



IAEA welcome

Janos Eiler

Gyeongju, Republic of Korea, 4 December 2017



IAEA

International Atomic Energy Agency

The Paks Nuclear Power Plant in Hungary





Outline

- Introduction to the IAEA and a global nuclear power outlook
- Most significant issues in the nuclear instrumentation and control area today
- IAEA Nuclear Energy Series report on the “Application of FPGAs in I&C Systems of NPPs”

IAEA at a glance

- Founded in 1957
- 168 member states
- New member in 2016
 - Turkmenistan
- 2453 staff
- Nobel Peace Prize



XINHUA/AFP



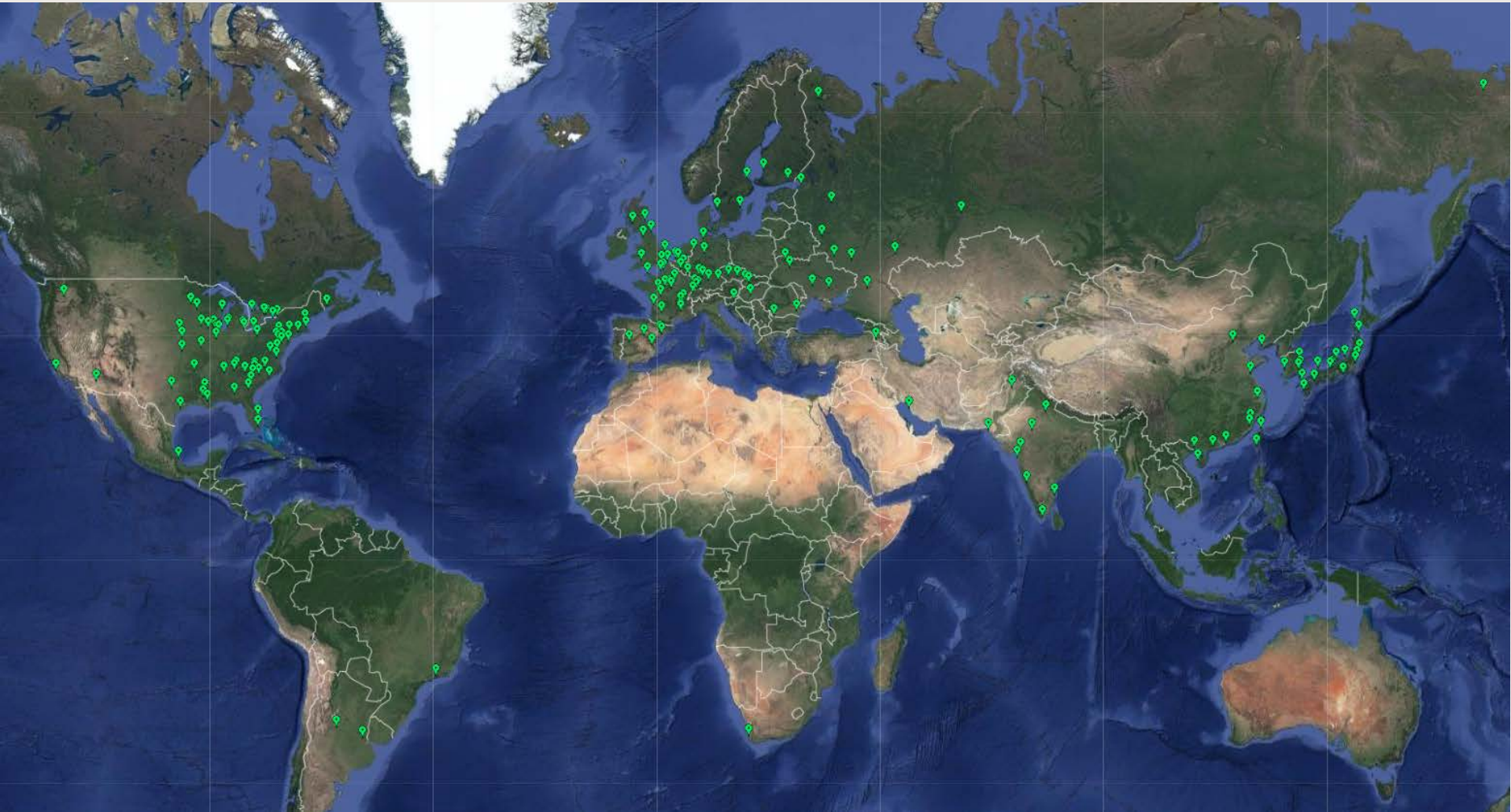
