

Status and Prospects of Nuclear Power

Asia Cooperation Dialogue Conference towards energy security, sustainability and resiliency Bohol, Philippines, 7 August 2017

> Dohee Hahn Director, Division of Nuclear Power International Atomic Energy Agency



International Atomic Energy Agency

IAEA is the UN's scientific forum for cooperation in the nuclear field.



Maximizing the contribution of nuclear technology to the world, while verifying its peaceful use



United Nations Sustainable Development Goals



NPPs - Current Position



446 in operation* in 30 countries



390 GW(e) capacity*

61 under construction* in 15 countries



163 Shutdown reactors



• USA 99

- France 58
- Russia 35
- China 37
- Rep Korea 24

Approximately 2/3rds are in Asia with 2 newcomer countries - Belarus & the United Arab Emirates

Some recent announcements of further permanent shutdowns in Sweden, Korea and the USA.

2030 Projections





Nuclear Power Development in Different Regions







Drivers for nuclear power post-Fukushima

- Drivers for consideration of nuclear power have not changed:
- Energy security
- Volatile fossil fuel prices
- Climate change
- Increased demand for clean energy



http://www.opec.org/opec_web/en/data_graphs/40.htm







IAEA and Newcomer Countries

"It is each country's sovereign decision whether to add nuclear power to its energy mix."



For those who choose to do so, the IAEA role is to help them build the expertise to use nuclear power safely, securely, and sustainably."

Yukiya Amano IAEA Director General

General Conference 2015 Africa Side Event



Newcomer country numbers

Number of Member States at different stages of decision making and planning for nuclear power in 2012–2016 according to their official statements

	2012	2013	2014	2015	2016
First nuclear power plant started construction/under construction	1	2	2	2	2
First nuclear power plant ordered	2	1	1	1	2
Decided to introduce nuclear power and started preparing the appropriate infrastructure	6	6	7	7	6 ^a
Active preparation for a possible nuclear power programme with no final decision	6	5	5	6	7
Considering nuclear power programme	13	19	18	11	10*

^a Includes Viet Nam, whose National Assembly in November 2016 endorsed the Government's decision to cancel the country's nuclear power plans

* Another 17 countries expressed interest in nuclear power during the IAEA General Conference or in high level bilateral meetings



The Milestones Approach

- Comprehensive framework for IAEA guidance to newcomers
- Adopted by Newcomers and industry
- 2007 edition based on experts past experience
- Revised in 2015





Milestones in the Development of a National Infrastructure for Nuclear Power

Nuclear power option included in national energy strategy	Ready to knowle commitr nuclea progr	MILESTONE 1 Ready to make a knowledgeable commitment to a nuclear power programme		MILESTONE 2 Ready to invite bids/negotiate a contract for the first nuclear power plant		to sion and the first wer plant	
	PHASE 1 Considerations before a decision to launch a nuclear power programme is taken	PHASE 2 Preparatory work for the contracting and construction of a nuclear power plant after a policy decision has been taken		PHASE 3 Activities to implement the first nuclear power plant			
FIRST NUCLE	AR POWER PLAN	PROJE	CT				
	Pre-project activities	P deve	roject elopment	Final ir de Con Cons	nvestment cision tracting struction	Commi Ope Decomn	ssioning ration hissioning
" <u>Milestones in the Development of a National Infrastructure for Nuclear Power</u> " (IAEA Nuclear Energy Series No. NG-G-3.1, Rev. 1)							

(IALA MUCIEAL LITELY SELIES NO. NG-G-3.1, NEV 1)



Infrastructure Issues



The Milestones Approach is holistic and considers 19 specific infrastructure issues



Integrated Nuclear Infrastructure Review

- Based on the Milestones Approach: 19 Infrastructure Issues, 3 Phases, 3 Milestones
- International expert review led by a high level IAEA manager
- Identifies areas for further action and makes suggestions and recommendation
- Results are delivered to Government and decisionmakers



13

Integrated Nuclear Infrastructure Review Missions 2009 - 2017

1. Jordan	2009
2. Indonesia	2009
3. Vietnam	2009
4. Thailand	2010
5. UAE (Phase 2)	2011
6. Bangladesh (Phase 1&2)	2011
7. Jordan follow-up	2012
8. Belarus (Phase 1&2)	2012
9. Vietnam (Phase 2)	2012
10. Poland	2013
11. South Africa (Phase 2)	2013
12. Turkey (Phase 2)	2013
13. Jordan (Phase 2)	2014
14. Vietnam follow-up	2014
15. Nigeria (Phase 2)	2015
16. Kenya	2015
17. Morocco	2015
18. Bangladesh follow-up	2016
19. Poland follow-up	2016
20. Malaysia (Phase 1)	2016
21. Kazakhstan (Phase 1)	2016
22. Ghana (Phase 1)	2017





Nuclear innovation in climate change mitigation

- New technologies and creative approaches
- Technical innovations
 - Long term operation of current nuclear power plants
 - Advanced and evolutionary reactors
 - Small modular reactors
 - Future revolutionary reactors
 - Non-electrical applications

Advanced Water Cooled Reactors

ABWR Shika (1996)

60 Years

- Operation
 - ABWR
 - APR-1400
 - VVER-1200
- Under Construction
 - EPR
 - AP-1000
- Detailed Design
 - ESBWR
 - APWR
 - ATMEA1









ADVANCED LARGE WATER COOLED REACTORS A SUPPLEMENT TO THE IAEA'S ADVANCED REACTOR INFORMATION SYSTEM (ARIS)







16

Small Modular Reactors

- Advanced reactors producing electricity up to 300 MW(e) per module
- Flexible power generation
- Enhanced safety performance
- Lower upfront capital cost
- Suitable for cogeneration and nonelectric applications
- Option for remote regions



Advances in Small Modular Reactor Technology Developments

A Supplement to: IAEA Advanced Reactors Information System (ARIS)







IAEA Technology Roadmap of SMRs for Near Term Deployment



19

Interests in HTGRs

- 14 MSs in the TWG-GCRs
- Active Projects
 - China (HTR-10 and HTR-PM)
 - Japan (HTTR and Hydrogen project)
 - USA, South Africa, Korea, Russia
- Indonesia
 - 10MW experimental power reactor
- MSs that recently expressed interest
 - Saudi Arabia, Australia, Poland, Singapore



Advances in Small Modular Reactor Technology Developments

A Supplement to: IAEA Advanced Reactors Information System (ARIS) 2016 Edition





Non-electric Applications





INTERNATIONAL MINISTERIAL CONFERENCE



Nuclear Power in the 21st Century

30 OCTOBER - 1 NOVEMBER 2017 ABU DHABI, UNITED ARAB EMIRATES





60 Years

In cooperation with the OECD Nuclear Energy Agency



Hosted by the United Arab Emirates Government through the Ministry of Energy and the Federal Authority for Nuclear Regulation



CONTRACT





Thank you!

D.Hahn@iaea.org

Follow us on Twitter: @IAEANE