

CONSIDERATIONS TO LAUNCH NUCLEAR DESALINATION PROGRAMME

KHAMIS, Ibrahim
Division of Nuclear power



*Atoms for Peace: The First Half Century
1957–2007*

Summary of presentation

- Overview of a nuclear power programme
- IAEA approach to support infrastructure building
- Major phases and milestones of nuclear power programme
- Sharing nuclear power infrastructure: Regional approach
- Conclusion

The need for Nuclear Power

- **Diversification of Energy Resources**
- **Secure Stable Power Supply**
- **Meet rapidly Growth of Population and Industry (without smoking chimneys)**
- **Meet High Living Standards**
- **Reduce Pollution and Source of Acid Rain**
- **Preserve Natural Environment**
- **Better Economy (Prices of Gas oil is up)**
- **.....etc.**

Development  Security

Need for Nuclear Power (in Developing countries)?

- **Development of Skilled Manpower (enhance Safety)**
- **Establishment of Advanced Research and Development programme**
- **Upgrade of local Technology and infrastructure (local participation)**
- **Extensive transfer of Advanced Technologies (Tech. Transfer)**
- **Achievement of Self-reliance**
- **Improvement of Quality of Standards**
- **Know-how in Management of large projects**

What is a Nuclear Power Plant?? And how to introduce? especially in developing countries



Introduction of nuclear power

- Is it a matter of funds, adequate site, good communications with suppliers and stakeholders?
May be **True for developed countries**
- How to sustain a NPP?

Rely 100% on imports!!!!

You need knowledge and infrastructure to decide:

- 1. What to develop?**
- 2. What to produce locally?**
- 3. Who is your partner?**
- 4. What for and under what conditions of profits for both of you?**
- 5. Why, how, where, and what should be imported?**
- 6. Which and from where know-how should be acquired?**

Introduction cont.

- Is it sufficient to construct a safe, reliable, and efficient NPP?

Not true

unless:

Make available:

1. Qualified human resources for all NPP activities
2. Local technical and industrial capacities and abilities

Nuclear power and sustainability

- NPP life cycle extends to more than 100 years
i.e. at least 2-3 generations of people.

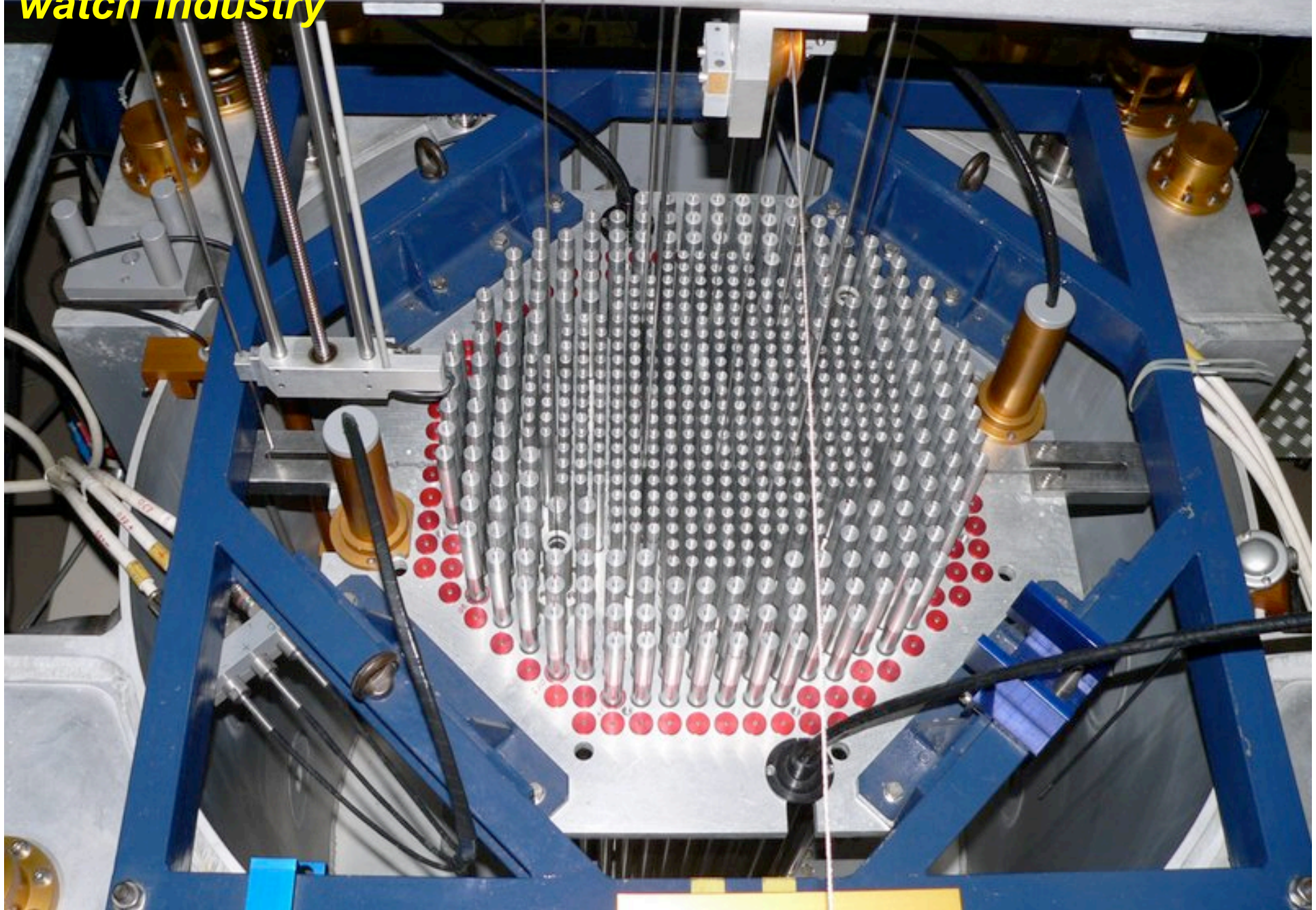
What will happen during the lifetime of NPP?