Global nuclear power outlook



IAEA

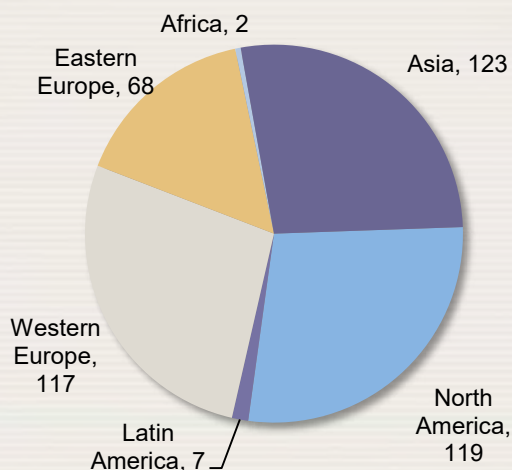
International Atomic Energy Agency

Nuclear power plants in the world



Global nuclear power status

Geographical distribution



448 reactors in operation (392 GW_e)

1 reactor in long-term shutdown

164 reactors in permanent shutdown

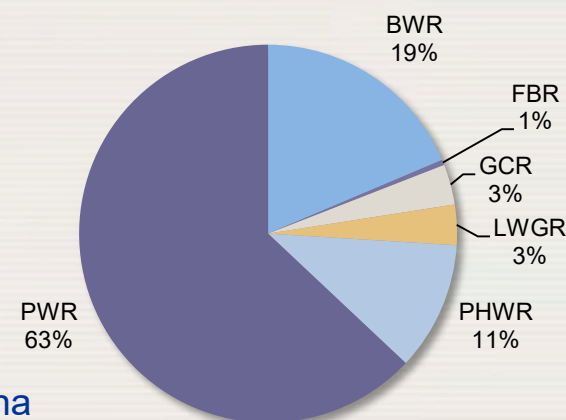
58 reactors under construction

As of November 2017

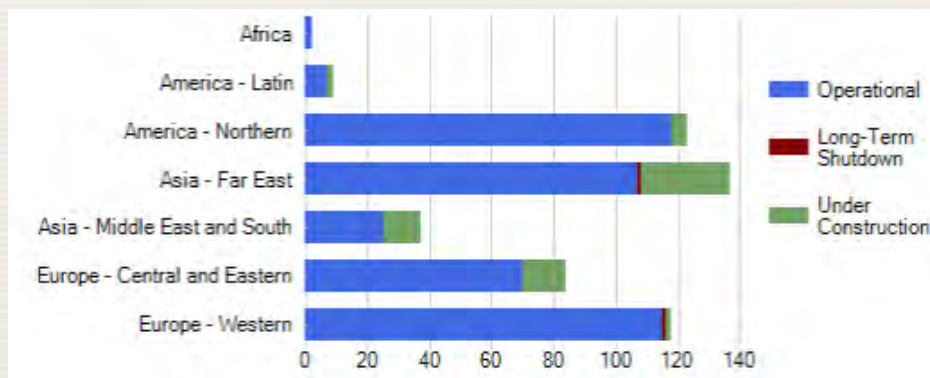
Latest connections to the grid (2017):

- ❖ YANGJIANG-4, 1000 MW(e) PWR, China
- ❖ FUQING-4, 1000 MW(e) PWR, China
- ❖ CHASNUPP-4, 315 MW(e) PWR, Pakistan

