Programs of the International Atomic Energy Agency on Nuclear Power Plants

Atomcsill at ELTE

Budapest, Hungary
25 February 2010

IAEA
International Atomic Energy Agency

Introduction

Oszvald Glöckler

Scientific Secretary for the IAEA Technical Working Group on Nuclear Power Plant Instrumentation and Control (TWG-NPPI&C)

Nuclear Power Engineering Section,

Division of Nuclear Power,

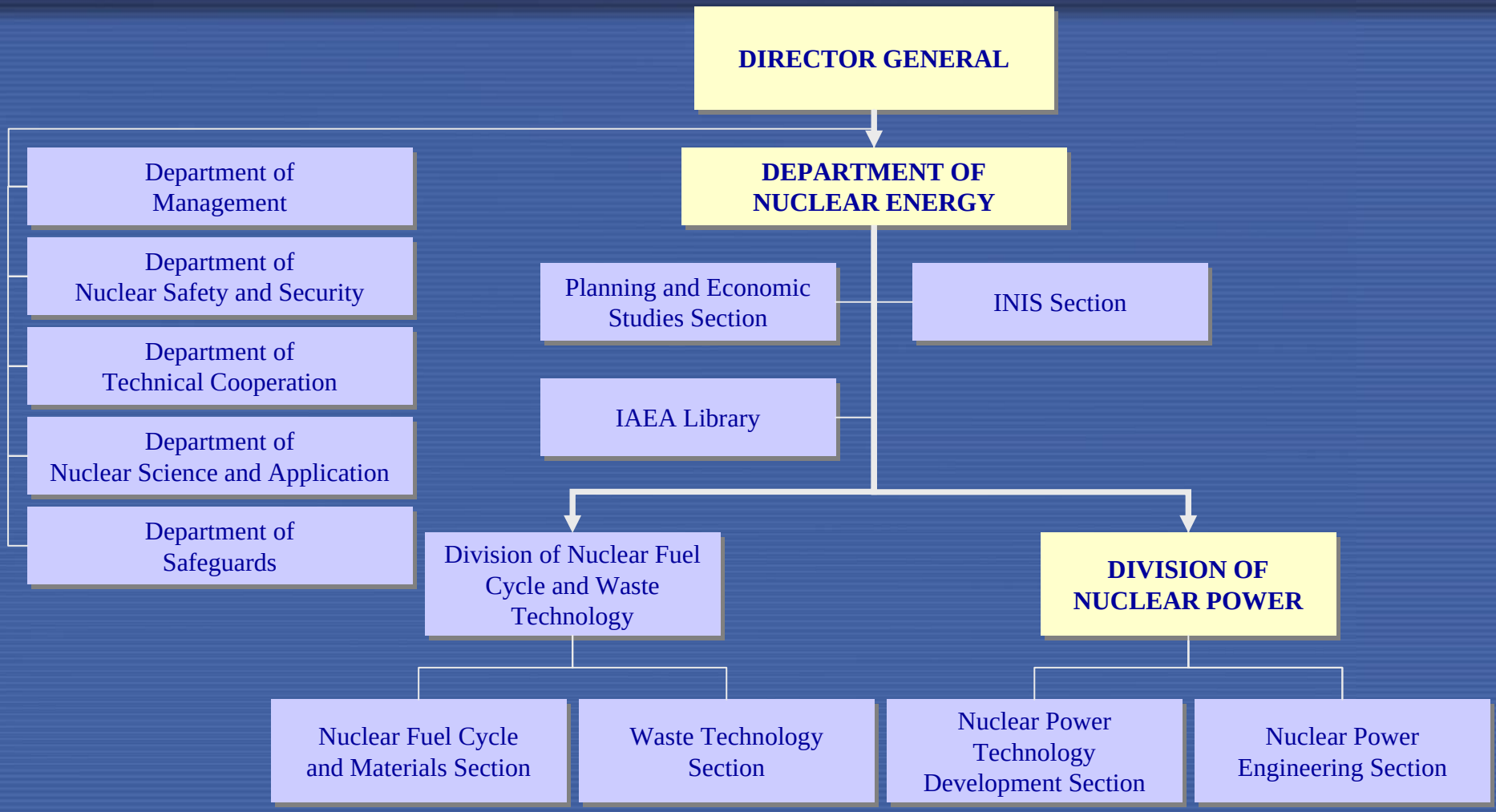
Nuclear Energy Department,

International Atomic Energy Agency

IAEA

IAEA: 6 Departments, 26 Divisions, 110 Sections

Structure of Nuclear Energy Department



IAEA

150 IAEA Member States

- 30 with operating NPPs (436 units 372 GWe)
- Additional 61 are interested in launching new NPP projects

NPP industry - a time of transition

Current: 436 NPP units (372 GWe) in operation in 30 countries

Plans in major countries:

- USA - 31 plants are under NRC review
- China - 25 plants are planned
- Japan - 9 plants are planned
- Russia - 6 plants are planned
- Korea - 5 plants are planned

IAEA

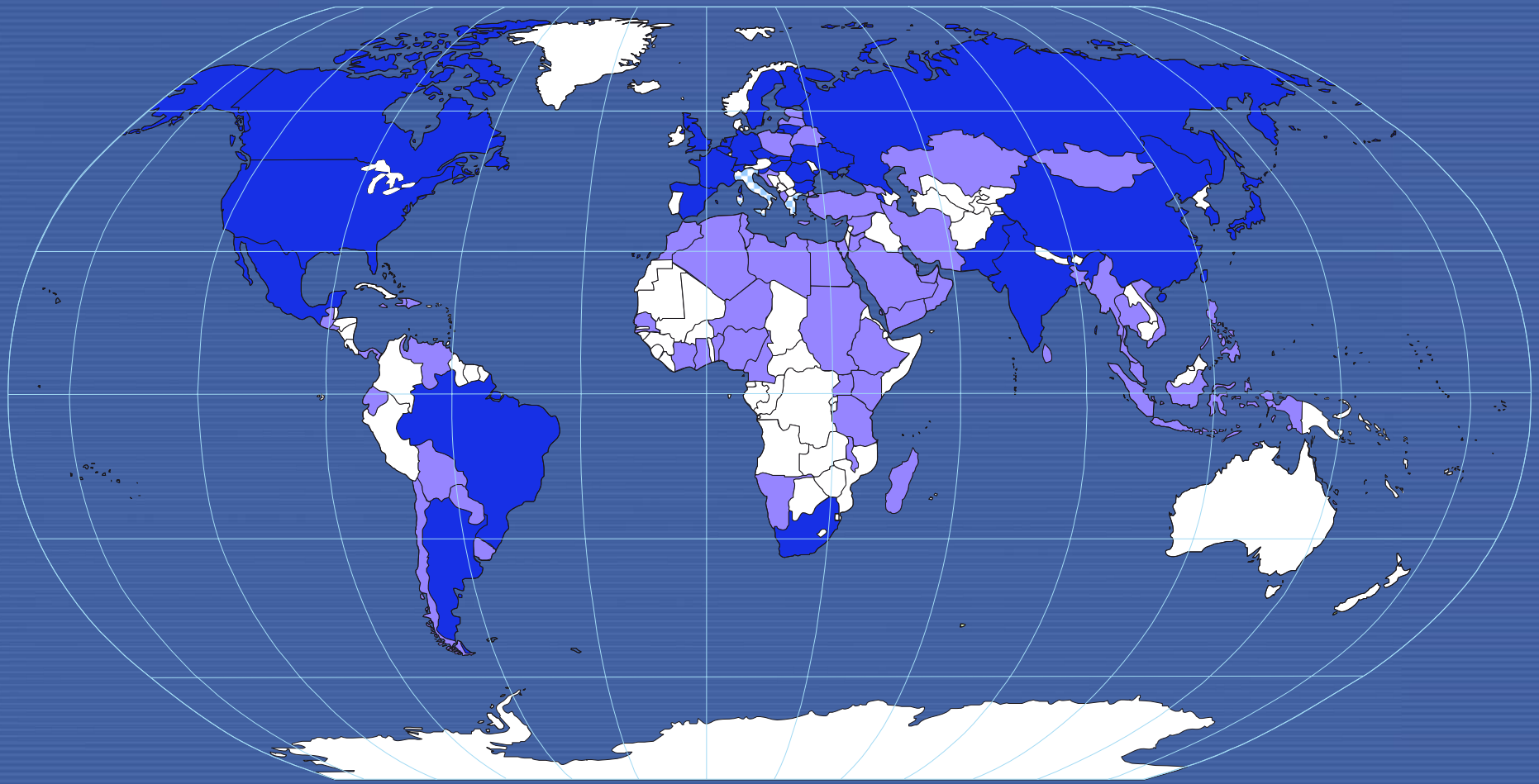
New Nuclear Countries

61 have requested support from IAEA on what they need to introduce to have nuclear power

