

Nuclear Power Planning with focus on infrastructure building

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Atoms for Peace: The First Half Century
1957–2007

Introduction

Nuclear infrastructure building

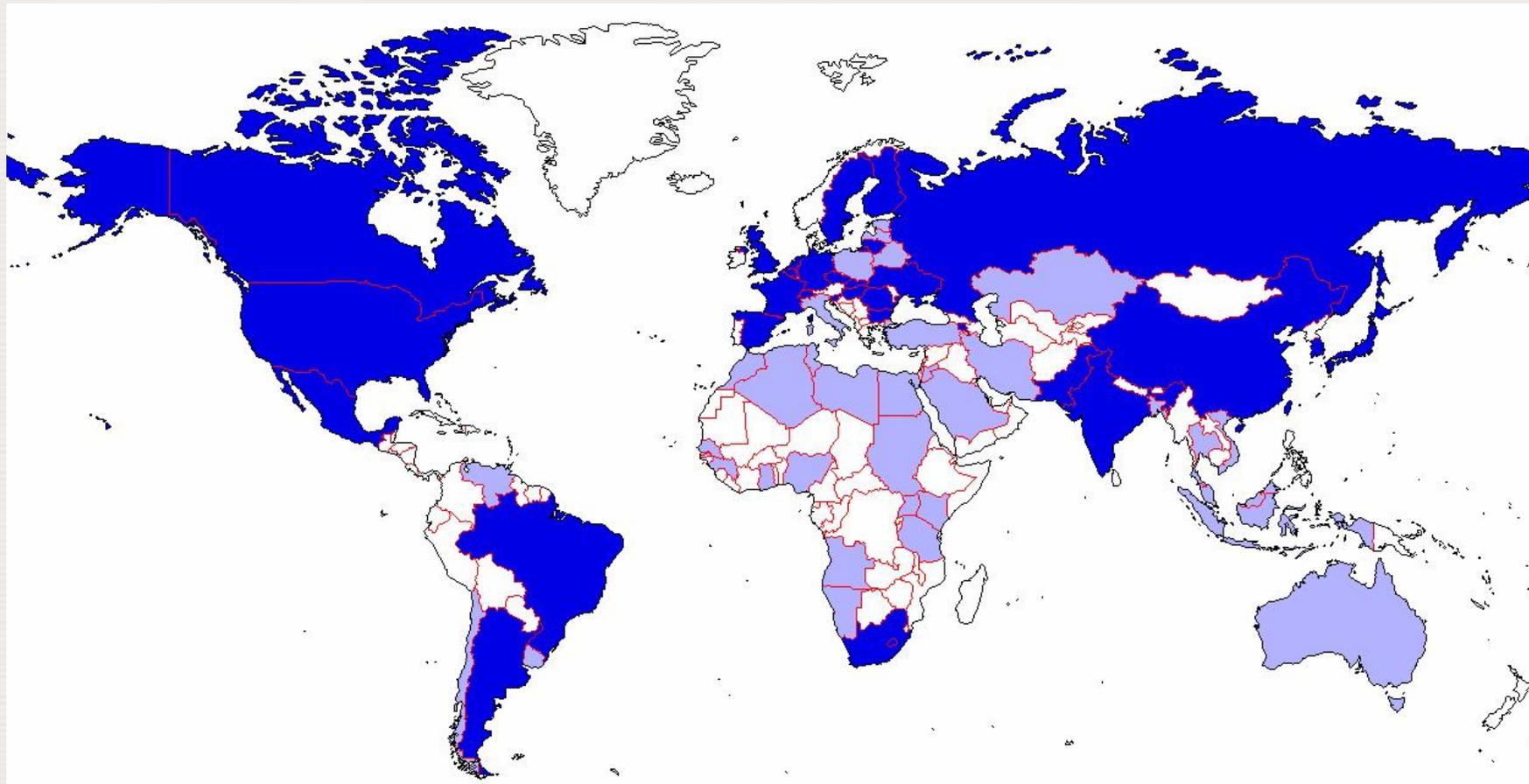
IAEA's guidance documents and approach

Summary

Increasing Nr. of countries considering introduction of nuclear power

- ✓ **Currently 30 countries are operating NPPs.**
- ✓ **Almost an equivalent number of countries in the various stages of considering or planning their first nuclear power plant**
- ✓ **Some developed countries are revisiting the nuclear option**
- ✓ **2007 IAEA Projection (published in RDS-1) by 2030**
 - 691 GWe in operation (up 321 GWe from now) in Hi-projection**
 - 447 GWe in operation (up 77 GWe from now) in Lo-projection**
- ✓ **Considering NP option in meeting the growing demand, considering;**
 - Fossil price rise**
 - Energy supply security**
 - Environment (GHG emission, air pollution)**
- ✓ **Confidence from operational trend : Stable & competitive in many places around the world**