1. Vendors may disappear,
2. Designer may no longer exist,
3. Suppliers of equipment and spare parts may go out of business,
4. Technology may evolve,
5. Experience and new safety regulations may demand the upgrading of NPP,
6. Public concerns on safety and environment may demand fast response to accidents,
7. Political changes may impose restrictions on critical supplies and technology,
8. Country may lose important importing capacity

Nature of nuclear power programme

- **Involves:** issues associated with: nuclear material, ionizing radiation, related challenges.
- **Requires:** careful planning, preparations, sustainable infrastructure (legal, regulatory, human, and industrial support)

Cleaner than the pharmaceutical, and more precise than the watch industry

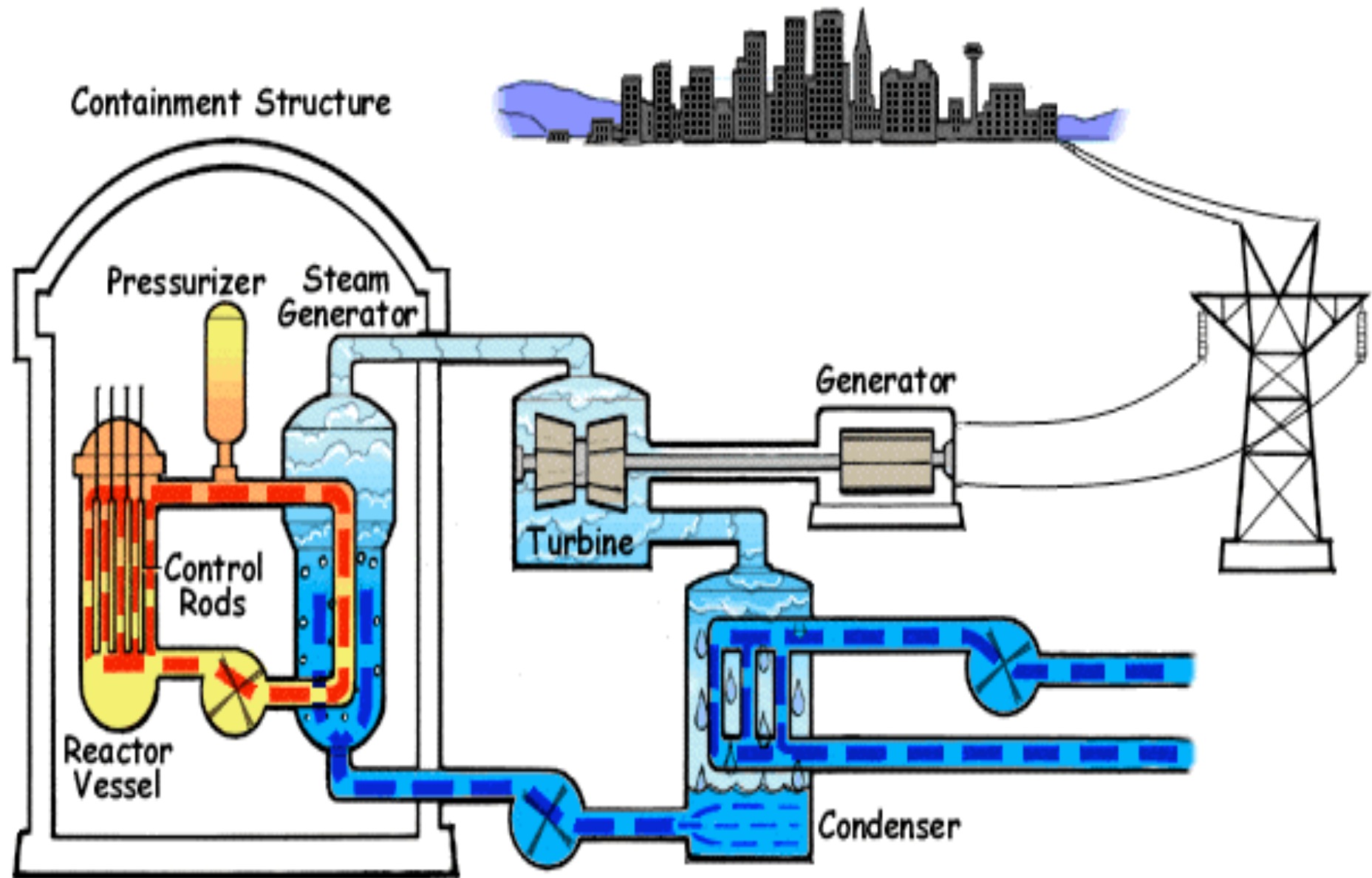


To have a NPP is a true challenge

Must be properly:




- Planned and constructed
- Commissioned/decommissioned
- Maintained (regularly, In-Service-Inspected)
- Repaired
- Upgraded
- Regulated
- Safeguarded
- Serviced (radiological protection, safety analysis, waste management...etc)