- Africa 20
- Latin America 12
- Asia pacific 20
- Europe and FSU 9

IAEA

Countries considering introduction/expansion of nuclear power



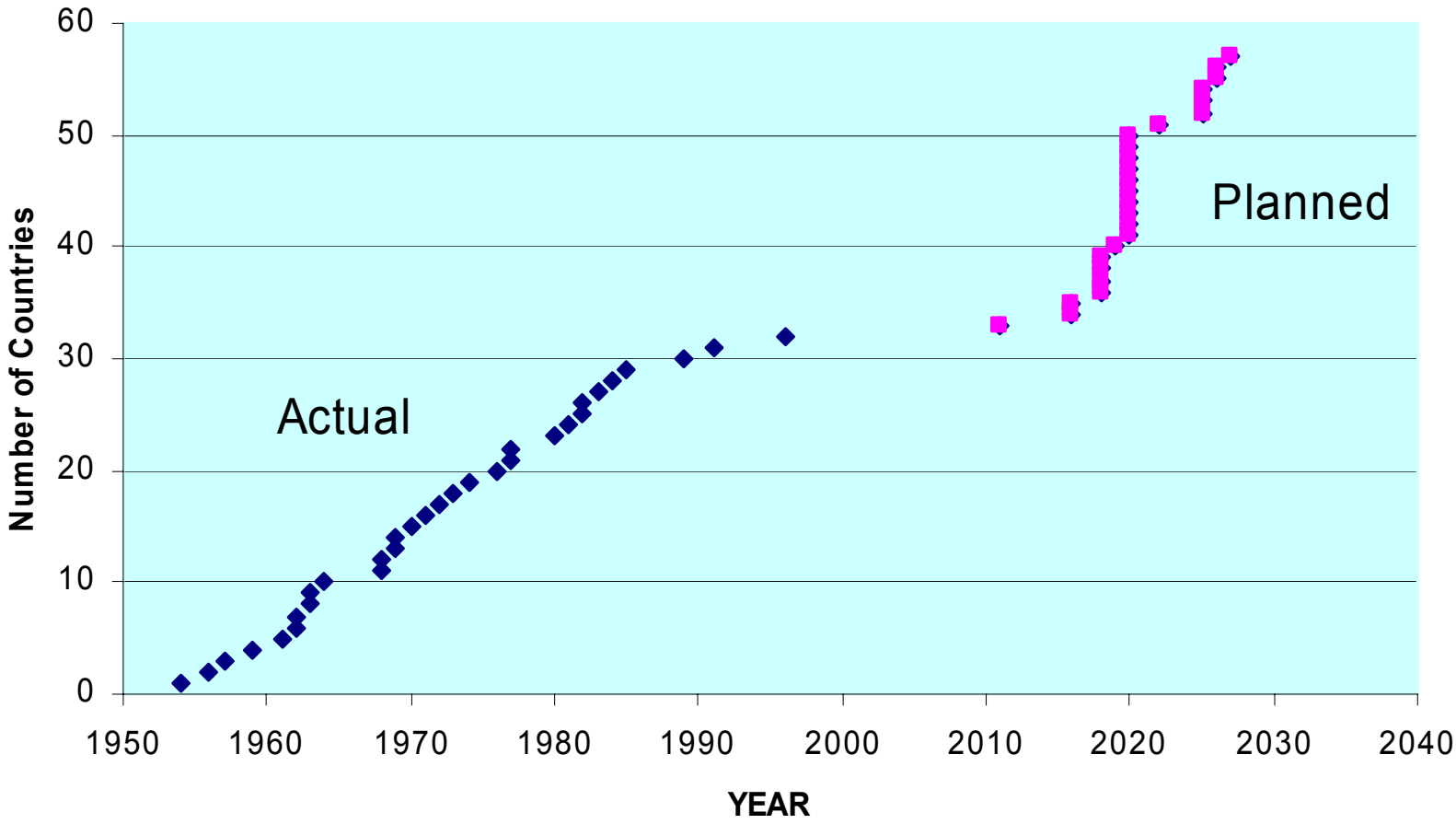
Operating (30)

Considering through IAEA TC Project (61)

Other countries having expressed interest

IAEA

Countries introducing their first NPP



IAEA

WHAT IS PRIS
PUBLICATIONS
SERVICES
HOW TO ORDER
PRIS PC SOFTWARE

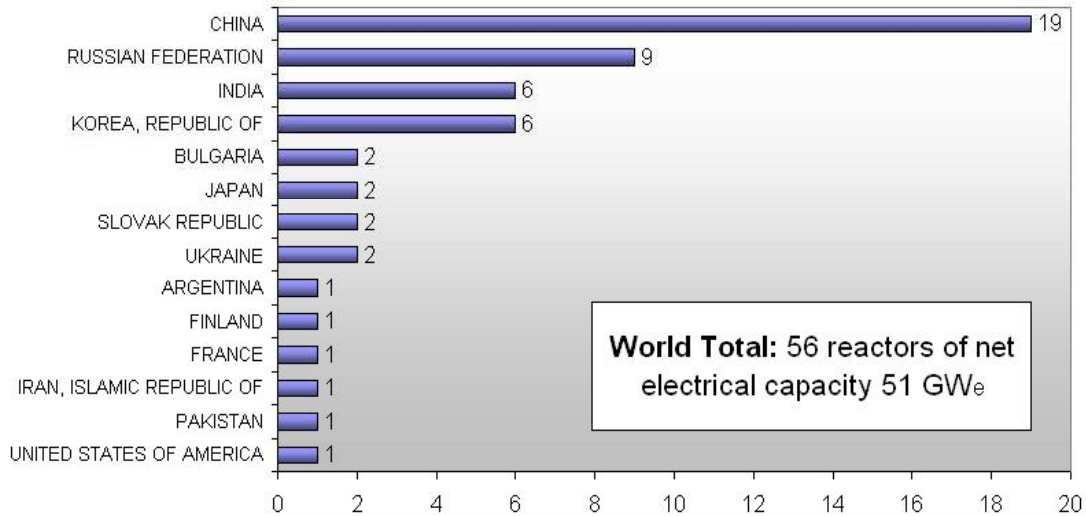
NUCLEAR POWER PLANT INFO
WORLD SUMMARY
REACTOR DETAILS
Select Country
Sorting Order
alphabetically
SEARCH

(*) Information on nuclear power plants in Taiwan, China can be provided on request.

Registered Users

NUCLEAR POWER PLANTS INFORMATION

Number of Reactors under Construction Worldwide



Note: The World Total includes also 2 reactors under construction in Taiwan, China.

Go Back to Nuclear Power Plant Information

WHAT IS PRIS
PUBLICATIONS
SERVICES
HOW TO ORDER
PRIS PC SOFTWARE

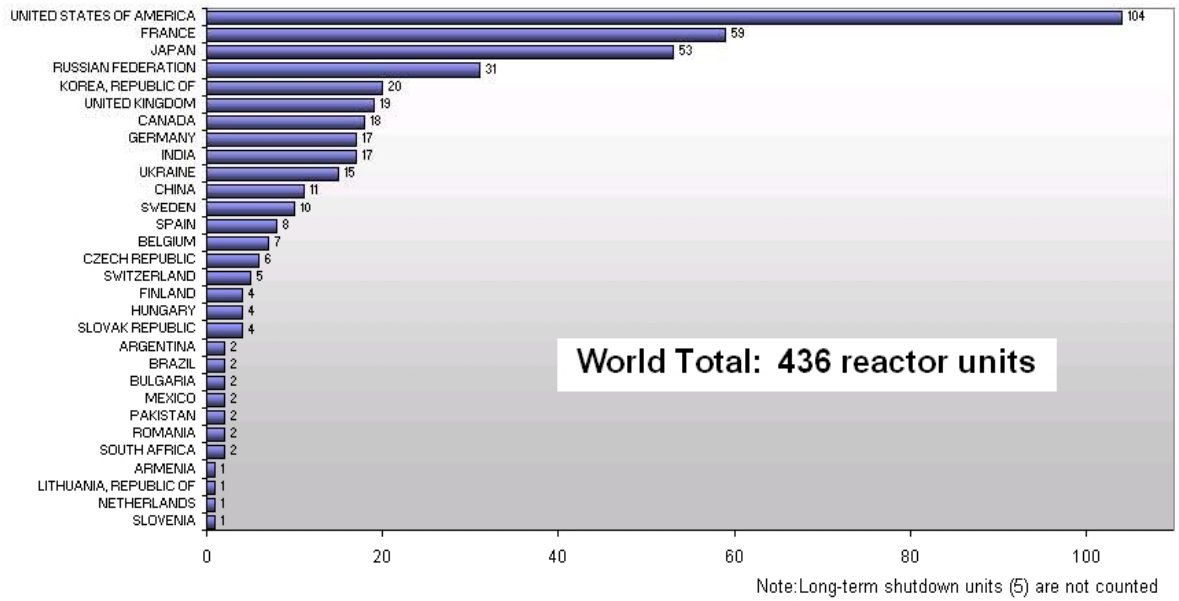
NUCLEAR POWER PLANT INFO
WORLD SUMMARY
REACTOR DETAILS
Select Country
Sorting Order
alphabetically
SEARCH

(*) Information on nuclear power plants in Taiwan, China can be provided on request.

Registered Users

NUCLEAR POWER PLANTS INFORMATION

Number of Reactors in Operation Worldwide



Note:Long-term shutdown units (5) are not counted

Note: In the World Total there are also 6 reactors in operation in Taiwan, China.

