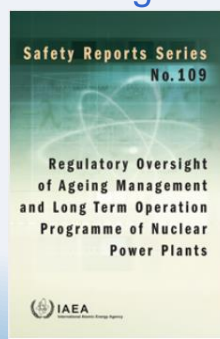
**SRS 106**  
Scoping



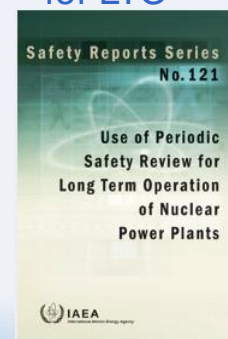
**SRS 82**  
IGALL, Rev.2



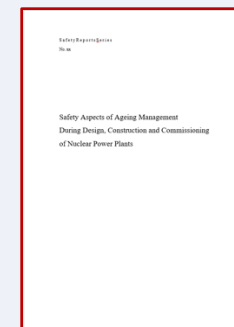
**SRS 109**  
Regulatory Oversight



**SRS 121**  
PSR support for LTO



**SRS XXX**  
Design, construction, commissioning



# LTO and AM related IAEA documents

[Available online](#)



# IAEA requirements on 60+

IAEA SSR-2/2 (Rev. 1)

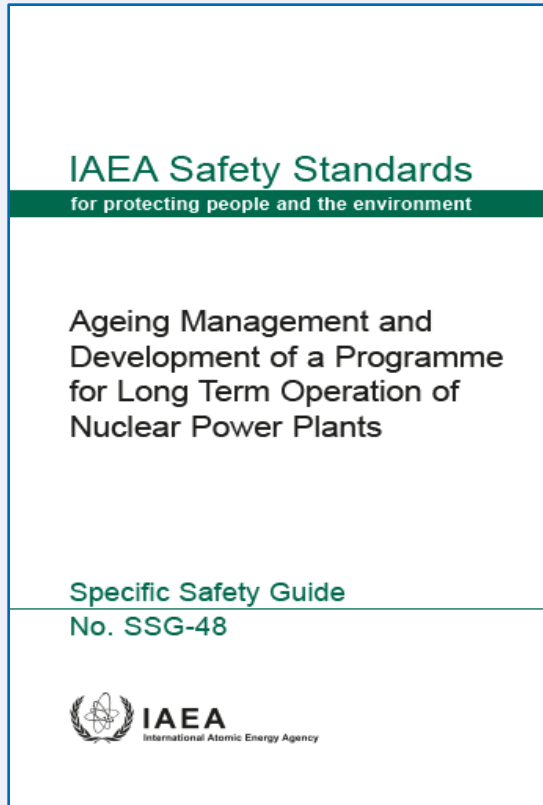
Requirement 16: Programme for long term operation

Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long term safe operation of the plant **beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.**