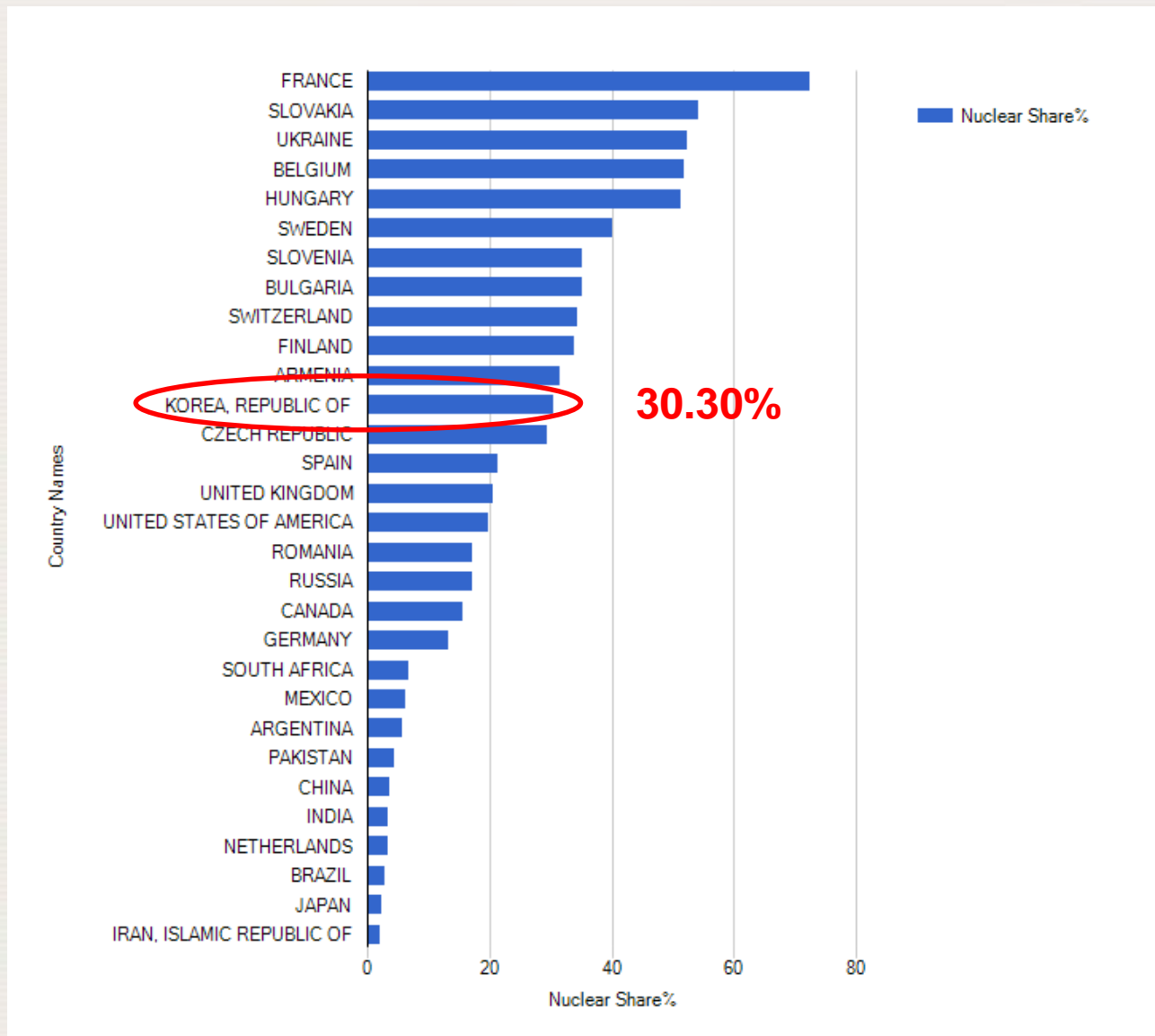
Reactor capacity by type



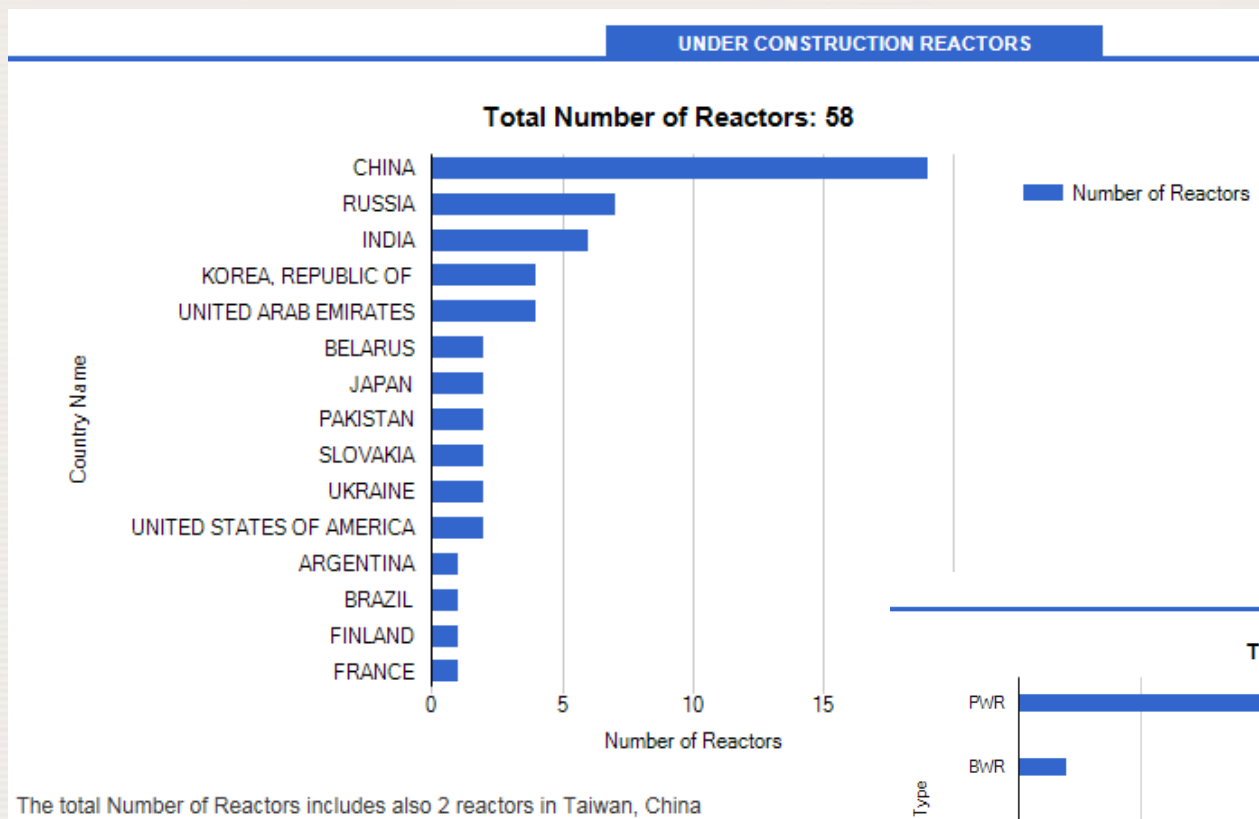