Go Back to Nuclear Power Plant Information

WHAT IS PRIS
PUBLICATIONS
SERVICES
HOW TO ORDER
PRIS PC SOFTWARE

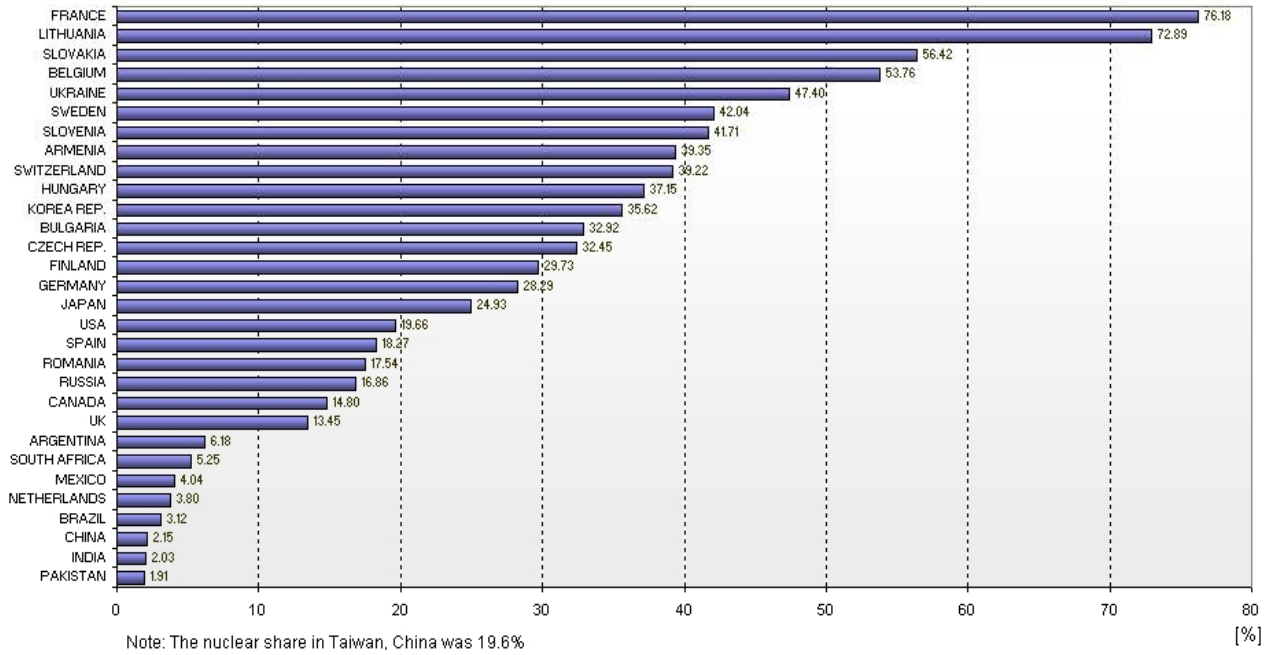
NUCLEAR POWER PLANT INFO
WORLD SUMMARY
REACTOR DETAILS
Select Country
Sorting Order
alphabetically
SEARCH

(*) Information on nuclear power plants in Taiwan, China can be provided on request.

Registered Users

NUCLEAR POWER PLANTS INFORMATION

Nuclear Share in Electricity Generation in 2008



Note: The nuclear share in Taiwan, China was 19.6%

Go Back to Nuclear Power Plant Information

This page was automatically created on 06 Dec 2009, 10:48:59 .

POWER REACTOR INFORMATION SYSTEM

WHAT IS PRIS
PUBLICATIONS
SERVICES
HOW TO ORDER
PRIS PC SOFTWARE

NUCLEAR POWER PLANT INFO
WORLD SUMMARY
REACTOR DETAILS

Select Country

Sorting Order
alphabetically

SEARCH

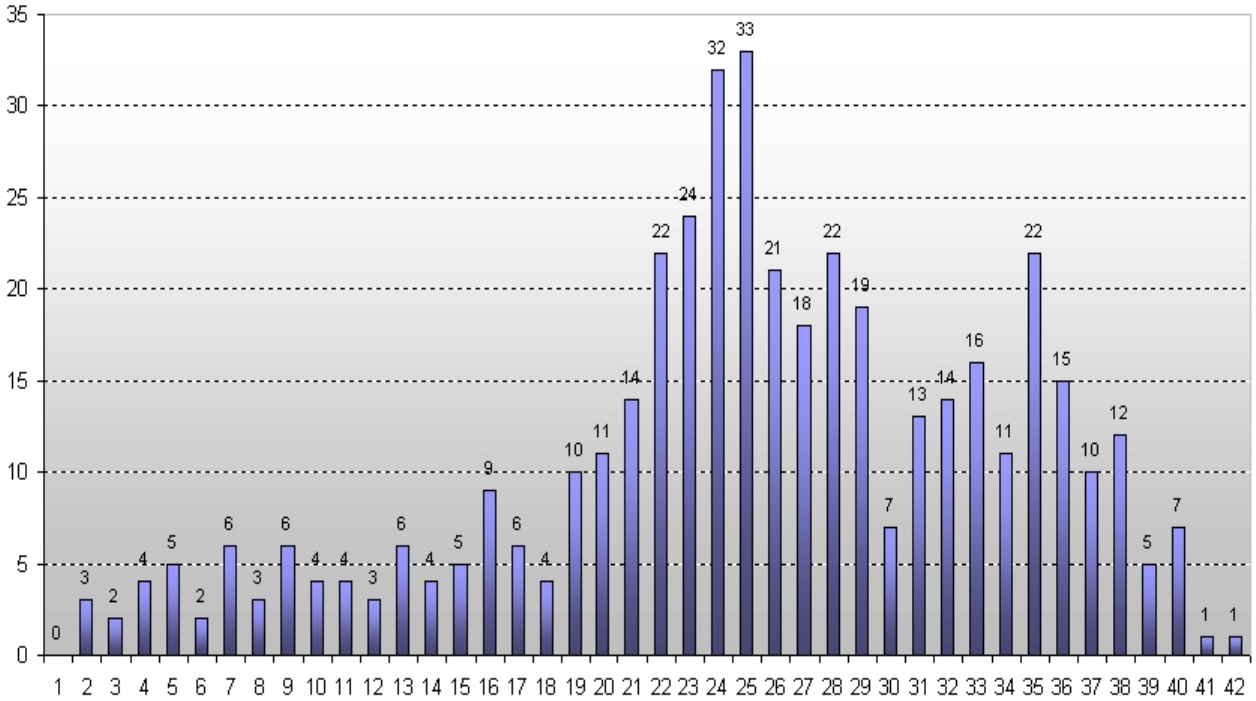
(*) Information on nuclear power plants in Taiwan, China can be provided on request.

Registered Users

NUCLEAR POWER PLANTS INFORMATION

Number of Operating Reactors by Age

(as of March 2009)



Note: Age of a reactor is determined by its first grid connection.

Go Back to Nuclear Power Plant Information

 Comments to Project Officer

This page was automatically created on 29 Mar 2009, 18:19:52 .

WHAT IS PRIS
PUBLICATIONS
SERVICES
HOW TO ORDER
PRIS PC SOFTWARE

NUCLEAR POWER PLANT INFO
WORLD SUMMARY
REACTOR DETAILS
Select Country
Sorting Order
alphabetically
SEARCH
(*) Information on nuclear power plants in Taiwan, China can be provided on request.

Registered Users

LATEST NEWS RELATED TO PRIS AND THE STATUS OF NUCLEAR POWER PLANTS

Current status of the nuclear industry:

- **436 nuclear power reactors in operation** with a total net installed capacity of 370.304 GW(e)
- **5 nuclear power reactors in long term shutdown**
- **56 nuclear power reactors under construction**

2009 Highlights:

- Construction initiation:
  - **Hongyanhe 3** (1000 MW(e), PWR, China) - construction officially started on 7 March
  - **Sanmen 1**, (1000 MW(e), PWR AP-1000, China) - construction officially started on 19 April
  - **Yangjiang 2** (1000 MW(e), PWR, China) - construction officially started on 4 June
  - **Fuqing 2**, (1000 MW(e), PWR, China) - construction officially started on 17 June
  - **Novovoronezh 2-2** (1085 MW(e), PWR-VVER, Russia) - construction officially started on 12 July
  - **Fangjiashan 2** (1000 MW(e), PWR, China) - construction officially started on 17 July
  - **Hongyanhe 4** (1000 MW(e), PWR, China) - construction officially started on 15 August
  - **Shin-Kori 4** (1340 MW(e), PWR-APR 1400, S. Korea) - construction officially started on 15 September
  - **Haiyang 1** (1000 MW(e), PWR, China) - construction officially started on 24 September
  - **Taishan 1** (1700 MW(e), PWR-EPR, China) - construction officially started on 18 November
- Construction reactivation:
  - **Akademik Lomonosov 1&2**, (2x30 MW(e), PWR-KLT40, Russia) - floating NPP will be finally located close to Vilyuchinsk instead of Severodvinsk
  - **Mochovce 3&4**, (2x405 MW(e), PWR-VVER, Slovakia) - construction officially reactivated on 11 June
- Final shutdowns:
  - **Hamaoka 1&2**, (515/806 MW(e), BWR, Japan) were officially closed on 31 January