Increasing Nr. of countries considering introduction of nuclear power



■ Operating

■ Considering

Introduction

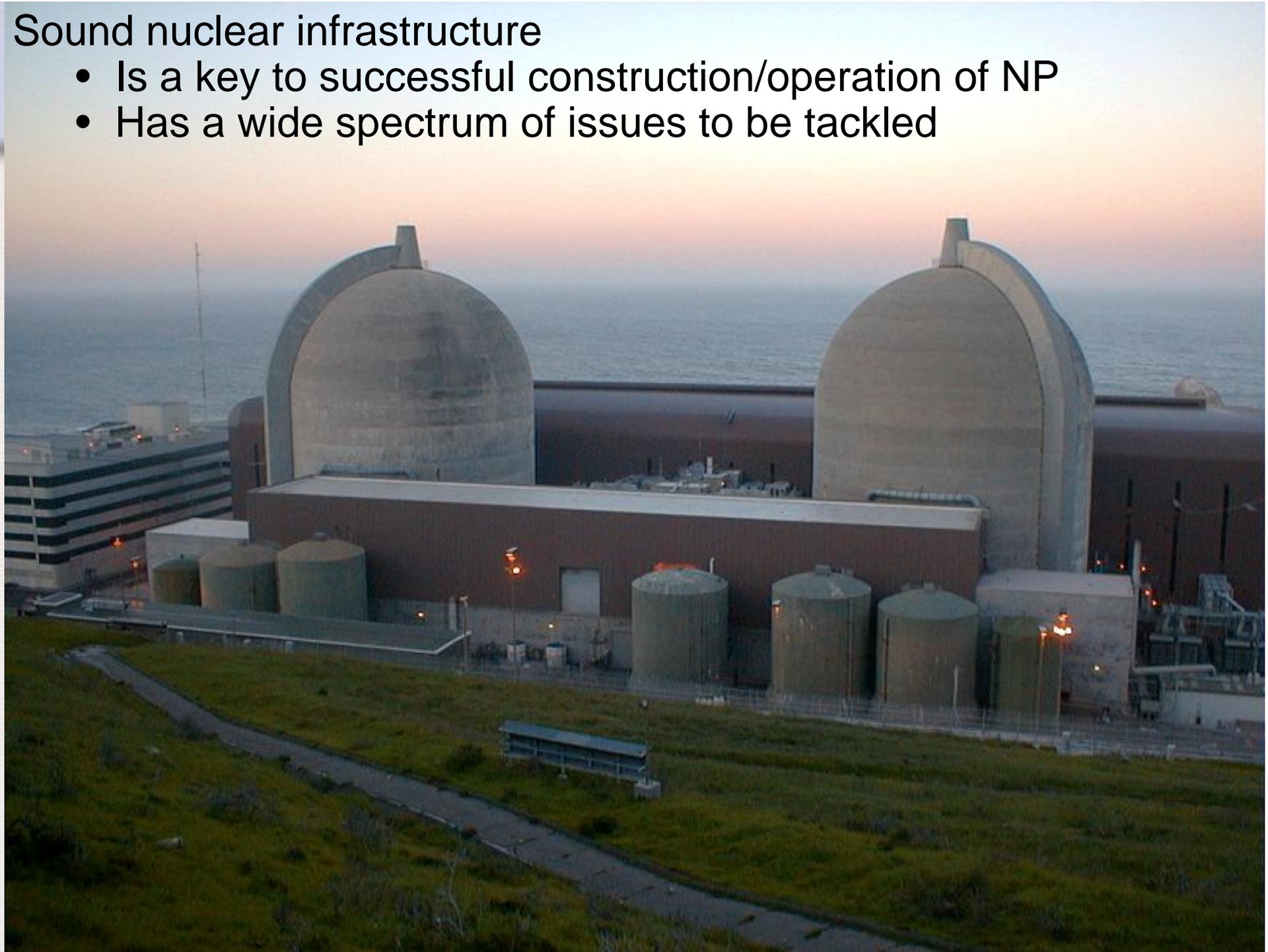
Nuclear infrastructure building

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Summary

Sound nuclear infrastructure

- Is a key to successful construction/operation of NP
- Has a wide spectrum of issues to be tackled



❑ From “policy decision to consider NP” to “start of operation of first NPP” : will be at least 10-15 years, since there are many complex and inter-related issues to look at

❑ Need step-by-step decision-making to reach

❑ Requires long term commitment of the nation

❑ Technology and market will evolve with time

❑ Jumping into advanced stage without establishing balanced infrastructure : may eventually retard the whole process

Potential risk of missing elements:

- Commitment by the Government & prospective Operator
- Definition of the role of government and private sector
- Human resources development
- Public acceptance
- Licensing framework etc.

Issues to be considered in nuclear infrastructure building

National Position
Regulatory Framework
Financing
Safeguards
Emergency Planning
Nuclear Waste
Nuclear Safety
Stakeholder Involvement
Management
Procurement

Legal Framework
Radiation Protection
Human Resource Development
Security and Physical Protection