Website: <http://www.iaea.org/pris/>



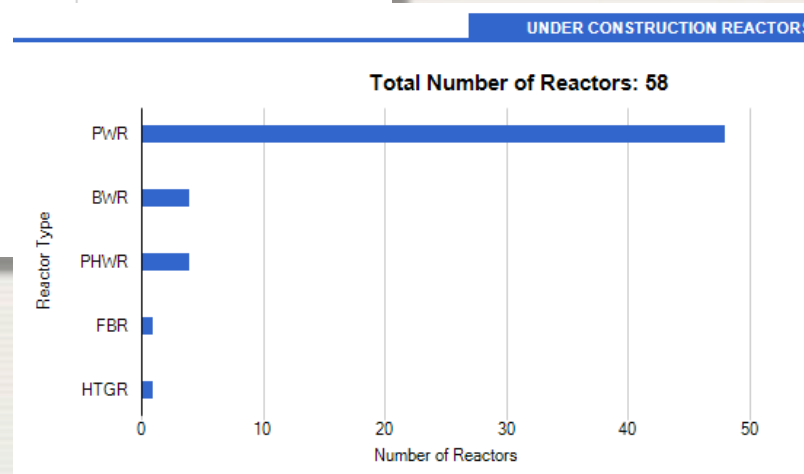
Nuclear share of electricity generation in 2016



