

FLAGSHIP FOR INDUSTRY CLUSTER (NUCLEAR ENERGY)



BY

MALAYSIAN NUCLEAR AGENCY

AGENSI NUKLEAR MALAYSIA

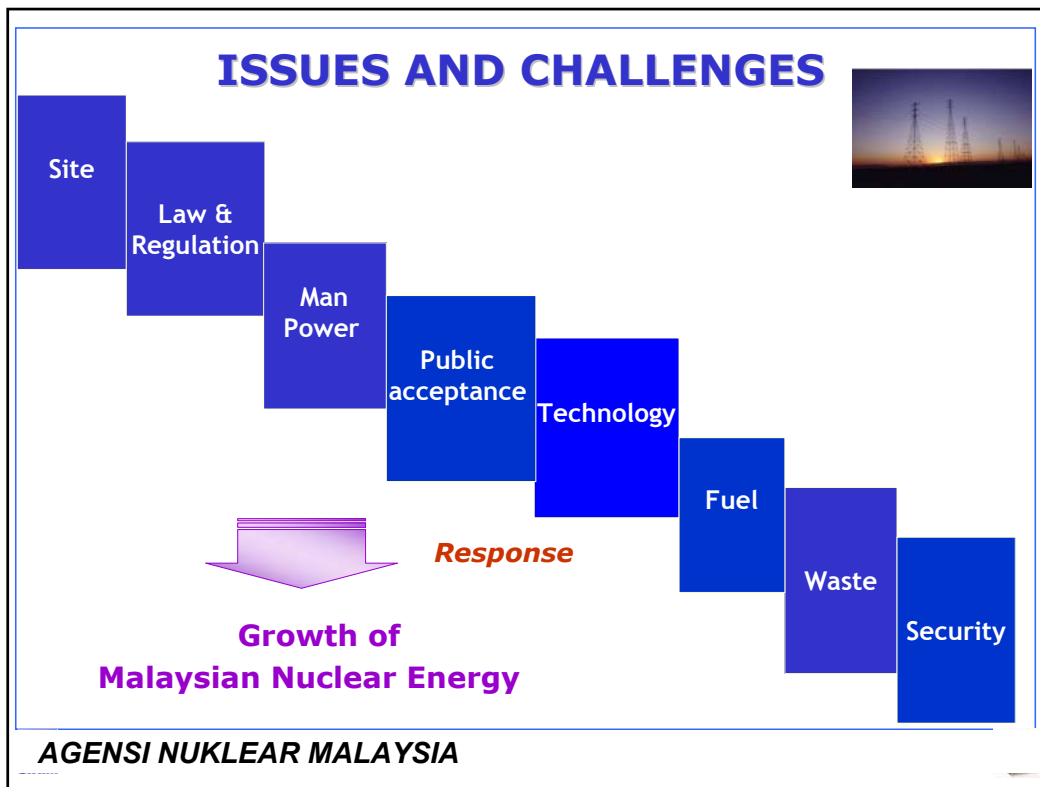
INTRODUCTION

DEFINITION/SCOPE



- Nuclear energy is produced from the transformation of matter into energy. The amount of energy can be calculated from Einstein's equation, $E = mc^2$, where E is the heat energy given out, m is the mass of radioactive substance, and c is the speed of light.
- Nuclear energy is released by one of three nuclear reactions:
 - Fusion, the fusing together of atomic nuclei.
 - Fission, the breaking of the binding forces of an atom's nucleus.
 - Decay, is a term used for the slower natural fission process of a nucleus breaking down into a more stable form.
 - Nuclear energy was first discovered accidentally by French physicist Henri Becquerel in 1896, when he found that photographic plates stored near uranium compounds behaved as though they had been exposed to light in a manner similar to X-Rays, which had been just recently discovered at the time.
 - farlex dictionary

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ISSUES AND CHALLENGES

Issue 1: Site

- Suitable
- Transparent
- Inform the public

Issue 2: Law and Regulation

- Enforced the law and regulations accordingly

Issue 3: Man Power

- Need more professionals, expertise and capabilities in the field of nuclear technology

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ISSUES AND CHALLENGES

Issue 4: Public Acceptance



- Public education - understanding about the link between global warming, fossil fuel usage and the need for low-carbon energy sources
- More program on nuclear power in mass media and electronic
- Open discussion and transparency on nuclear energy issues

Issue 5 : Fuel

- Sufficient fuel supply during world crisis
- Fuel process technology
- Continuity and security supply of nuclear fuel