Nuclear Fuel Cycle
Environmental Protection
Sites & Supporting Facilities
Electrical Grid
Industrial Involvement

NE series guide NG-G-3.1 “Milestones in the Development of a National Infrastructure for Nuclear Power, September 2007

Key steps to follow

Declaration of interest in nuclear as an option
ENERGY PLANNING

Phase 1: 1-3 years

- ✓ Development of knowledge of commitment/obligation & Assessment (national capacity, role of government..)
- ✓ Milestone: Formal Intention To Implement Nuclear Power Program

Phase 2: 3-7 years

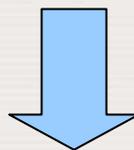
- Start implementation of INFRASTRUCTURE BUILDING PLAN...
- ✓ Milestone: Invitation To Bids Issued

Phase 3: 3-6 years

- ✓ First Project Contract Signed
- CONSTRUCTION of the FIRST NPP
- ✓ Milestone: Ready for Criticality and Operational Testing

Main issues to reach milestones

In each **Phase**



19 major issues to fulfil
for reaching the corresponding milestone

Each issue requires specific actions during
each phase

Infrastructure issues and milestones (NE series guide NG-G-3.1)

ISSUES	MILESTONE-1	MILESTONE-2	MILESTONE-3
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	☒	☒	☒

CONDITIONS

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CONDITIONS

Summary of Conditions to achieve the milestones (Sample from NE series guide NG-G-3.1)