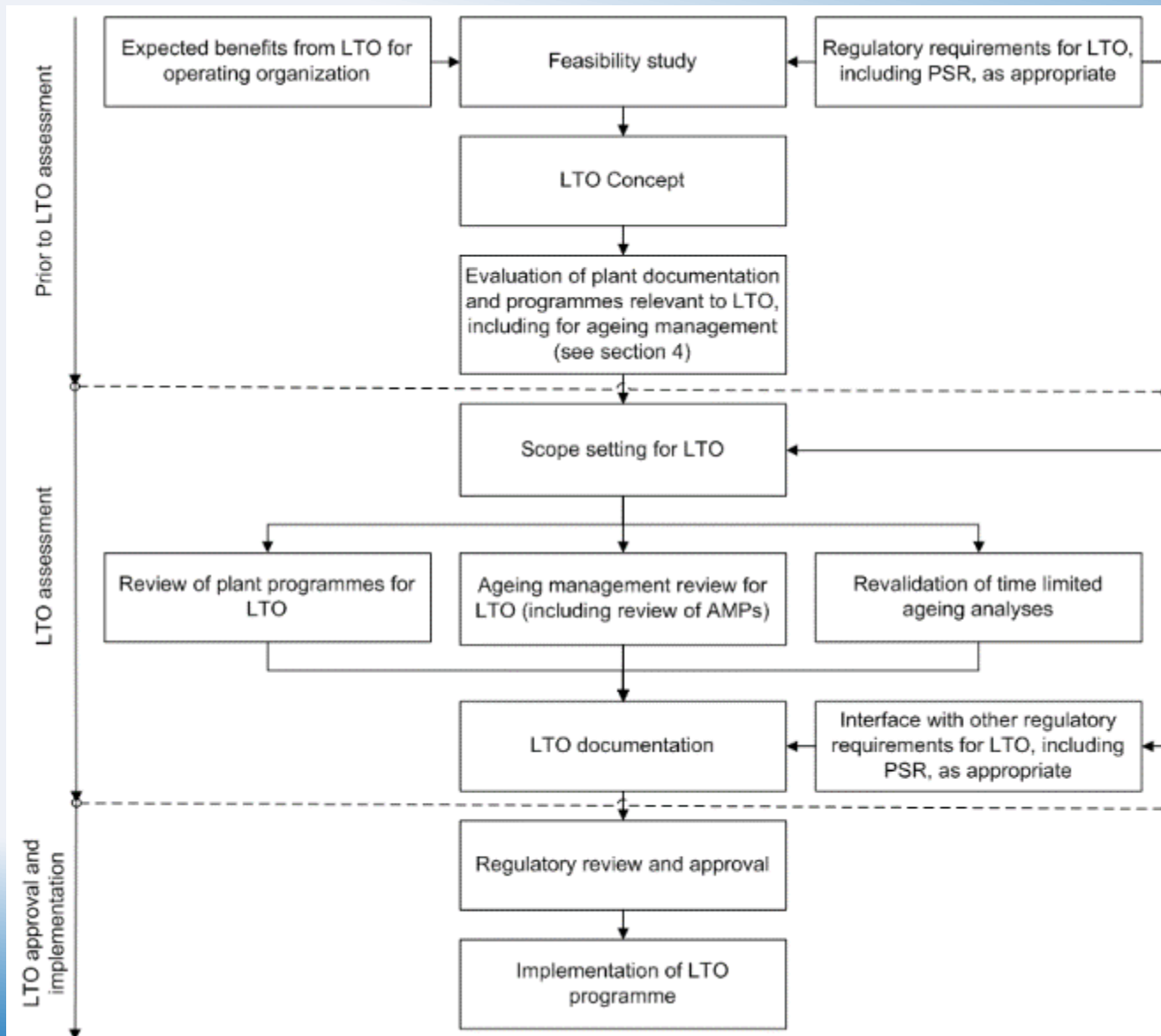
# Specific Safety Guide on AM and LTO

## SSG-48



- Comprehensive and systematic guidance on ageing management
  - Focused on physical ageing and management of technological obsolescence
- Provides methodology for LTO independently of age and period
- Issued in 2018
- **Revision starts in 2025**

# Need for change due to 60+?



No major gaps or need for change identified for 60+

# Planned revision of SSG-48

- General review timeline: 2025-2028
- **Technical Meeting: 28-30 October 2025**
  - Collect MS experience on using SSG-48
  - Finalize development goals, schedule and contents
- **Technical aspects (proposed)**
  - Experience from **subsequent LTO preparations**
  - Extend guidance on early life cycle phases
    - design, construction, commissioning and decommissioning
  - Better integration of HR and knowledge management
  - Concept of plant level ageing management and effectiveness assessment
  - SALTO experience
  - Advanced data analysis (AI)
  - Periodic Safety Review synergies

## 2. International Generic Ageing Lessons learned programme - IGALL

- Collect **proven** ageing management **practices**
- Establish a repository of ageing management techniques
- Support the **systematic approach** described in SSG-48
- Fully **extrabudgetary** programme
- Member States are encouraged to contribute!

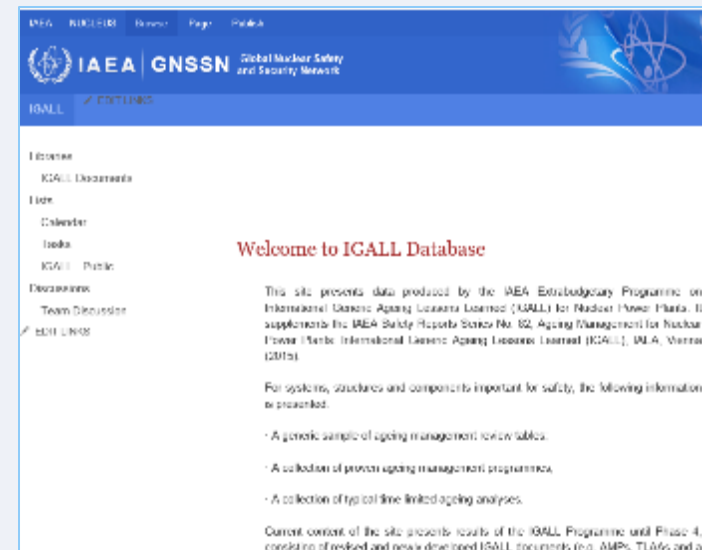
# IGALL Participation as of 2024 (Phase 7)