NPP with a Pressurized Water Reactor



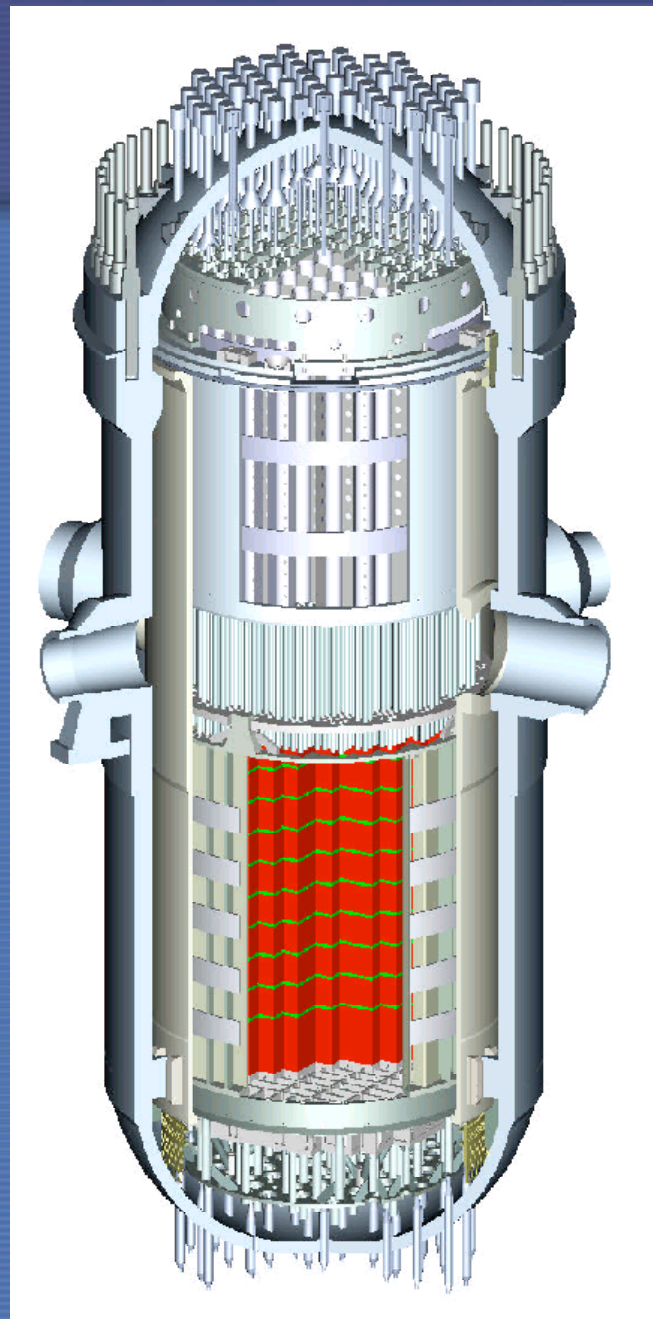
Industrial and technological infrastructure

A country without industrial infrastructure may have difficulties to sustain NPP operation.

- Good industrial infrastructure 
- High level of quality standards/assurance 
- High level of safety culture 
- High level of safety of NPP.

Reactor

- More than 6 m height and 4 m in diameter ,
- Up to 3000 fuel assemblies,
- 100 ton of fuel, 3-5 tons of fissile U-235

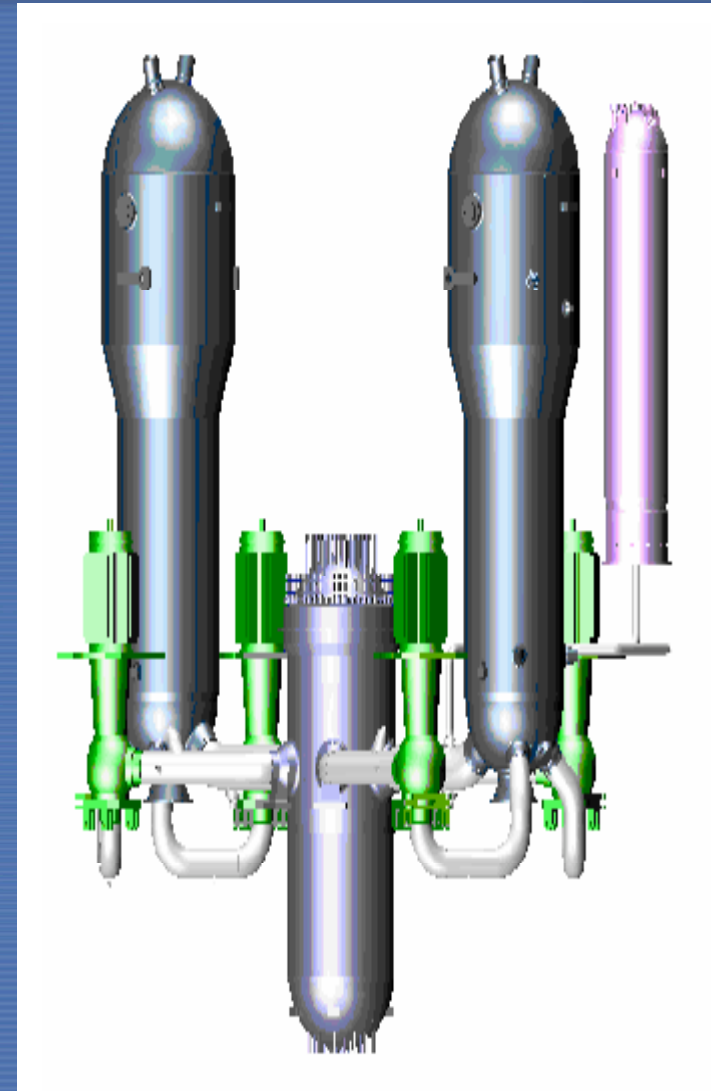


Major equipments of PWR reactor.

- The thickness of reactor vessel is 30 cm
- Steam generator has 60,000 1 inch tube
- Pump capacity is 7000Kw: almost 10,000 Hp.

Typical car Hp is less than 150 hp.

One pump power = Moving force of more than 100 cars



How many people involved during construction period?

- The construction duration is about 100 Month (8 – 9 years) and normally 5,000 persons are involved during construction.
- And maximum stage, 10,000 people will participate in the construction.
- Total 2,000 rotating machinery are running , such as motor, crane and 60,000 valves.
- The total construction cost is more than 2 Billion US\$.