Reactors under construction in the world

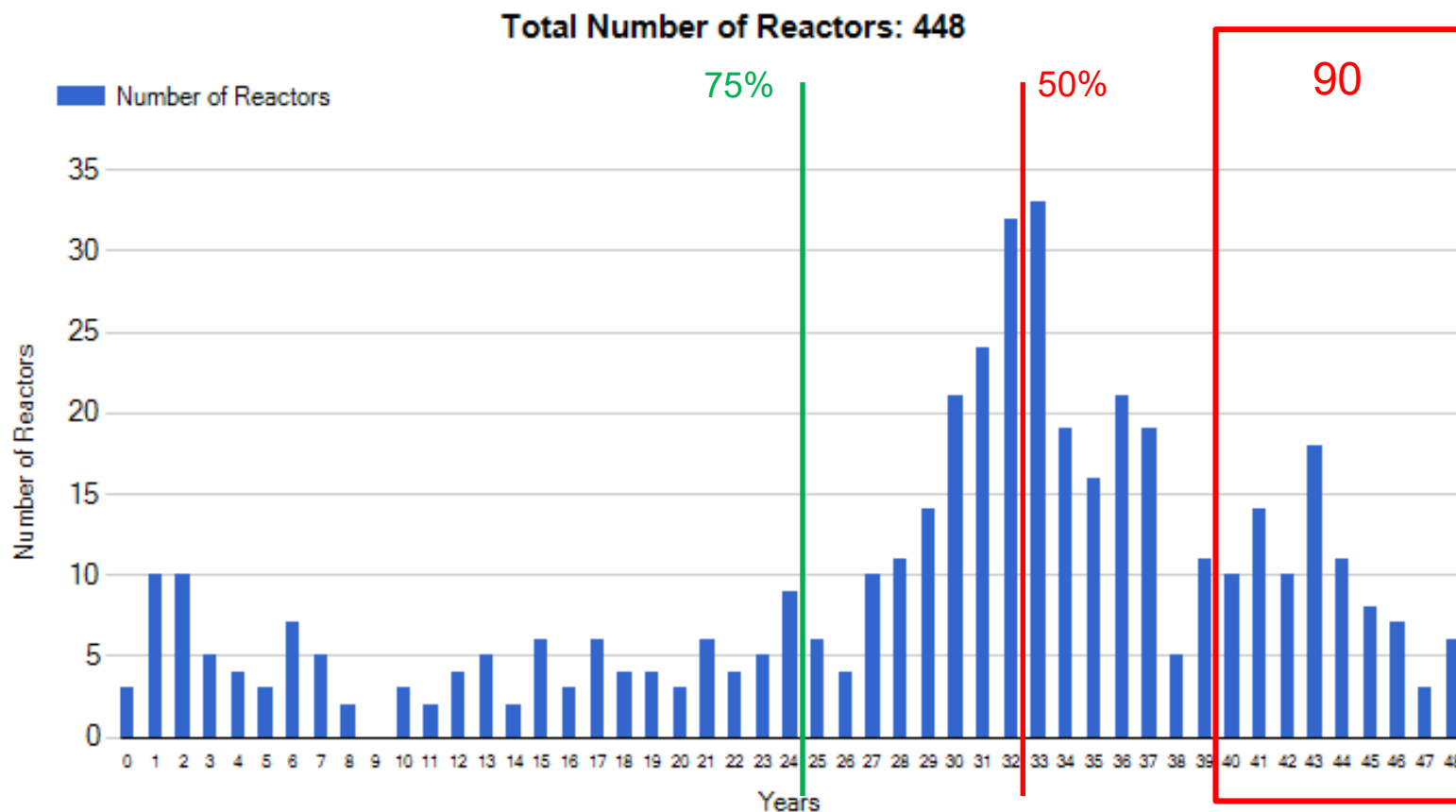


As of November 2017



Age of operating reactors

OPERATIONAL REACTORS BY AGE



Most significant issues in the nuclear instrumentation and control area today



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TWG group photo from 2017

- The program for 2018 - 2021 was compiled in the last biennial meeting in 2017



Current challenges in the nuclear I&C field

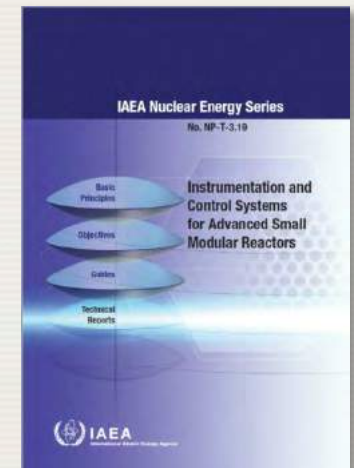
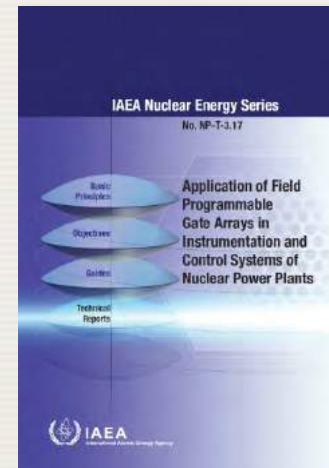
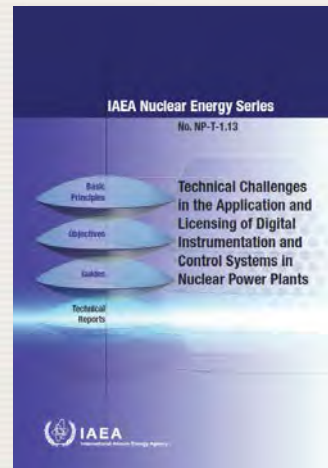
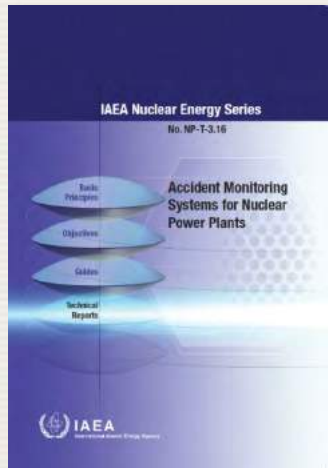
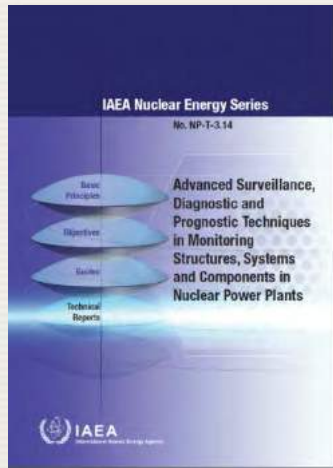
- **Safety, security and licensing**-driven issues
 - Enhancement of safety through improved systems and processes
 - Implementation of all necessary post-Fukushima improvements
 - Harmonization of standards, licensing practices, and safety classification schemes
 - Issues with software dependability (common cause failure)
 - Digital communications, independence, computer security
- **Economic** driven issues
 - Improvement of plant efficiency, increase of plant and personnel productivity for cost-effective operation -> competitiveness
 - Long term operation -> ageing management
 - Rapid evolution of digital technologies -> obsolescence management

Current challenges in the nuclear I&C field (2)

- Issues related to **new technologies**
 - Use of wireless technologies
 - Use of new information and communications technologies
 - Use of new Human Factors Engineering technologies
 - New reactor designs such as small modular reactors (SMRs)