Argentina		Hungary		South Africa	
Armenia		India		Spain	
Belarus		Iran		Sweden	
Belgium		Japan		Switzerland	
Brazil		Korea		Türkiye	
Bulgaria		Mexico		Ukraine	
Canada		Netherlands		UAE	
China		Pakistan		UK	
Czechia		Romania		USA	
Finland		Russia		EU JRC	
France		Slovakia		OECD/NEA	
Germany		Slovenia		EPRI	
				WANO	

# IGALL information share

## Public website

- 119 Ageing Management Programmes
- 33 Time Limited Ageing Analysis
- 4 other programmes
- 5 regulatory documents
- IGALL AMR table
- IGALL Safety Report and IGALL TECDOC
- IGALL Dynamic Register
- Calendar of IGALL meetings



# IGALL support to 60+

- IGALL Phase 4 to 6
  - Systematic review and comparison if IGALL documents with GALL-SLR report and collection of other Member States experience
  - Outcomes are incorporated in IGALL AMPs/TLAAs
- No specific document developed for SLR in IGALL
  - No SLR specific degradation mechanism or ageing effect was identified
  - Known mechanisms: more severe and/or new locations
  - New phenomena: due to increased exposure levels
  - LTO guidance document can be effectively used

# Technical/safety issues for 60+ in IGALL

- RPV neutron embrittlement
  - high fluence trends, surveillance programmes
- RPV internals – high fluence effects
  - irradiation-assisted stress corrosion cracking
  - loss of fracture toughness
  - swelling of reactor internals
- Concrete and containment performance
  - long-term radiation, high temperature exposure
  - wooden piles in structures
- Electrical cables
  - environmental qualification
  - in-service cable testing
  - long-term cable submersion
- Buried piping
- High Density Polyethylene (HDPE) and Carbon Fiber Reinforced Polymer (CFRP) piping





# Safety Aspects of Long Term Operation (**SALTO**) missions - Objectives

- Objective assessment of preparedness for LTO with respect to IAEA Safety Standards
- Recommendations and suggestions for improvement where performance falls short of IAEA Safety Standards
- Opportunity for the plant to discuss practices with experienced experts
- Experience exchange and sharing of lessons learned

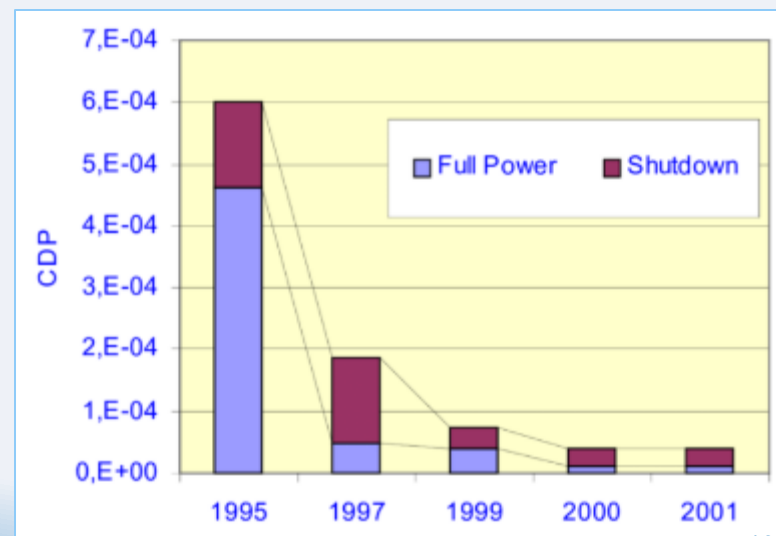
# SALTO Mission Scope

Scope of the **standard SALTO Peer Review service**, divided to areas according IAEA SALTO Guidelines is as follows:

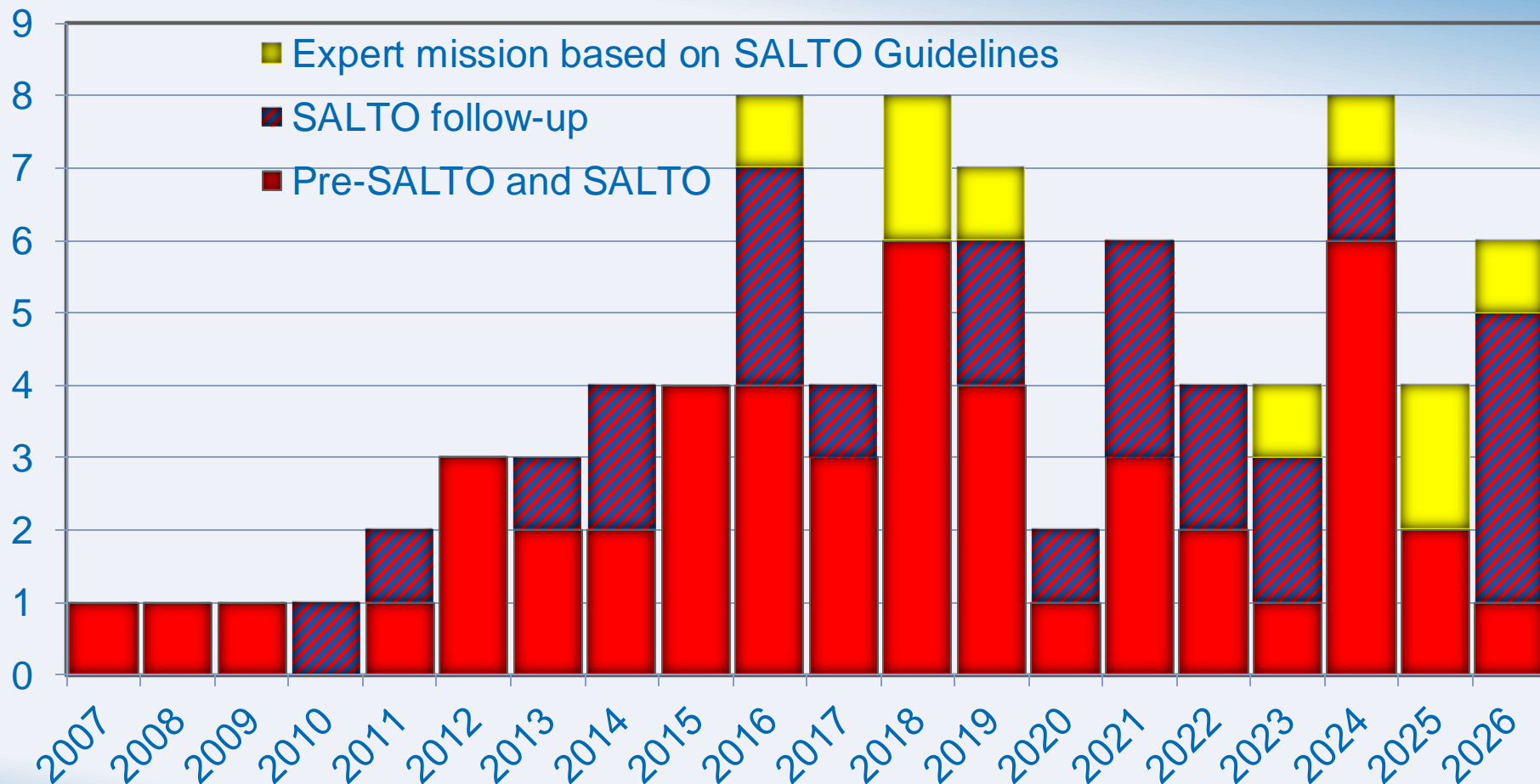
- Area A      Organization of ageing management and LTO activities
- Area B      Scope setting, plant programmes and corrective action programme
- Area C      Ageing management of mechanical SSCs
- Area D      Ageing management of electrical and I&C SSCs
- Area E      Ageing management of civil SSCs
- Area F      Human resources, competence and knowledge management for LTO

# Standard SALTO Peer Review scope

- The scope of the SALTO peer review does **NOT** include:
  - Assessment or review of the plant **design**
  - Assessment of the **environmental impact** of LTO
  - **Economic assessment** and LTO investment strategies
- Review scope does include activities for **design improvements**
  - Periodic Safety Review are meant to identify potential safety improvements



# SALTO missions 2007 – 2026 (partially plan)



# SALTO mission to prepare for subsequent LTO

- NPPs for 2<sup>nd</sup> SALTO peer review service cycle
  - Borssele, the Netherlands (license: 2034): pre-SALTO in 2024
  - Armenian NPP, Armenia (2026): SALTO in 2025
  - Paks NPP, Hungary (2032): pre-SALTO in 2026/27
- Issues to focus for 60+
  - Maintained effectiveness of existing activities?
  - Plant changes addressed by/in ageing management?
  - Further modernization project?
    - What is safe enough? Do we need more for 60+?
  - Loss of knowledge is significant in 20 years
  - Clear regulatory expectations
  - Timely decision making (for safety and investments)



IAEA

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**Thank you!**

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