NPP is a sophisticated technology



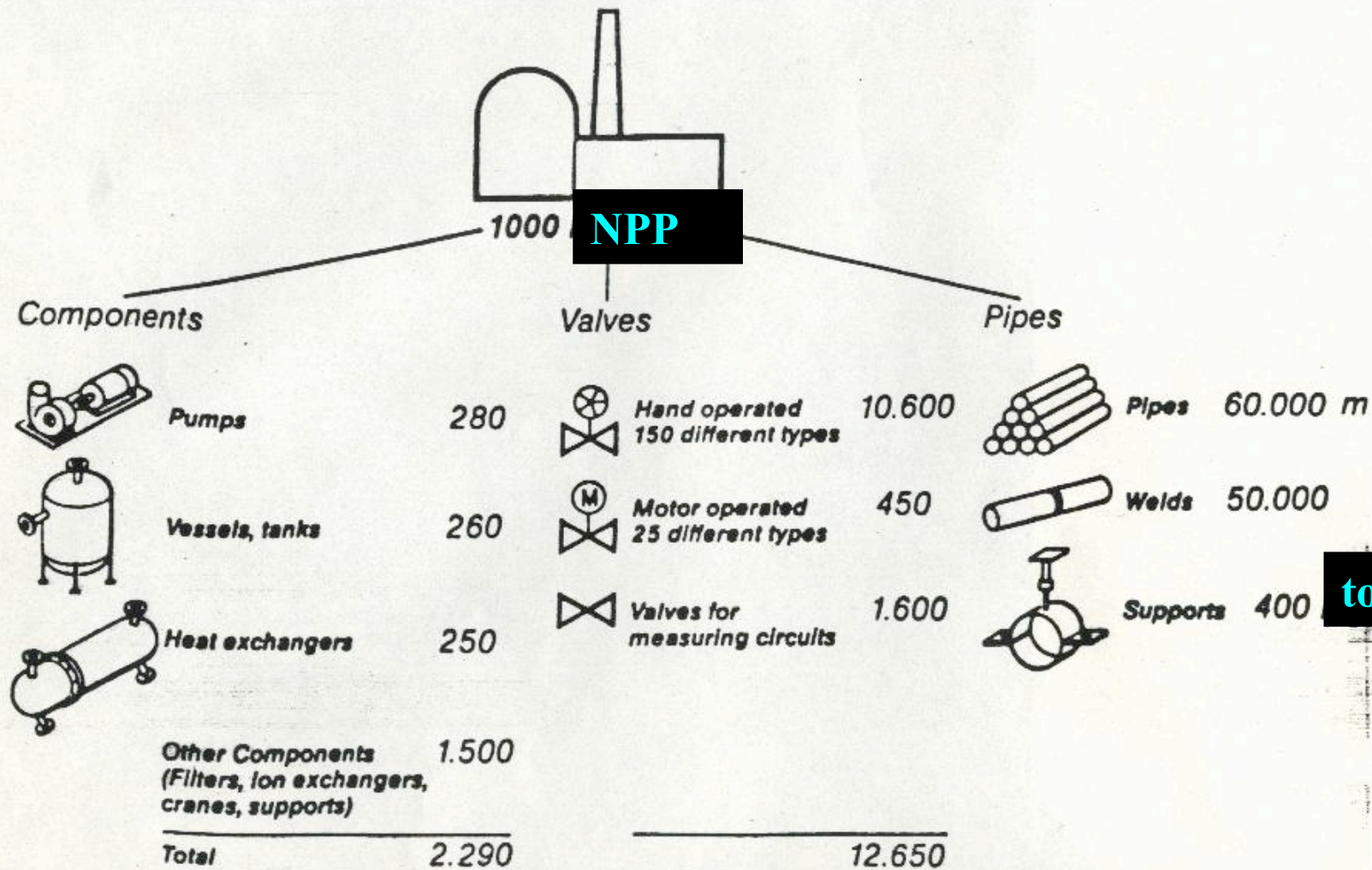
Inside of KSNP(UCN 3) Main Control Room



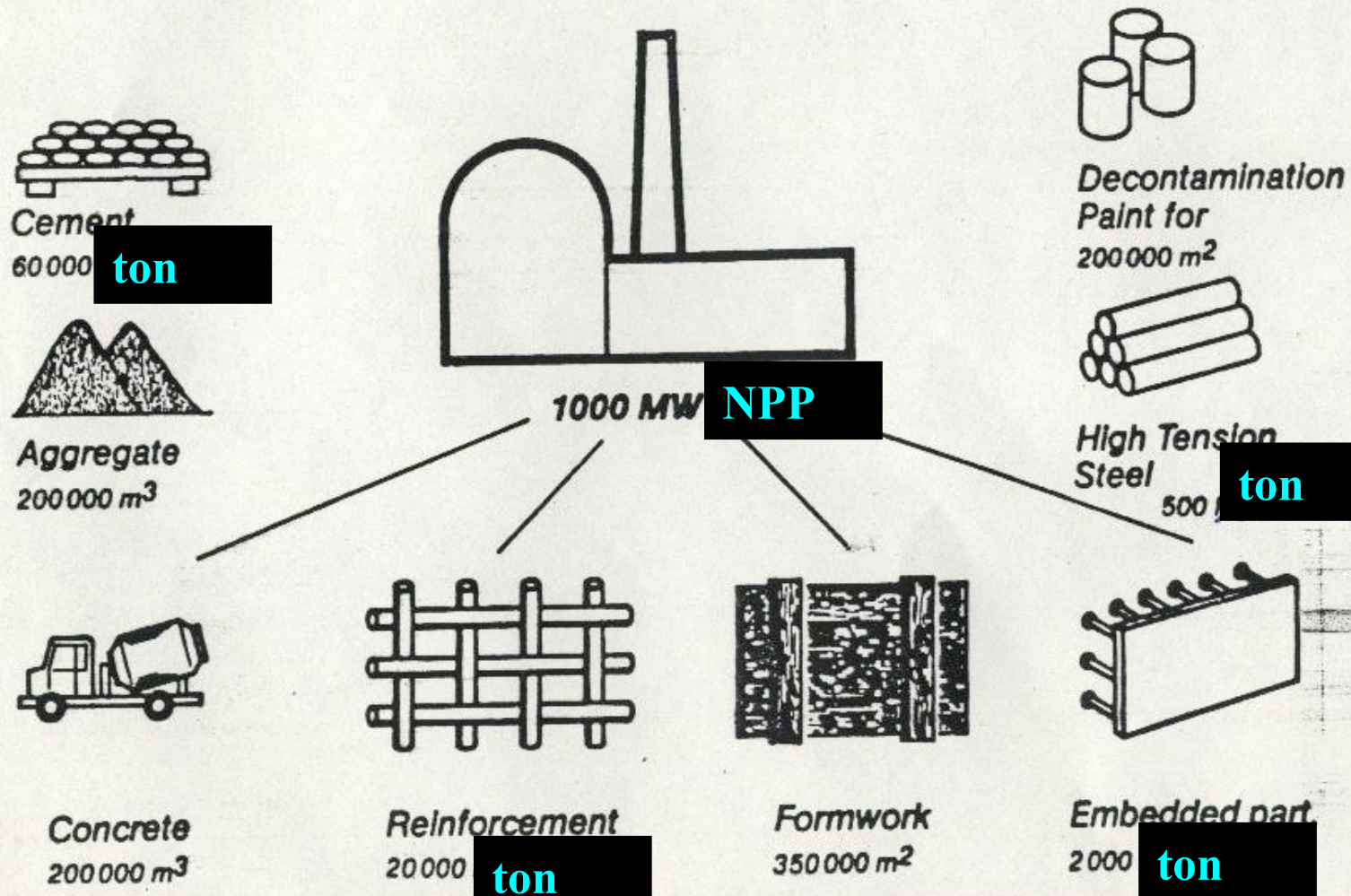
IAEA
Atoms for Peace: The First Half Century