Infrastructure Issue	Milestone 1 – Ready to Make a Knowledgeable Commitment to a Nuclear Programme	Milestone 2 – Ready to Invite Bids for the First NPP	Milestone 3 - Ready to commission and operate the first NPP
3.1. National Position	<ul style="list-style-type: none"> • NEPIO established and staffed • Safety, security and non-proliferation needs recognized • Appropriate international legal instruments identified • Comprehensive legal framework identified • Establishment of effectively independent regulatory body recognized • Nuclear power inserted in nation's development strategy • Needs of project management identified • Human resources needs surveyed • Financial resources evaluated • Arrangements for handling and storage of radioactive waste identified • Supply of national and international components and services assessed • Transparent communication and interaction regarding the nuclear programme established 	<ul style="list-style-type: none"> • National legislation enacted • International legal instruments adopted • Regulatory body established • An effective SSAC established • Financial and operational modalities established • Policy for nuclear fuel cycle established • Legal & financial arrangements for decommissioning established • Socio-political involvement established • Stakeholder involvement established and maintained • Policy for national industrial participation established • Human resources development programme started • Safeguards programme provided • Security programme provided • Radiation protection and emergency plans established • International standards for environmental protection adopted • Commitments and obligations of owner/ operator organisations established 	<ul style="list-style-type: none"> • Implementation national laws and regulations assured • Regulatory body funds and staff assured • Technical & managerial owner's competence verified by regulatory body • Acceptable level of socio-political involvement maintained • Sufficient financing availability assured • Human and physical resources assured • Appropriate funding plan for waste, long term spent fuel management and decommissioning implemented and assured
3.2 Nuclear Safety	<p>Recognized the need for :</p> <ul style="list-style-type: none"> • Relevance of nuclear safety • Long-term commitment for the first NPP • Cooperation in international partnerships • Need of intergovernmental instruments on safety • Support through international co-operation • Independent regulatory body 	<ul style="list-style-type: none"> • Safety responsibilities by all stakeholders recognized • Legal and governmental framework consistent with Fundamental Safety Principles implemented • Safety culture evaluated • Regulatory body able to evaluate the safety submission 	<ul style="list-style-type: none"> • Safety culture adopted by the constructor, engineer, operator and regulatory body organisations • Regulatory body prepared to determine whether an adequate appreciation for safety is present and with the authority to act independently • Programs to maintain technical skills and management attitude to assure strong safety culture are in place

First phase : Considerations Before a Decision to Launch a Nuclear Power Program is Taken

□ Outline

- Assess implications of launching nuclear programme
- Understand the commitment and obligations
- Develop nuclear energy strategy

□ Assessment

- National/regional energy plan (& non-electric application)
- Assessment of various energy options
- Assessment of viability of nuclear option

□ Understanding the need for development and establishment;

- Legal and regulatory framework
- Human resources development plan
- Financial and operational modality for the ownership/Operation
- Industry capability development & localization
- Fuel cycle strategies (procurement policy, disposal etc)

First phase : Considerations Before a Decision to Launch a Nuclear Power Program is Taken

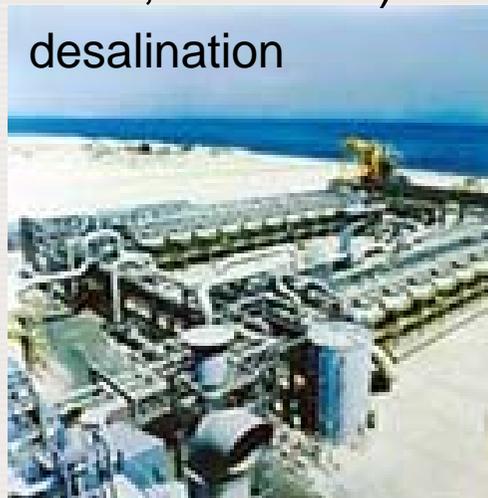
Nuclear power : required long-term commitment and stable policy

- Government may wish to support NP programme to **reduce uncertainties** of the implementation programme, by
 - Energy policy in support of NP as a option
 - Investment to national infrastructure building
 - Pre-licensing arrangement
 - Funding/loan-guarantee to NPP Project
 - Arrangement for long-term power off-take for capital intensive NPP project

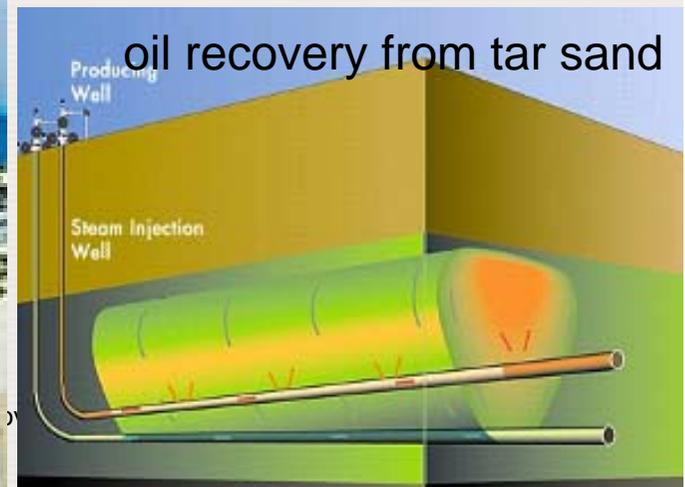
Consideration may be given also to non-electric applications of NP