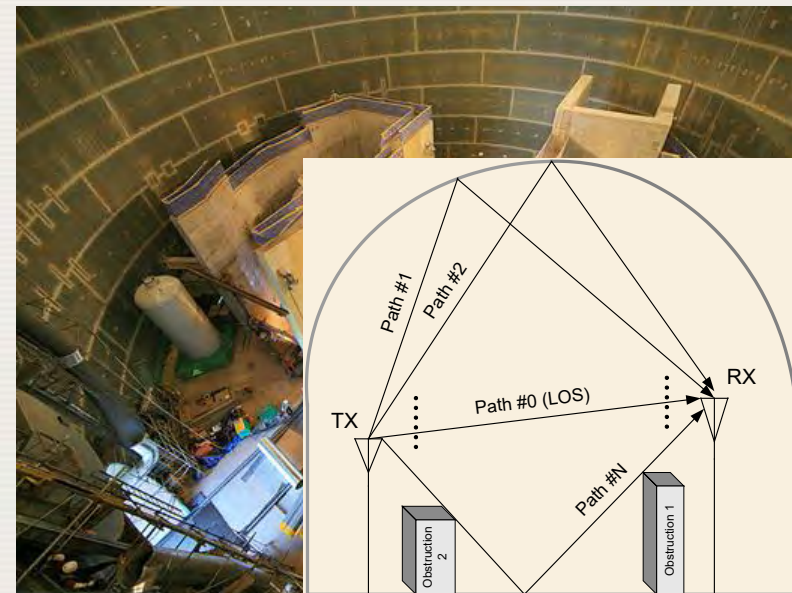
Recent NE publications

- Advanced **Surveillance, Diagnostics and Prognostics** Techniques in Monitoring Structures, Systems and Components in Nuclear Power Plants
- **Accident Monitoring** Systems for Nuclear Power Plants
- Technical **Challenges** in the **Application and Licensing** of Digital I&C Systems in NPPs
- **Application of FPGAs** in I&C Systems of NPPs
- I&C Systems for **Advanced Small Modular Reactors**



Ongoing publications on at the Nuclear Energy Department

- Publications under printing
 - Dependability **assessment of software** for safety I&C systems at NPPs
 - Approaches for overall **I&C architectures** of nuclear power plants
- Publications in progress
 - Design aspects of **computer security** in NPP I&C systems
 - Application of **wireless technologies** in NPP I&C (CRP final report)



Major meetings planned for 2018

- Technical meeting on TM on **Justification of commercial industrial I&C equipment** for nuclear power plant applications, 19-22 June 2018, Toronto, Canada
- Technical meeting on **I&C aspects of Human Factors Engineering** (HFE): Design and analysis, 4-7 Sept 2018, Madrid, Spain
- 11th International workshop on **the application of FPGAs in NPPs???**

IAEA Nuclear Energy Series report on the “Application of FPGAs in I&C Systems of NPPs”



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Objective

- To summarize current **knowledge**, best **practices** and **issues** associated with the application of FPGA based solutions in nuclear power plants
- To describe **development processes** and **tools** as well as **licensing** issues
- The document is intended to be used by Member States to support the **design**, **licensing**, and **implementation** of FPGA-based systems. Potential users are:
 - Nuclear power plant operators
 - Technical support organizations
 - Regulatory bodies
 - Research and development organizations
 - Manufacturers/ vendors

4th Workshop on the Application of FPGAs

November 2011, Chatou, France



5th Workshop on the Application of FPGAs October 2012, Beijing, China



List of participants at the 1st CS meeting

- Andrashov, A. Radiy, Ukraine
- Naser, J. EPRI, United States of America
- Arndt, S. US NRC, United States of America
- Seaman, S. Westinghouse, United States of America
- Eiler, J. International Atomic Energy Agency
- Glockler, O. SunPort SA, Switzerland
- Thuy, N. EdF R&D STEP, France
- Zeng, H. SNPAS, China



6th Workshop on the Application of FPGAs

8-11 October 2013, Kirovograd, Ukraine



List of participants at the last CS meeting

- Eiler, J. International Atomic Energy Agency
- Russomanno, S. Global Nuclear Solutions Inc., Canada
- Thuy, N. EdF R&D STEP, France
- Gassino, J. IRSN, France
- Arndt, S. US NRC, United States of America
- Naser, J. EPRI, United States of America
- Glockler, O. SunPort SA, Switzerland



The IAEA report

- Nuclear Energy Series
 - NP-T-3.17
- Chairman: Joe Naser
- 79 pages
- 6 main chapters

IAEA Nuclear Energy Series

No. NP-T-3.17

Basic
Principles

Objectives

Guides

Technical
Reports

**Application of Field
Programmable
Gate Arrays in
Instrumentation and
Control Systems of
Nuclear Power Plants**



Structure

- Foreword
- 1. Introduction
- 2. Introduction to FPGA technology
- 3. Methods and tools for development and verification
- 4. Licensing
- 5. Replacement systems and new NPP designs
- 6. Summary
- References
- Annex I: Specific application examples and experience
- Annex II: Typical life cycle for an FPGA platform
- Glossary



Thank you for your attention!