To control NPP:

- 5- 6 operators are working in 24 hours in main control room.
- About more than 1300 alarm panel, more than 3000 information through indicator, recorder etc.
- So difficult job and heavy stress job to control and monitor the plant condition.



Quantities of Hardware of the Mechanical Part (typical figures)



Quantities of Hardware of the Civil Part (typical figures)

Human resources for NPP

- Large NPP, requires many people, therefore, Large HR programme (training, educations, centres...)

Ask: Do you need HR in design of reactors, safety analysis, licensing....?

- Balance your HR based on your objectives

Human resources

Operating organization: 100-200 persons majoring in: nuclear engineering, I&C, Electrical, mechanical engineering, chemistry, radiation protection, emergency preparedness, safety analysis, technicians, physicists, quality managements, waste management, maintenance...etc.

Regulatory body: effective, competent, and independent needs 30-50 staff for starting NPP

Human resources

Human resources development are country specific

- **Not only in** civil, chemical, mechanical, computational, electrical, electronics, programming engineering, chemistry, physics, management, economics,
- **BUT also in** Nuclear engineering, reactor physics, radiochemistry, radiation protection, welding, tool machining, non-destructive testing, quality assurance, quality control, quality management, material science, heat transfer, I&C, public relation, waste

How to build human resources for NPP

1. Prepare your own experts: rely on international cooperation (IAEA, regional, bilateral agreements) for education and training
2. Establish your own nuclear education programme (National Atomic Energy Agency)
3. Establish a fellowship programme directed at young professionals, university degrees
4. Establish academic institutes in associations with national universities aiming at graduate levels in special fields (NE, physics, material science and E, nuclear applications, nuclear medicine..)
5. Rely on your professionals and technicians to perform studies as required (feasibility studies, call for bids and evaluations, regulators, solving problems, design components, systems, and facilities..)

IAEA Support to infrastructure building

- ❑ Infrastructure is a key to successful introduction/expansion

legal and regulatory framework, human and financial resources, industrial background etc

- ❑ Agency's guidance for the introduction of nuclear power and for development of infrastructure
 - Numerous guidance documents
 - Systematic programme for filling in gaps & updating guidelines

IAEA approach in providing support

- ❑ Recommend **comprehensive assessment** of infrastructure preparedness to **avoid missing factors** for effective implementation of NE plan to achieve the use of NE in **safe, secure, technically sound** manner
- ❑ Recommend the use of relevant **Agency documents**
- ❑ Recommend **regional approach** for efficiency
- ❑ Through **TCP** (if TC recipient country)
- ❑ Support in the form of; **energy planning, safety assessments, infrastructure review (future), training, workshops, multinational topical meetings** etc
- ❑ Inter-departmental coordinated response to Member States

Guideline documents in assisting the first NPP Plan

Published in the last 20+ years

- Handbook on Nuclear Law, IAEA (2003)
- Introduction of Nuclear Power: A Guidebook, TRS No. 217 (1982)
- Manpower Development for Nuclear Power: A Guidebook, TRS No. 200 (1980)
- 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.