POWER REACTOR INFORMATION SYSTEM

Changes of NPP status during 2008:

- Final shutdowns:
  - **Bohunice 2** (408 MW(e), PWR-VVER, Slovakia) was closed on 31 December
- Construction initiation:
  - **Ningde 1**, (1000 MW(e), PWR, China) - construction officially started on 18 February
  - **Hongyanhe 2** (1000 MW(e), PWR, China) - construction officially started on 28 March
  - **Novovoronezh 2-1** (1085 MW(e), PWR-VVER, Russia) - construction officially started on 24 June
  - **Shin-Wolsong 2** (960 MW(e), PWR, S. Korea) - construction officially started on 23 September
  - **Leningrad 2-1** (1085 MW(e), PWR-VVER, Russia) - construction officially started on 25 October
  - **Shin-Kori 3** (1340 MW(e), PWR-APR 1400, S. Korea) - construction officially started on 31 October
  - **Ningde 2** (1000 MW(e), PWR, China) - construction officially started on 12 November
  - **Fuqing 1** (1000 MW(e), PWR, China) - construction officially started on 21 November
  - **Yangjiang 1** (1000 MW(e), PWR, China) - construction officially started on 16 December
  - **Fangjiashan 1** (1000 MW(e), PWR, China) - construction officially started on 26 December

Changes of NPP status during 2007:

- New units:
  - **Kaiga 3**, 202 MW(e), PHWR, India, (11 April)
  - **Tianwan 2**, 1000 MW(e), PWR-VVER, China, (14 May)
  - **Cernavoda 2**, 655 MW(e), PHWR-CANDU, Romania, (7 August)
- Restarts after a long term shutdown:
  - **Browns Ferry 1**, 1065 MW(e), BWR, USA, (2 June)
- Construction reactivation:
  - **Watts Bar 2**, 1165 MW(e), PWR, USA, (15 October)
- Construction initiation:
  - **Qinshan II-4**, 610 MW(e) PWR, China, (28 January)
  - **Severodvinsk - Akademik Lomonosov 1&2**, 2x30 MW(e), PWR-KLT40, Russia, (15 April)
  - **Shin Kori 2**, 960 MW(e), PWR, S. Korea, (5 June)
  - **Hongyanhe 1**, 1000 MW(e), PWR, China, (18 August)
  - **Shimane 3**, 1325 MW(e), ABWR, Japan, (12 October)
  - **Shin Wolsong 1**, 960 MW(e), PWR, S. Korea, (20 November)
  - **Flamanville 3**, 1600 MW(e), PWR, France, (3 December)
- Suspended construction:
  - **Balakovo 5**, 950 MW(e), PWR, Russia

Forms of IAEA activities to support NPP programs in Member States

- Technical Meetings, Specialists' Meetings
- Consultancy meetings to produce technical documents (TECDOCs) and guidance documents
- Coordinated Research Programmes (CRP)

- Regional and National Workshops and Training Courses
- Expert/review missions at specific utilities or countries

- Publications: Nuclear Energy Series Reports

IAEA

What we do

Producing IAEA reports/documents
Holding IAEA meetings

People, communication, sharing

IAEA


IAEA


CHAIRPERSON


GHANA
GERMANY


AEA


IAEA
DIRECTOR GENERAL
CHAIRPERSON
SECRETARY


)ONESIA

Magyar Középiskolások Látogatása a Nemzetközi Atomenergia Ügynökségnél (NAÜ)

Visit of Hungarian High Schools at the International Atomic Energy Agency (IAEA)

28 October 2008
IAEA Board Room, Vienna International Centre
Vienna, Austria

IAEA
International Atomic Energy Agency

… and all our distinguished guests in the audience:

Résztvevő vendégek:

- Baranya Megyei Önkormányzat Nagy László Gimnázium, Szakközép Iskola, Szakképző Iskola és Kollégium (Hajnal Gabriella, Tanárnő, az angol nyelvi munkaközösség vezetője)
- Paksi Energetikai Szakközépiskola és Kollégium (Szabó Béla, Igazgató)
- Komlói Honismereti és Városszépítő Egyesület (Jégl Zoltán alpolgármester)

IAEA

Distinguished guests at the head table:

- Dr. Györgyi Martin Zanathy, Ambassador, Permanent Representative of the Republic of Hungary to the United Nations Office and Other International Organisations in Vienna
- Mr. Miklós Csuvár, Nuclear Safety Inspector of the Hungarian Atomic Energy Authority
- Mr. János Eiler, Project Manager, Paks NPP
- Mr. Giovanni Verlini, Public Information Specialist, IAEA Division of Public Information

IAEA


I wish you a successful meeting
and a pleasant stay in Vienna
Thank you
IAEA
IAEA
IAEA

Recent meetings – September 2009

- Consultants' Meeting on "Cable Ageing in Nuclear Power Plants", September 3-4, OECD, Paris, France
- Consultants' Meeting to complete the NE Series Report titled "Core Knowledge on Instrumentation and Control Systems in Nuclear Power Plants" (D-NP-T-3.12), September 8-11, 2009, Vienna
- 2nd International Workshop on "The Applications of Field-programmable Gate Arrays in Nuclear Power Plants", September 29-October 1, 2009, Kirovograd, Ukraine

IAEA

Recent meetings – October 2009

- 2nd Research Co-ordination Meeting on “Advanced Surveillance, Diagnostics, and Prognostics Techniques used for Health Monitoring of Systems, Structures, and Components in Nuclear Power Plants”, October 6-9, 2009”, KAERI, Daejeon, Republic of Korea

- Consultants’ Meeting to initiate the development of a new Nuclear Energy Series Report on “Electric Grid Reliability and Interface with Nuclear Power Plants”, October 19-22, 2009, Vienna

- IAEA International Conference on Opportunities and Challenges for Water Cooled Reactors in the 21st Century, Vienna, Austria, October 27-30, 2009 (Plenary panel discussion and technical session on I&C Systems)

IAEA

Recent meetings – November 2009

- Consultants' Meeting on "Guidance to Consistent Compliance of Licensing Digital I&C Systems and Equipment in Nuclear Power Plants", November 3-6, 2009, Vienna, Austria
- TC VIE4015 Workshop on "Electric Grid Reliability and Interface with Nuclear Power Plants", November 10-12, 2009, Hanoi, Vietnam
- TC RER0031 Planning meeting on "Strengthening Sustainability of Nuclear Research and Development Institutes in the Modern Science and Technology Environment in Central and Eastern Europe", November 16-18, 2009, Vienna
- TC ARG4090 Workshop/expert mission on the I&C system of the Atucha NPP Unit 2 restart, November 24-27, 2009, Buenos Aires, Argentina

IAEA

Meetings – December 2009

- Consultants' Meeting on "Developing an IAEA Report on the Qualification of Digital Commercial Off-the-Shelf Equipment for use in the Safety Systems of NPPs", December 1-4, 2009, Vienna
- IAEA TC CPR4032 National Training Course on "Instrumentation and Control Codes and Standards Used in Nuclear Power Plants", December 8-10, 2009, Beijing, China
- Consultants' Meeting on "Establishing a Review Mission to Assess Member States' Readiness to Integrate Nuclear Power Plants into Electric Grids", 15-18 December 2009, Vienna, Austria

IAEA

Meetings – January/February 2010

- Consultants' Meeting on "Developing guidelines and reporting formats for future I&C review missions", January 12-14 2010, Vienna
- Consultants' Meeting on "Cable Ageing in Nuclear Power Plants", January 28-29, 2010, OECD, Paris, France
- Implement IERICS review mission on the prototype of the advanced digital I&C systems designed for APR-1400 NPP, 31 January - 6 February 2010, Doosan Company, Seoul, Rep. of Korea
- Consultants' Meeting on "Advanced Surveillance, Diagnostics, and Prognostics Techniques used for Health Monitoring of Systems, Structures, and Components in Nuclear Power Plants", February 9-12, 2010, Dunaujvaros, Hungary