- ❑ Global demand for portable water increase: **desalination**
- ❑ Most of the world's energy consumption is for **heat and transportation**. NE has potential to penetrate into these sectors currently served by fossil fuels (price volatility and finite supply)
- ❑ Technology development is ongoing so that nuclear energy can help **chemical energy production**
 - Recovery of oil from tar sand (Canada)
 - Sweetening of oil by adding hydrogen
 - Coal Liquefaction (S. Africa, Australia)

desalination



oil recovery from tar sand



Basic assessment by a WG (Inter-ministerial, inter-disciplinary)

- To study issues and conditions necessary for successful implementation of nuclear power
- To formulate policy,
- To plan their implementation, and
- To recommend to Government (Minister)
- Issue to look at includes;
 - Nuclear power in the electricity market and generation mix
 - Economics of nuclear power
 - Expected role of the government and the private sector
 - Available nuclear power technology etc.

*(18-24 months to conclude and recommend to the Government;
TECDOC 1513, Section 2.2)*

2nd phase : Policy decision for NP project ~ start of construction

□ Outline

- Follows Policy Decision – substantive work begins for ensuring the necessary level of technical and institutional competence is achieved by State and commercial organizations.
- Ensure the necessary level of technical/institutional competence is achieved

□ Assessment

- Confirm viability of NP by feasibility study

□ Establish framework and capabilities

- Enact legal framework
- Establish regulatory body
- Decide financial and operational modality for the ownership and implementation of NPP project (design assessment, establishing user requirement, tendering bid, bid evaluation)
- Evaluate available technology
- Tender bid & Bid evaluation etc.

EXAMPLE

Consideration in evaluation of available technology

- ❑ Desirable reactor & size would be **different by countries** (grid, finance, electricity market, multiple-purpose use etc.)
- ❑ Workshop on technology assessment (22-26October2007)
- ❑ Discussion of Common User Criteria may help (26-30November2007 workshop)
- ❑ In general
 - Near term** : most new nuclear build will likely be evolutionary designs pursuing economies of scale and based on operational experiences.
 - Longer term**: innovative designs (even shorter construction times and competitive economics) would emerge in the market including SMR (Small and Medium Sized Reactor).

Introduction

Nuclear infrastructure building

IAEA's approach and guidance documents

Summary

IAEA's approach in providing support

- ❑ Through Technical Cooperation Projects
- ❑ Inter-departmental coordinated response to Member States
- ❑ Recommend the use of relevant Agency documents
- ❑ Recommend regional approach for efficiency
- ❑ Recommend comprehensive assessment of infrastructure preparedness for balanced development of infrastructure
 - **Milestone** as checklist
 - **Self-critical assessment** and **IAEA's expert mission**, *if required*
- ❑ Recommend **basic assessment** by inter-ministerial and inter-disciplinary WG in early stage
 - Viability of nuclear power
 - The role of government and private sector
 - National industrial capability etc.