Agency's recent/ongoing/planned activities for Guidance documents

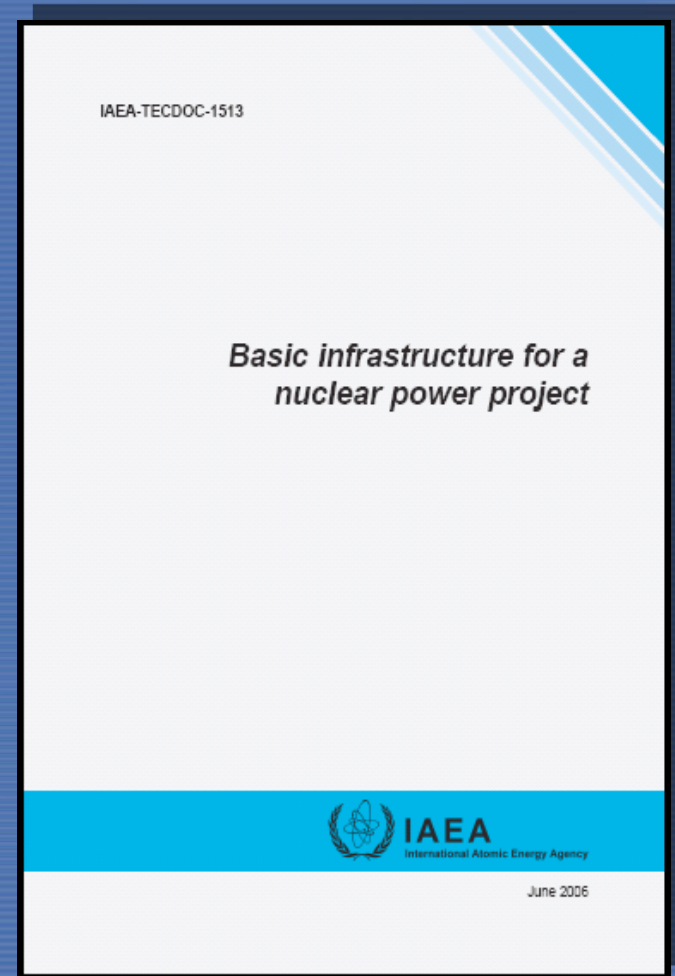
- ❑ **Basic infrastructure** for a nuclear power projects (TECDOC 1513, June 2006)
- ❑ Potential for **sharing nuclear** power infrastructure between countries (TECDOC 1522, October 2006)
- ❑ **GOV/INF/2007/2** “Consideration to launch a nuclear power programme” (March 2007)
- ❑ **Managing** for the first NPP (published)
- ❑ **“Milestone”** document (published)
- ❑ Subsequently systematically filling in gaps and updating guidance documents

Basic nuclear power infrastructure

TECDOC 1513

**Basic infrastructure
for a nuclear power
project**

June 2006



Towards the First NPP Project as GOV/INF/2007/2

- ❑ Many complex and inter-related issues to look at
- ❑ Overview summary of the Considerations to launch a nuclear power project presented to IAEA board of Governors as GOV/INF/2007/2.
- ❑ Requires long term commitment:
 - Requires at least 10 to 15 years to develop the expertise and infrastructure and reach operation of the first NPP.
 - Realization that commitment should last for one-hundred years with considerations for diversified social and technical factors.

Considerations to Launch a
Nuclear Power Programme



□ 3 MAJOR PHASES

1. Considerations **before** a decision to launch a nuclear power program is taken
2. Preparation work for the construction of a NPP **after** a policy decision has been made, and
3. Activities to **implement** the first NPP

3 MAJOR PHASES

PHASE 1

CONSIDERATIONS BEFORE A DECISION TO LAUNCH NPP IS TAKEN

Objective

Obtain a comprehensive understanding and identification of the national commitments and obligations associated with the introduction of nuclear power

3 MAJOR PHASES

PHASE 2

PREPARATORY WORK FOR NPP CONSTRUCTION AFTER DECISION TAKEN

Objective

Establish and adequately prepare the entire infrastructure needed to begin the construction of the first NPP

3 MAJOR PHASES

PHASE 3

ACTIVITIES TO IMPLEMENT FIRST NPP

Objective

Access to all the necessary competences and capabilities to be able to operate the first NPP safely, securely and economically

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
- Long-term financing resources (relative to other high priority areas)
- Ownership option and operational responsibility



IAEA Industry capability development & localization

Atoms for Peace: The First Half Century

5/19/09

36

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

Nuclear power : requires long-term commitment and stable policy

- ❑ At least 10-15 years of extensive work by various sectors (government, Utility, Industry) before connection of the first NPP to grid
- ❑ Operation of ~60 years + waste disposal
- ❑ Government may wish to support NP programme to **reduce uncertainties** of the implementation programme, such as
 - 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 intensive for capital intensive NPP project

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

Understanding the need for development and establishment

- Fuel cycle strategies (procurement policy, disposal)
- Nuclear material management plan
- Communication with stakeholders

MLESTONES

- At end of Phase 1



MILESTONE 1

Understanding the commitments & obligations



Ready to make decision to launch a nuclear power programme



IAEA

Atoms for Peace: The First Half Century

1957-2007

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)

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

- Establish framework and capabilities (continue..)
 - Establish policy for fuel cycle (procurement, transportation, storage of waste, long term waste management)
 - provided for security and safeguards for nuclear materials and facilities
 - provided for radiation protection and emergency planning
 - establish a plan for human and physical resource development consistent with the desires for national participation in the manufacturing, construction, operation and support of a nuclear facility
 - Site evaluation and selection
 - Evaluate available technology
 - Tender bid
 - Bid evaluation

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

- Establish framework and capabilities (continue..)
 - Determine contractual approach for the first NPP
 - Define the role of domestic and foreign entities, vendors and suppliers
 - Establish supply chain (material, services, component, engineering)

MLESTONES

- At end of Phase 2



MILESTONE 2

**Completion of work to be ready to start
construction**



Ready to request bid for the first NPP
-Preparation complete

Phase 3: Activities to implement a first NPP

Owner/Operator

- Construction, engineering, safety, standards and security guides, quality requirements,
- Human resource commitment will be greatest - during construction there can be more than 6000 people in the site.
- Financial Commitment will be greatest
- Build up of know-how and Expertise, prepare and accept the challenge for long term management of the NPP
- Develop safety culture
- Deal with regulator in open and transparent manner

Phase 3: Activities to implement a first NPP (cont.)

Regulatory Body

- Provide the framework to deal with Owner/Operator
- Possibly establish on site presence for inspection of NPP
- Establish safety standards
- Establish security guidelines

Phase 3: Activities to implement a first NPP (cont.)