IAEA

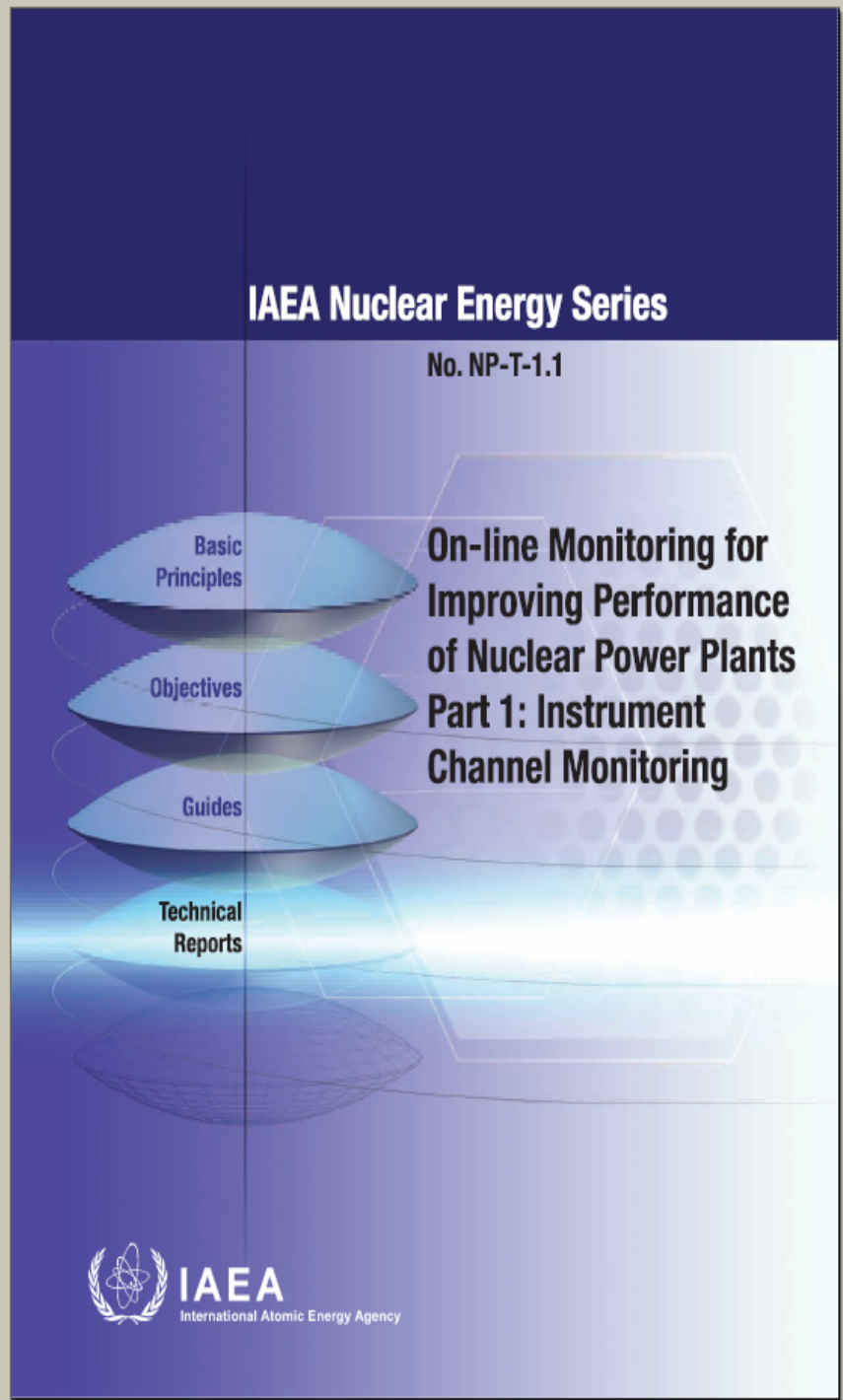
Planned meetings 2010 2Q

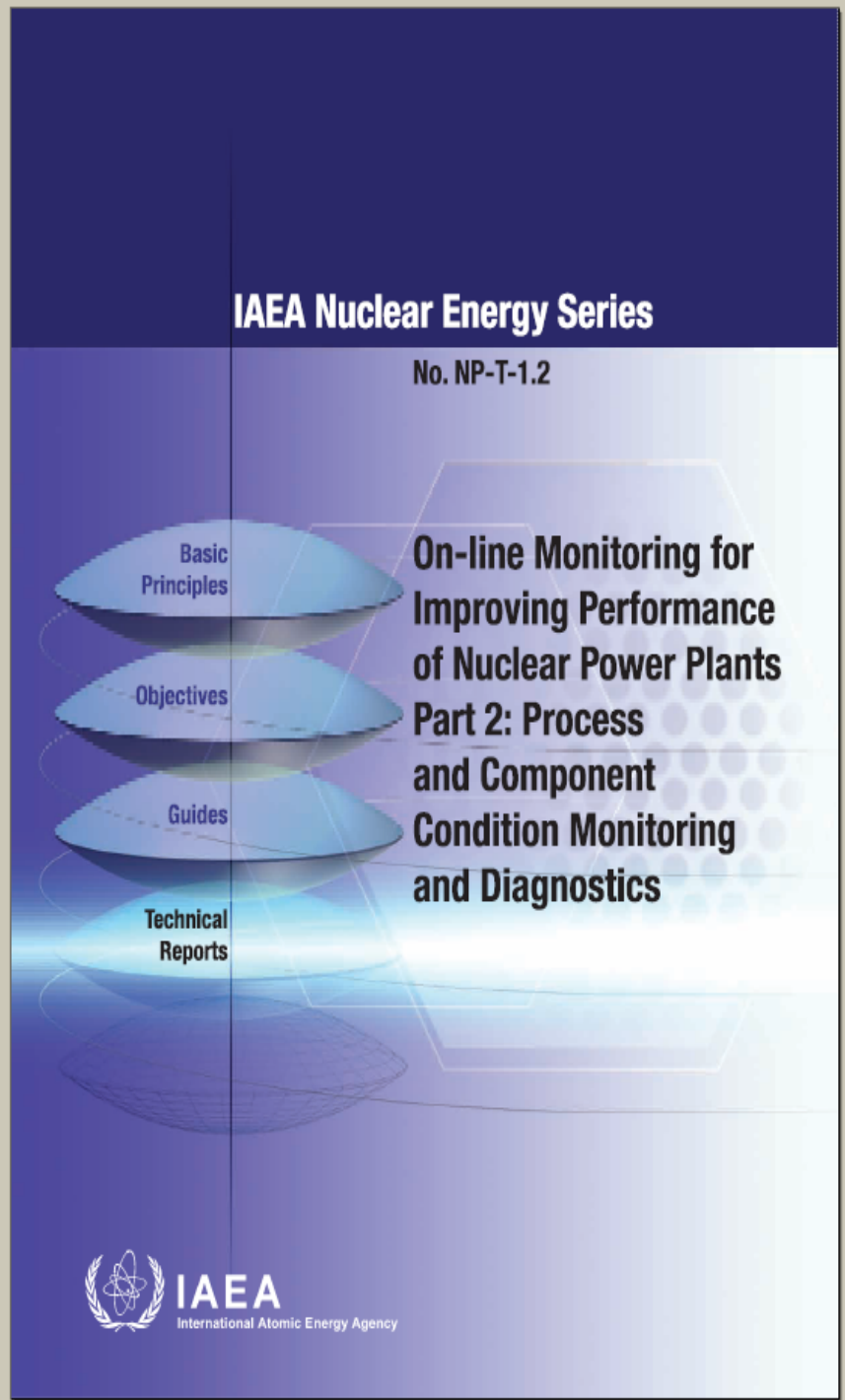
- Joint ICTP/IAEA Workshop on “Vulnerability of Energy Systems to Climate Change and Extreme Events”, April 19-23, 2010, Miramare, Trieste, Italy
- National Training Course on "Electric Grid Reliability and Interface with Nuclear Power Plants", 27-30 April 2010, Tunis, Tunisia
- 3rd Research Co-ordination Meeting on “Advanced Surveillance, Diagnostics, and Prognostics Techniques used for Health Monitoring of Systems, Structures, and Components in Nuclear Power Plants”, June 8-11, 2010, PNNL, Richland, Washington, USA
- Workshop on the “Role of digital I&C systems in modernization projects of NPPs”, May 11-14, 2010, Portoroz, Slovenia