Agency's recent/planned Guidance documents

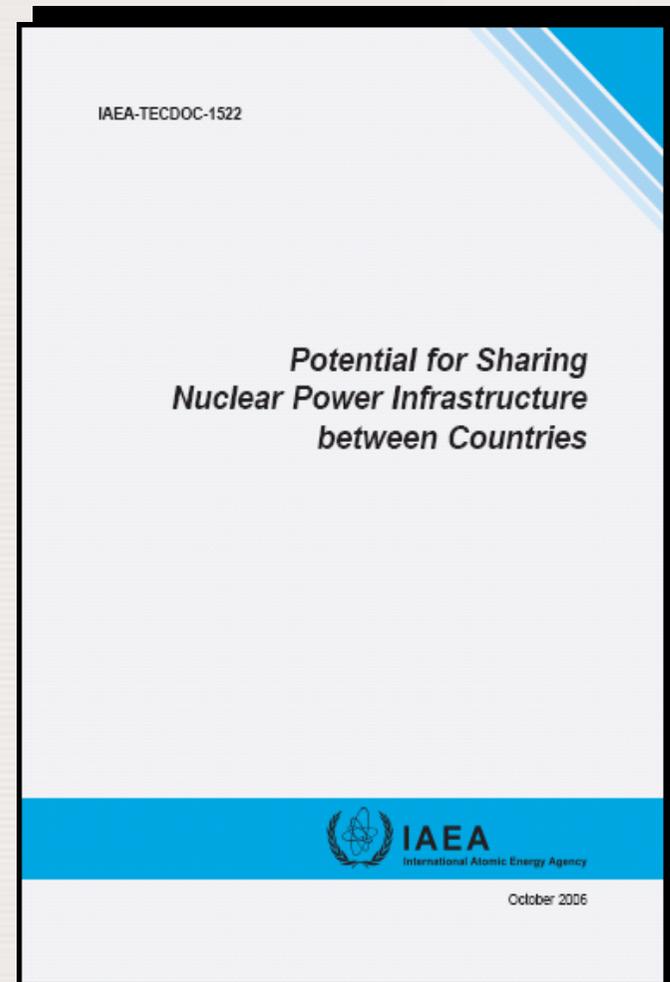
- **TECDOC-1513 “ Basic Infrastructure for a Nuclear Power Project”, June 2006**
- **TECDOC-1522 “Potential for Sharing Nuclear Power Infrastructure between Countries”, October 2006**
- **TECDOC-1555 “Managing the First Nuclear Power Plant Project”, May 2007**
- **Brochure “Consideration to launch a nuclear power programme” , March 2007**
- **NE series guide NG-G-3.1 “Milestones in the Development of a National Infrastructure for Nuclear Power, September 2007**
- TECDOC-xxx “Improving Prospects for financing Nuclear Power Plant Projects”
- TECDOC-xxx “Responsibilities and Competences of the Nuclear Power Implementing Organization to Initiate Nuclear Programme””.

Relationship between the Brochure and “Milestone” document

- **Both on preparation of infrastructure**
- **Brochure: concise document for consideration by decision-makers**
- **Milestone: will be usable as “checklist” utilized together with associated measuring index**

“Sharing nuclear power infrastructure”

TECDOC 1522
October 2006



Sharing nuclear power infrastructure

- **Grid system**
- **Models for national legal framework**
- **Regulatory framework**
- **Research and development**
- **Education and training**