Member State

- Maintain international commitments
- Maintain partnerships with other MS.
- Maintain trust of neighbouring States
- Ensure peaceful, safe, and secure operation of NPP project

MILESTONES

- At end of Phase 3



MILESTONE 3

Achieved competence to operate, manage and regulate



Ready to commission and operate the first NPP

■ Implementation

Main issues to reach milestones

In each **Phase**

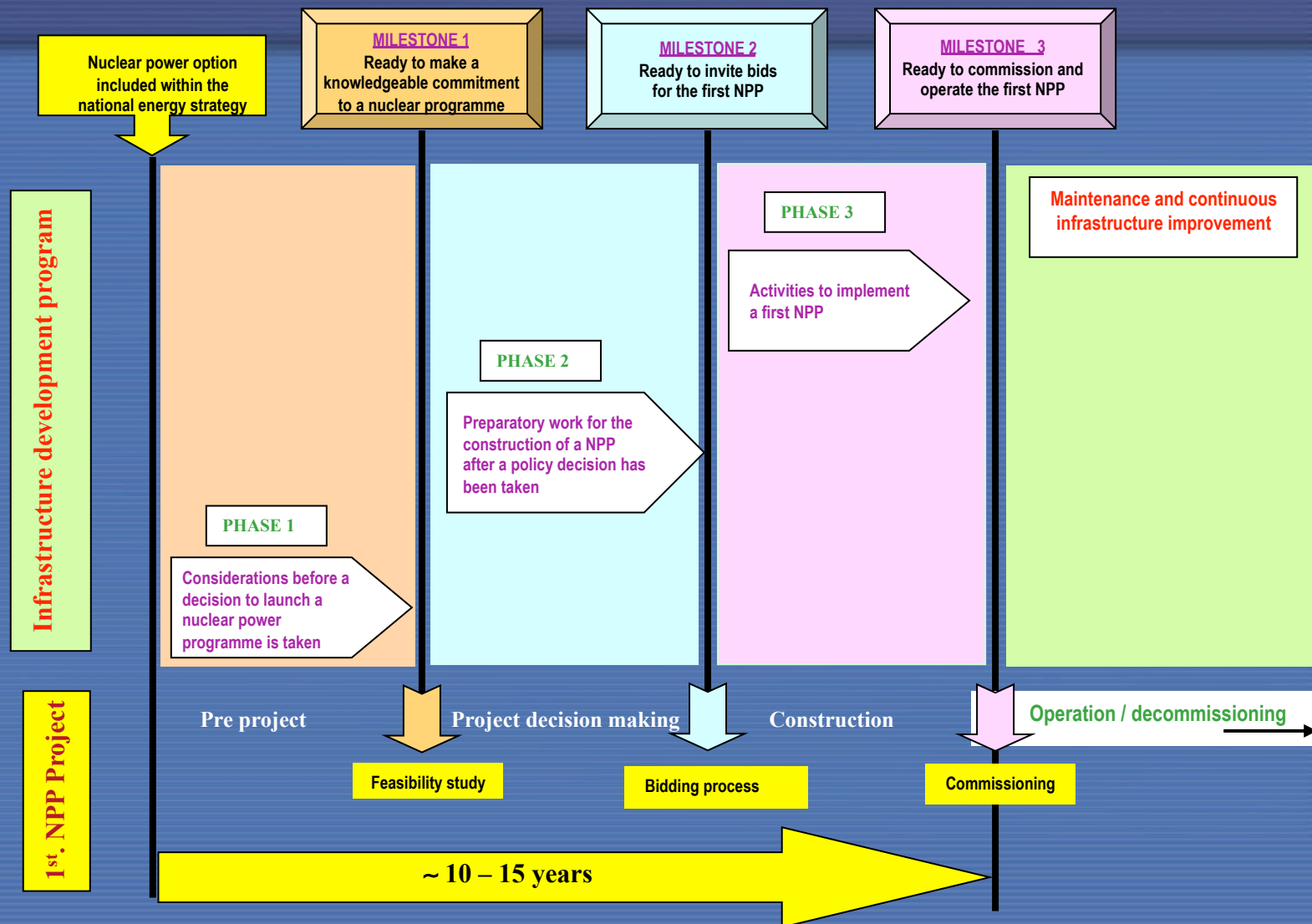


19 major issues to tackle
for reaching the corresponding milestone

- Each issue requires specific actions during each phase

ISSUES

- National position
- Nuclear safety
- Management
- Legislative framework
- Regulatory framework
- Financing
- Human Resource Development
- Safeguards
- Security and physical protection
- Emergency planning
- Radiation protection
- Nuclear Fuel cycle
- Nuclear waste
- Environmental protection
- Site and supporting facilities
- Industrial involvement
- Procurement
- Electric grid
- Stakeholder involvement