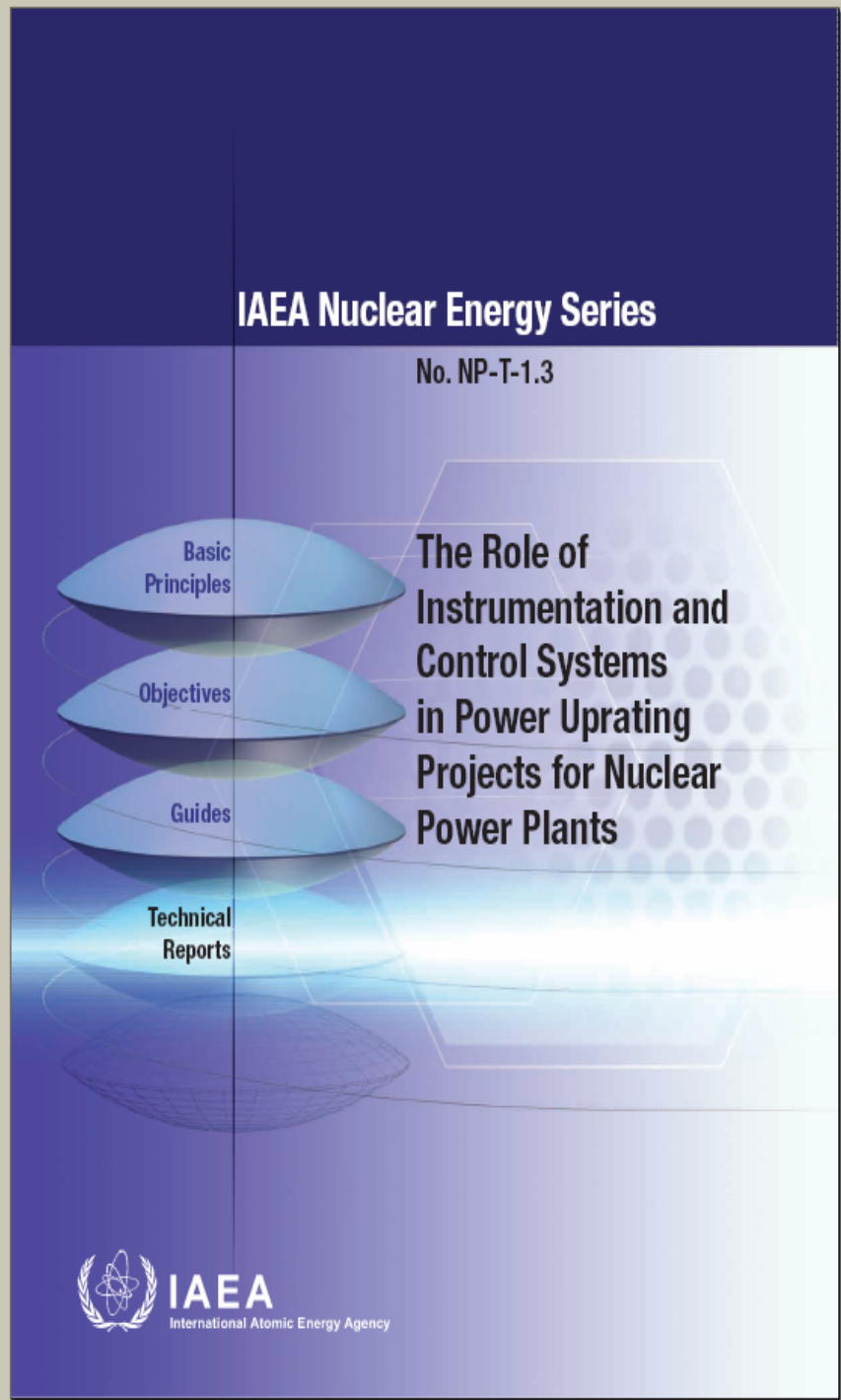
IAEA

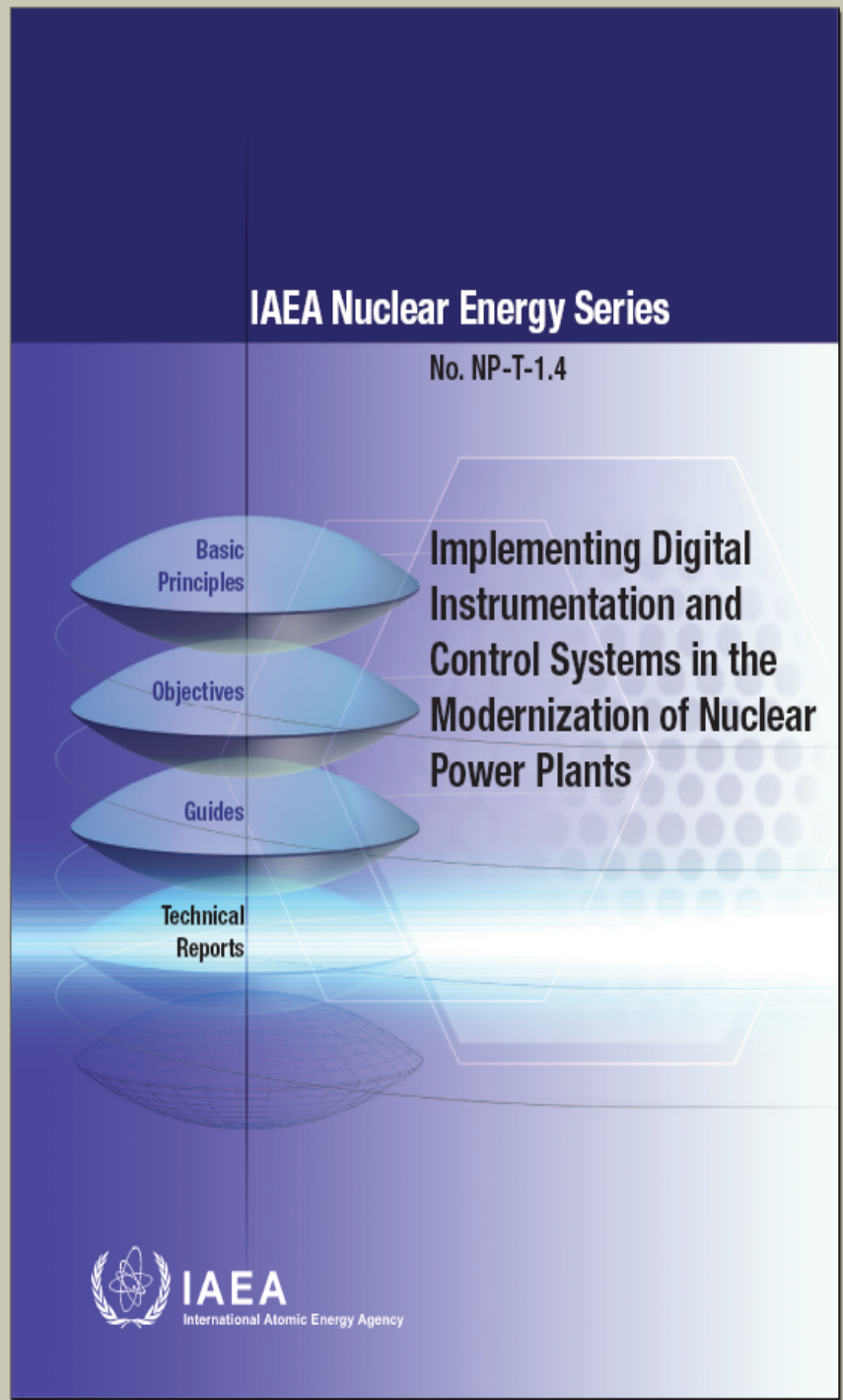
Planned meetings 2010 2Q

- TM on "Assessing and Managing Cable Ageing in NPPs", in cooperation with OECD/NEA, to be hosted by Halden Reactor Project on 14-17 September 2010, in Halden, Norway
- TM to further develop NE Series Report on "Electric Grid Reliability and Interface with Nuclear Power Plants", 4-6 August 2010, Vienna
- 7th Nuclear Power Instrumentation and Control and Human-Machine Interface Technologies (NPIC & HMIT) Conference, to be held in Las Vegas, NV, USA, on 7-11 November 2010









Useful websites

Publications in general

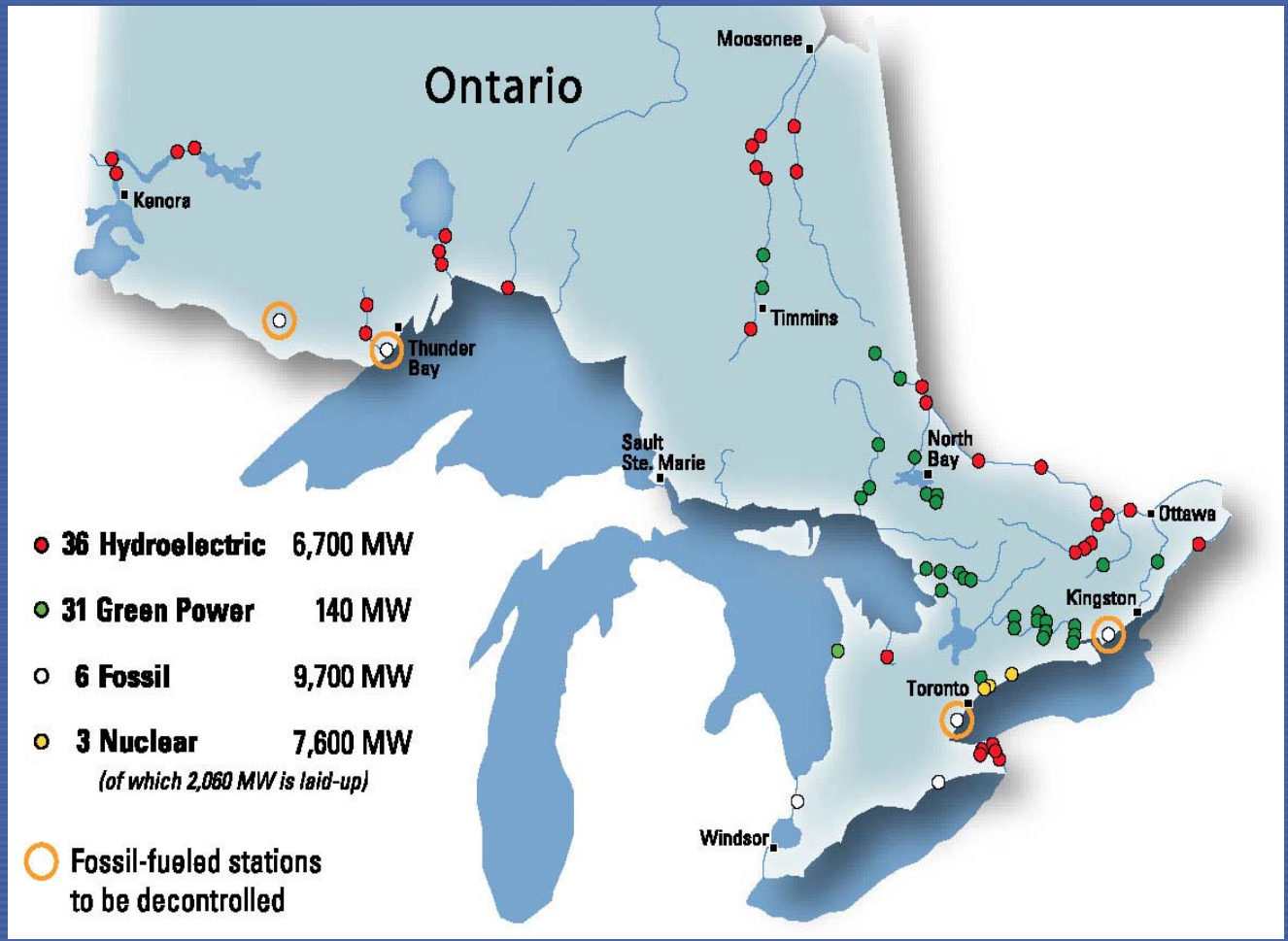
http://www.iaea.org/Publications/index.html