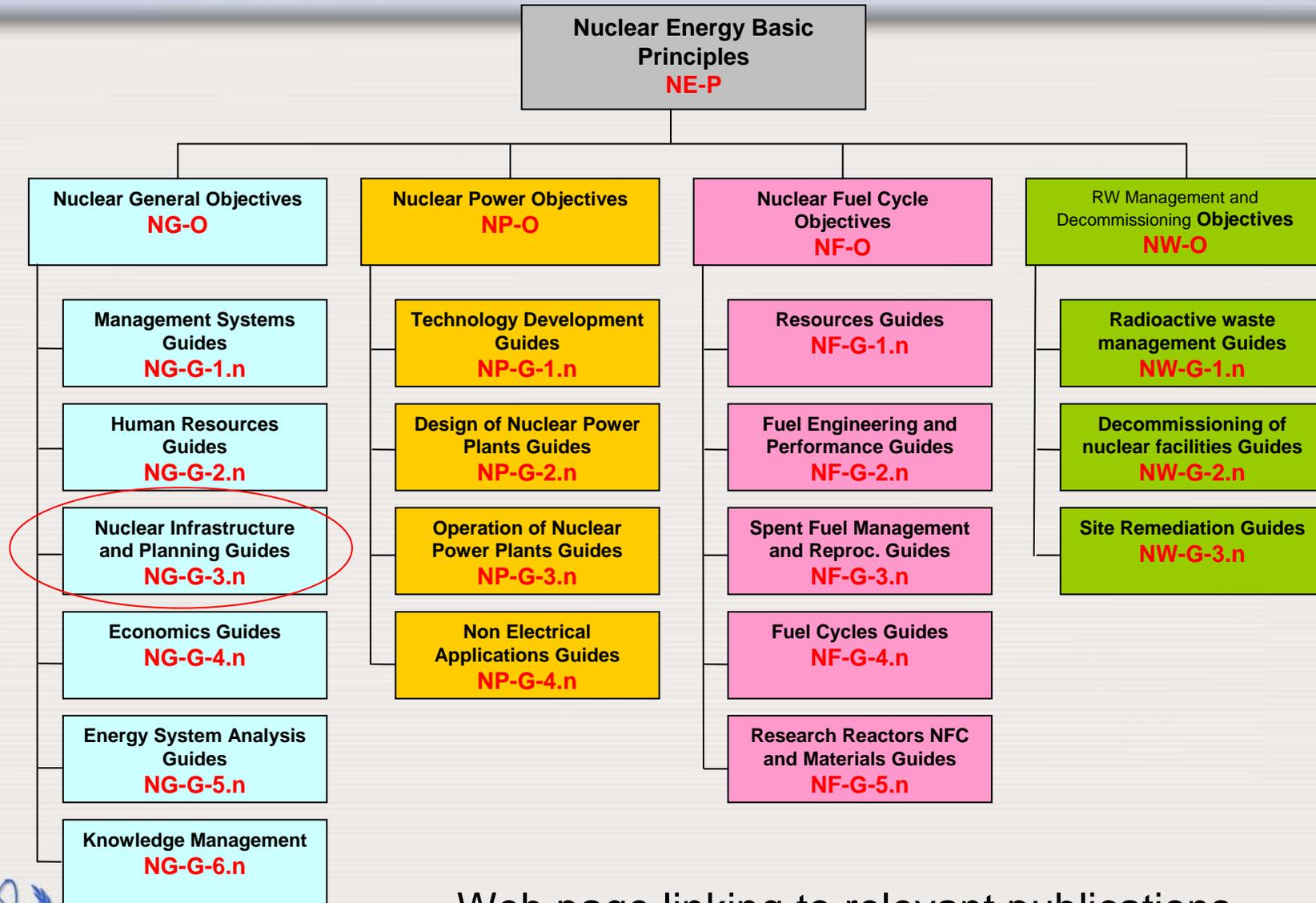
(in later stage as well)

- **Engineering and safety assessment**
- **Manufacturing**
- **In-service inspection etc.**

Other guideline documents in assisting the NP Plan (Published in the last 20+ years)

- Handbook on Nuclear Law, IAEA (2003)
- Interaction of Grid Characteristics with Design and Performance of Nuclear Power Plants: A Guidebook, Technical Reports Series No. 224 (1983)
- Promotion and Financing of Nuclear Power Programmes in Developing Countries, (1987)
- Developing Industrial Infrastructures to Support a Programme of Nuclear Power: Guidebook, TRS No. 281 (1988)
- Policy Planning for Nuclear Power: An Overview of the Main Issues and Requirements (1993)
- Choosing the Nuclear Power Option: Factors to be considered (1996)
- Economic Evaluation of Bids for NPPs, TRS No. 396, 1999
- Nuclear Power Programme Planning: An Integrated Approach TRS No. 1259 (2001)

Nuclear Energy Series Document



SUMMARY

- ❑ **Wide variety of issues to be addressed in infrastructure building**
 - ❑ **Support from the IAEA, but decision by each county**
 - ❑ **Taking your time for**
 - **Basic assessment**
 - **Defining national NE policy and user requirement**
 - **Balanced development of the country's nuclear infrastructure**
- “Haste is Waste” : a Japanese proverb*



...Thank you for your attention



IAEA

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