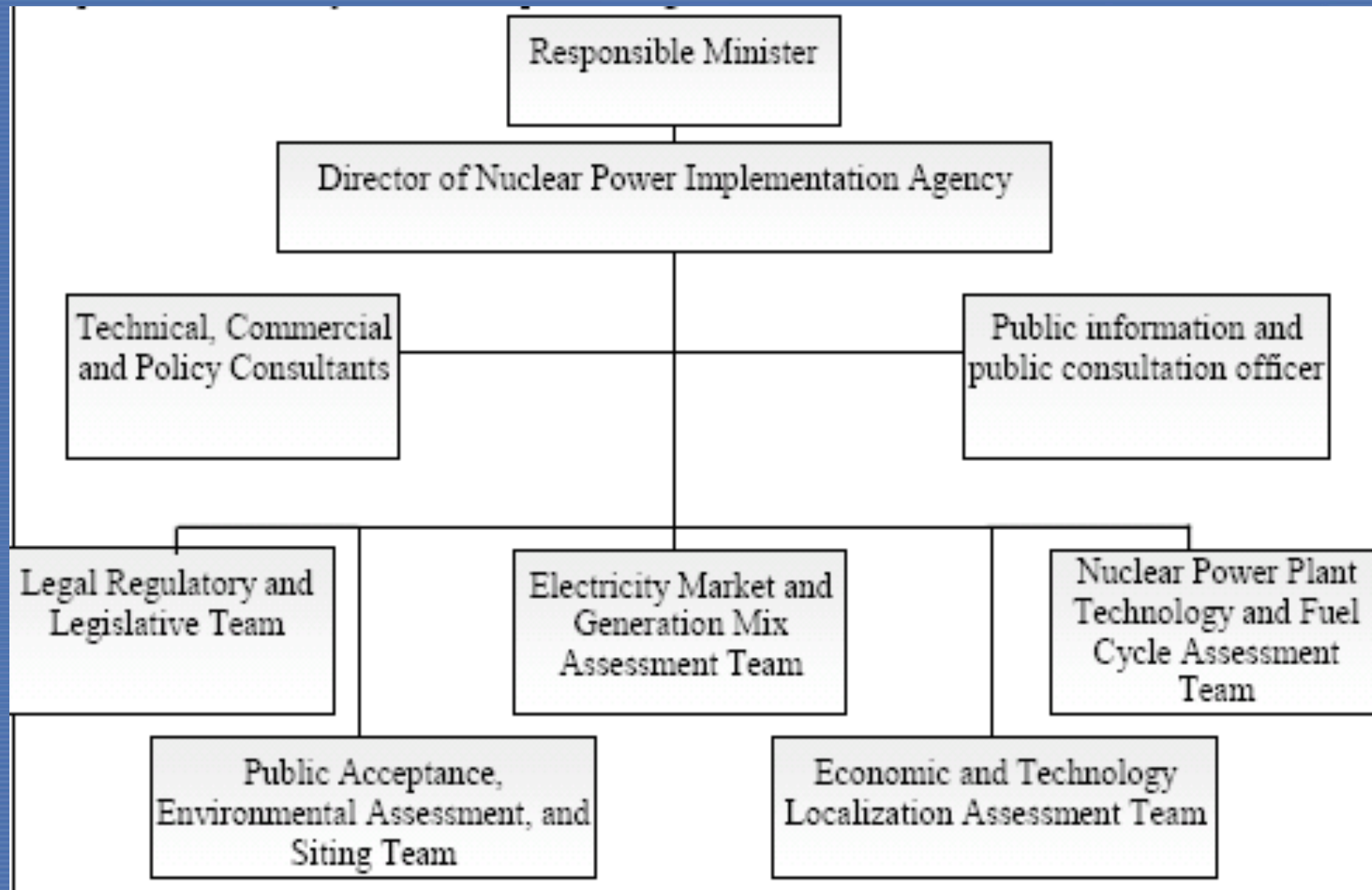
NEPIO (Nuclear Energy Programme Implementation Organization)

- ❑ Establishment of a dedicated agency by the government
- ❑ Government-wide coordination
- ❑ Could be prior to the involvement of the electric utilities and investors

Function

- To formulate policy by studying nuclear power option,
- To identify the basic infrastructure elements,
- To plan their implementation, and
- To recommend to Government (Minister)

Example: NEPIO (Nuclear Energy Programme Implementation Organization)

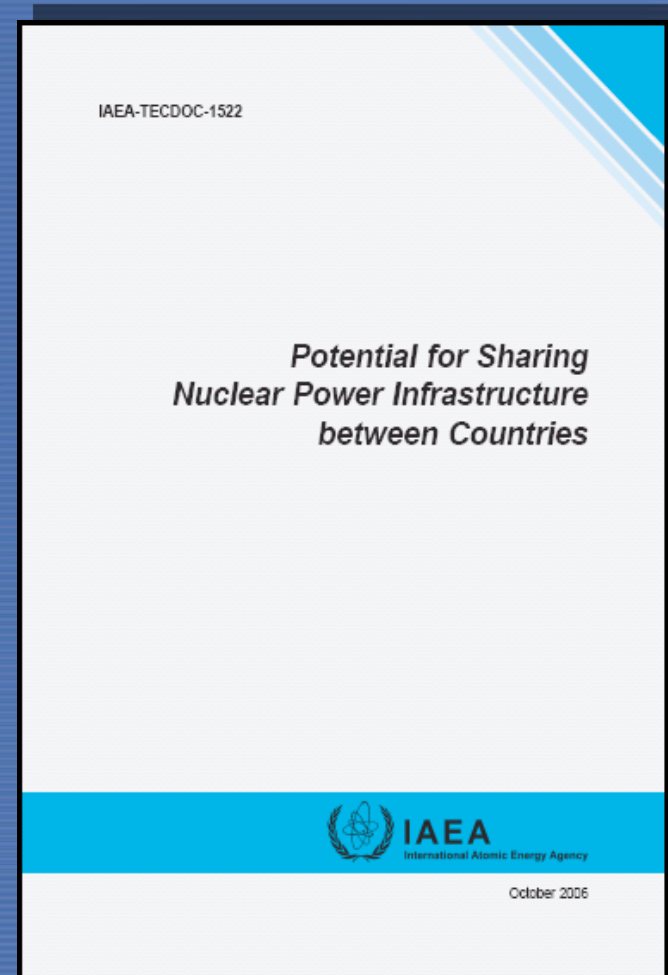


Sharing nuclear power infrastructure

TECDOC 1522

**Potential for sharing
nuclear power
infrastructure between
countries
(mostly in the region)**

October 2006



Sharing nuclear power infrastructure

Examples

- Grid system
- Models for national legal framework
- International cooperation
- Regulatory framework
- Research and development
- Human resources
- Education and training
- Finance of similar projects
- Comparison of economic evaluations

Sharing nuclear power infrastructure

Sharing physical facilities as well...


- Manufacturing pumps, valves and other components
- Nuclear fuel cycle (mining, fabricating, disposal)
- Fabrication key components (RPV, SG, TG, ...)
- Erection equipment (heavy duty crawler cranes)
- R & D facilities
- In core testing facilities for fuel and materials
- Mobile units for radioactive waste conditioning
- Transportation (vehicles, special casks for spent fuel)

CONCLUSION

NPP requires:

Commitment for a long term programme 
Consideration for sufficient infrastructure.

Decisions to be made !!!

- 1 NPP
 - Program of NPP
- 
- Development/ Security



...Thank you for your attention