IAEA NPP Meetings

http://www.iaea.org/NuclearPower/Engineering/

IAEA

Locations of CANDU Nuclear Generating Stations in Ontario, Canada



IAEA

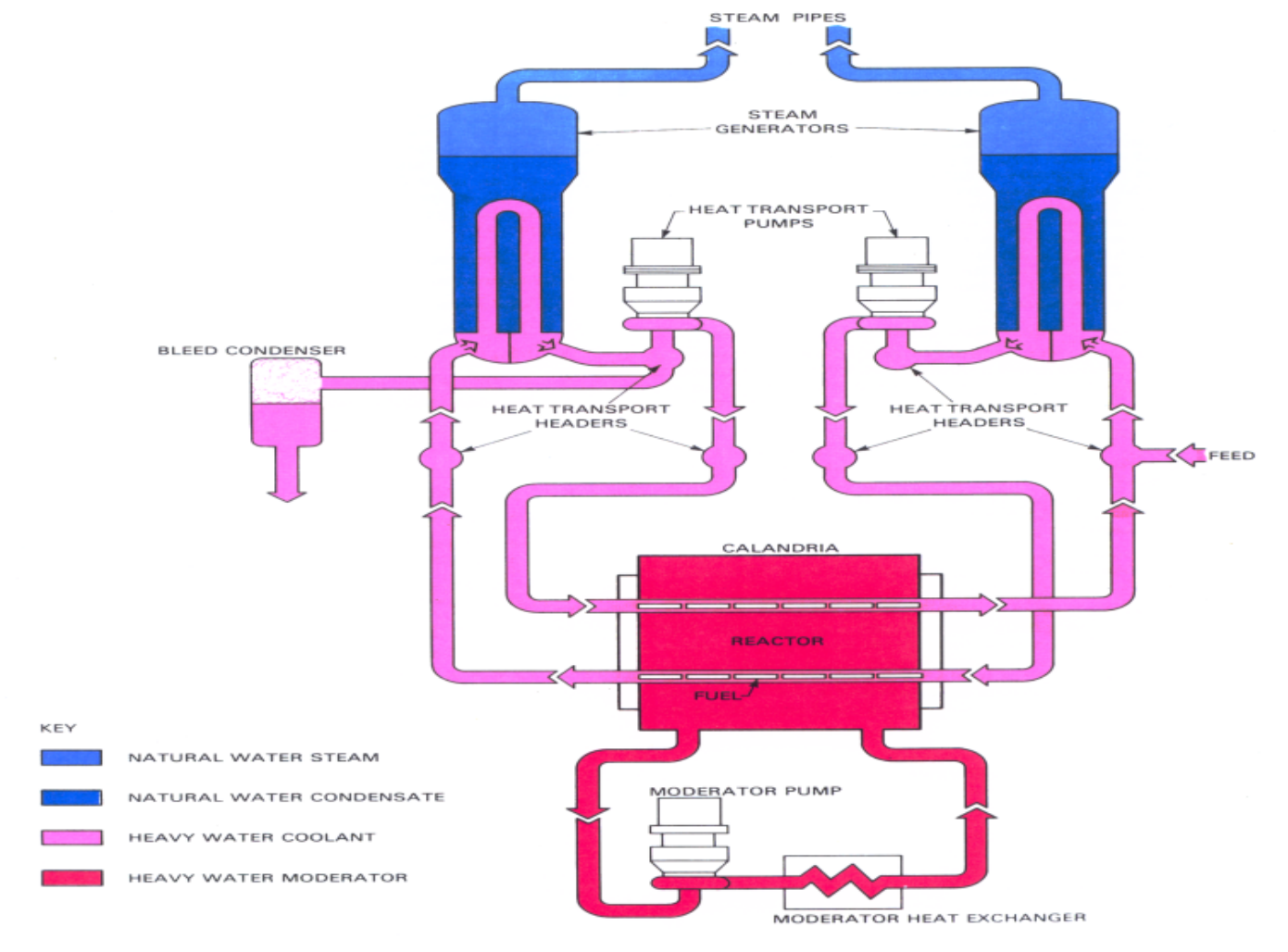
CANDU NPP sites of OPG and Bruce Power

- Darlington: 4 reactor units (880 MW, OPG)
- Pickering-A: 4 reactor units (515 MW, OPG)
- Pickering-B: 4 reactor units (515 MW, OPG)
- Bruce-A: 4 reactor units (770 MW, Bruce Power)
- Bruce-B: 4 reactor units (785 MW, Bruce Power)

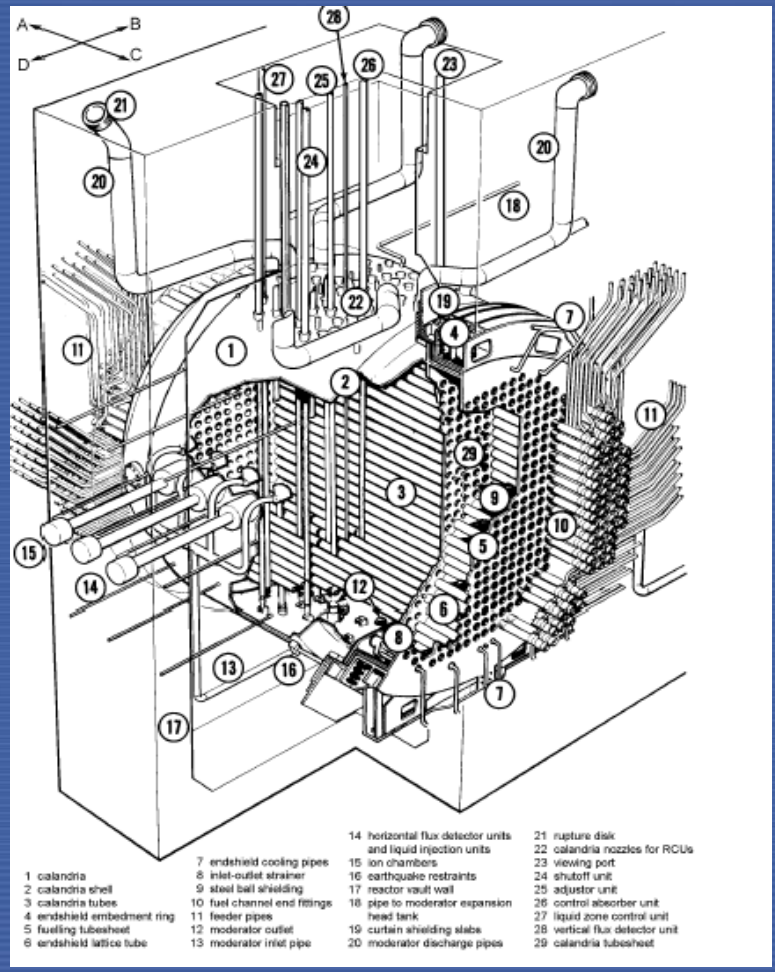
CANDU NPP sites of OPG and Bruce Power

IAEA

Simplified CANDU Schematic

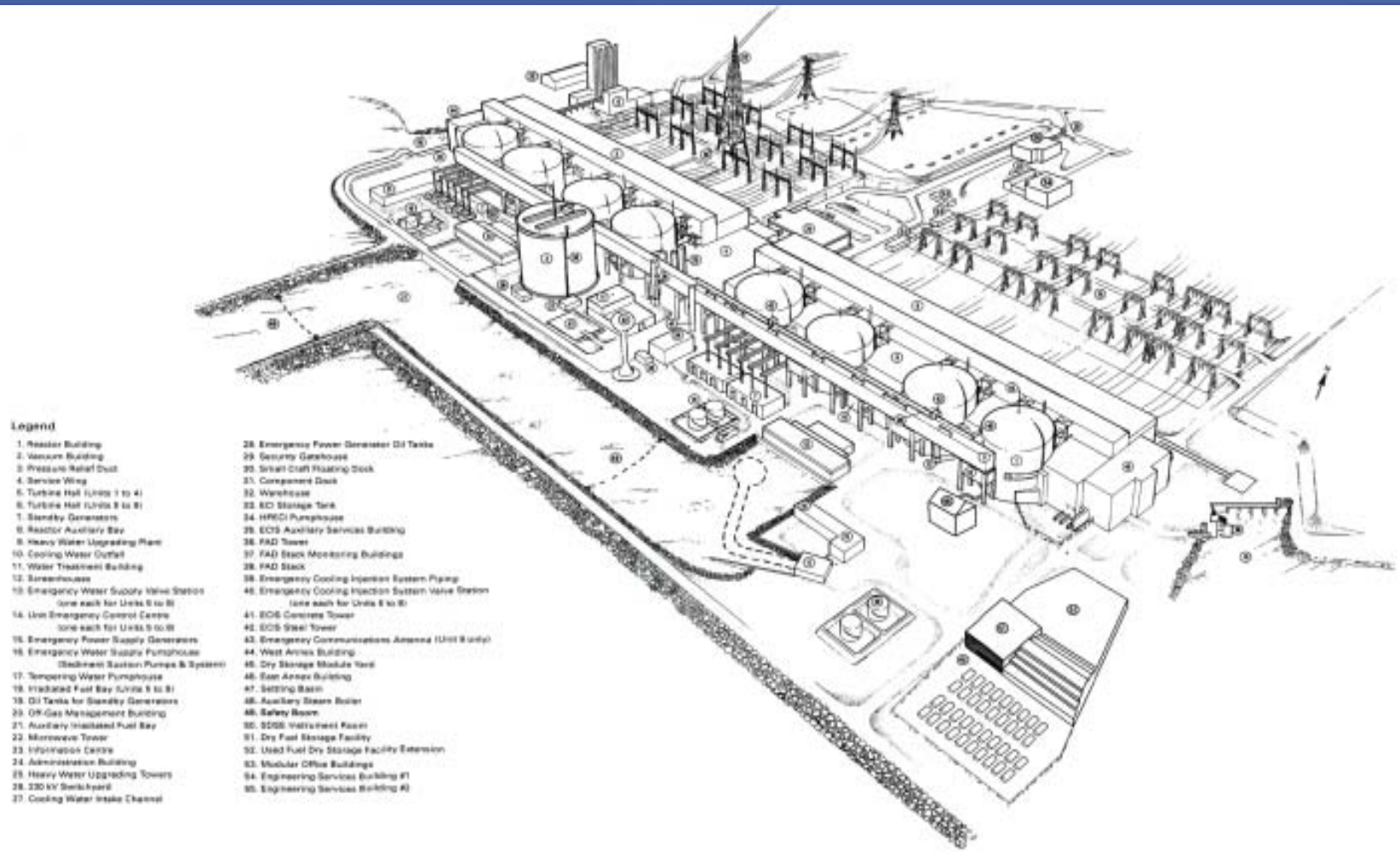


IAEA


A
B
C
D
1 calandria
2 calandria shell
3 calandria tubes
4 endshield embedment ring
5 fuelling tubesheet
6 endshield lattice tube
7 endshield cooling pipes
8 inlet-outlet strainer
9 steel ball shielding
10 fuel channel end fittings
11 feeder pipes
12 moderator outlet
13 moderator inlet pipe
14 horizontal flux detector units and liquid injection units
15 ion chambers
16 earthquake restraints
17 reactor vault wall
18 pipe to moderator expansion head tank
19 curtain shielding slabs
20 moderator discharge pipes
21 rupture disk
22 calandria nozzles for RCUs
23 viewing port
24 shutoff unit
25 adjustor unit
26 control absorber unit
27 liquid zone control unit
28 vertical flux detector unit
29 calandria tubesheet

IAEA

Perspective Sketch of Pickering A and B



IAEA

Safe Operation

Design
- Redundancy
- Independence
- Diversity
- Defence in depth

Operation & Maintenance
- Safety Culture
- Adherence to Procedures
- Monitoring, Diagnostics, Prognostics
- Ageing Management
- License Renewal

Regulation and Licensing
- National Responsibility

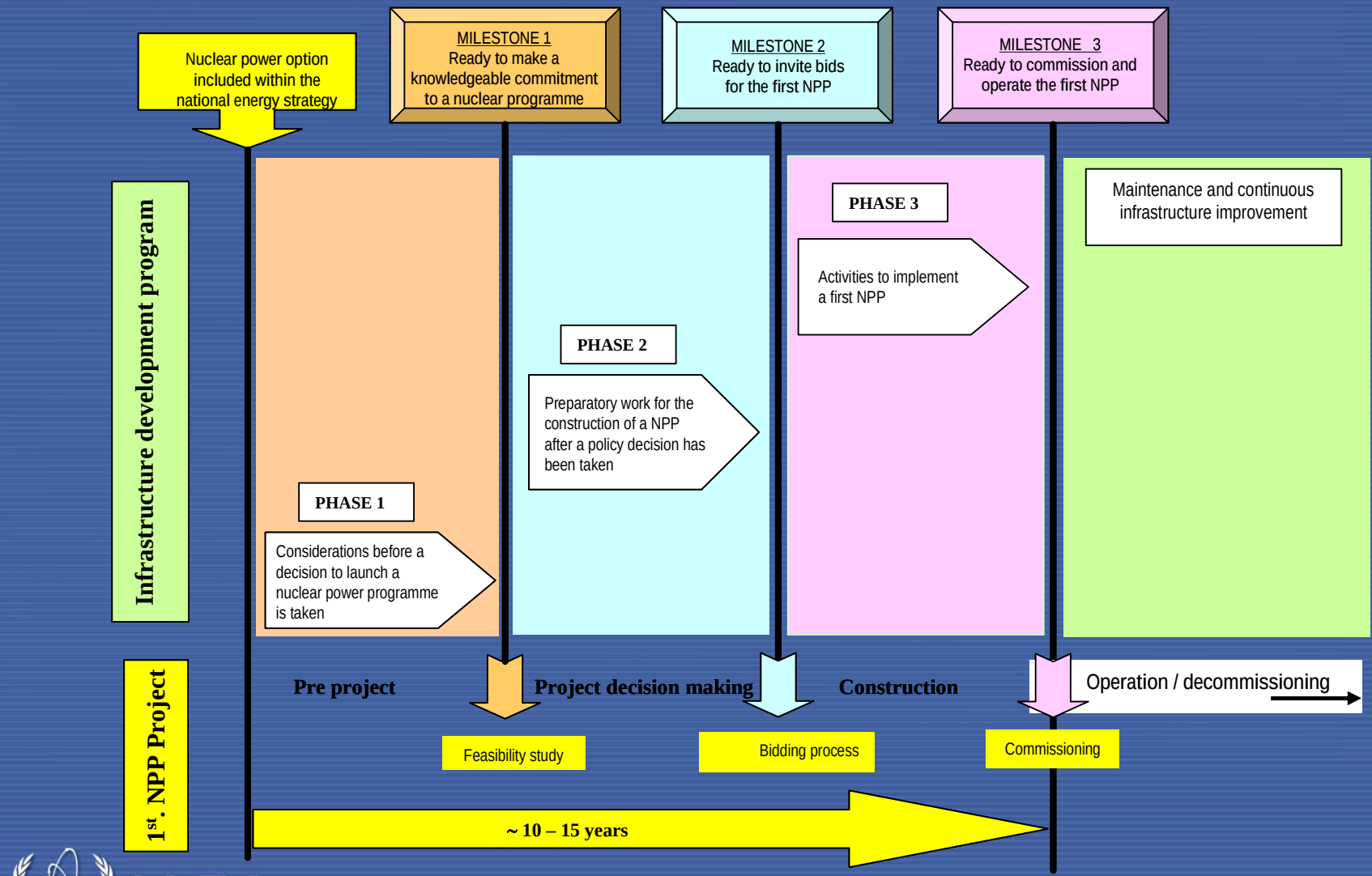
IAEA

Development Areas of a National Infrastructure for Nuclear Power

- National position
- Nuclear safety
- Management
- Funding and financing
- Legislative framework
- Safeguards
- Regulatory framework
- Radiation protection
- Electrical grid
- Human resources development
- Stakeholder involvement
- Site and supporting facilities
- Environmental protection
- Emergency planning
- Security and physical protection
- Nuclear fuel cycle
- Radioactive waste
- Industrial involvement
- Procurement

IAEA

Milestones in the Development of a National Infrastructure for Nuclear Power



IAEA

INFRASTRUCTURE DEVELOPMENT PROGRAMME

Additional items to discuss

- Expansion of national NPP projects
- Regional Cooperation
- New Technologies (Generation IV)
- Multinational Vendors – National Regulations
- Size and location of NPPs
- Zero GHG emission vs. waste management
- Life extension – qualified life
- Human resources
- Supply Chain
- Non-proliferation – safeguard
- Physical and cyber security
- Newcomer countries

IAEA

Thank you

O.Glockler@iaea.org

IAEA