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ISSUES AND CHALLENGES

Issue 6: Waste



- Need national waste policy
- Need high level waste disposal facility
- Need capacity and capability to manage low level and high level waste
- Agreement with the supplier for high level waste

Issue 7: Safety and Security

- Potential for terrorist strikes on nuclear plants
- Local capability in engineering safety as well as safety culture

Issue 8: Political

- To become an option in the National Energy Policy (Gas, Coal, Hydro, Oil, Renewable Energy)
- High political risk

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ISSUES AND CHALLENGES



Issue 9: Economy

- Expensive but competitive based on life cycle assessment compared to natural resources. However the natural resources reserved for future generation is depleting
- Commitment from the government to finance the nuclear power project

Issue 10: Social

- Negative perception on nuclear energy such as NIMBY, expensive & non-safe
 - Discuss the issues transparently
 - educate public and NGOs
- Risk communication
 - Communicating the benefit and risk to the public

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ISSUES AND CHALLENGES

Issue 11: Environmental

- Minimum issue

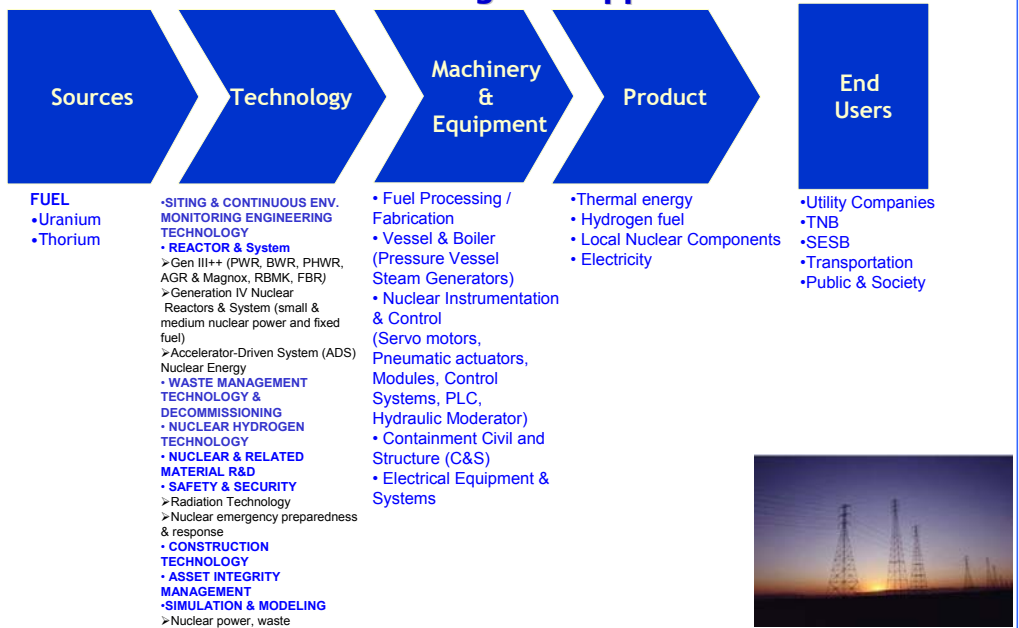
Issue 12: Energy and Technology Security

- To ensure energy and technology security to minimize the dependence on imported sources as well as sustainability (global politics).
- Lacking of local technology and components



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Framework to Identify the Needs for R&D and Technological Support



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INDUSTRY NEEDS (PURPOSE)

INDUSTRY NEEDS FOR NUCLEAR ENERGY

- **NEED 1: Source (Fuel)**
 - Constant supply of fuel
 - Constant quality and price
 - Create a level playing field

- **NEED 2: Technology and Machinery**
 - Acquisition and localisation of technology
 - Development of local design, operation and maintenance capability
 - Adopt and adapt technology to boost export
 - Technical expertise and capabilities will enable commercialisation to serve local and regional nuclear industry
 - Reduction in the production cost for nuclear components
 - An exporter of nuclear and related technology components



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INDUSTRY NEEDS (PURPOSE)

INDUSTRY NEEDS FOR NUCLEAR ENERGY

- **NEED 3: Product**
 - High quality product meeting nuclear standard
 - Market driven product
 - Competitive with other sources of energy and environmental friendly
 - Exportable
- **NEED 4: Support**
 - Policy
 - Finance
 - R&D



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BENEFITS & BENEFICIARIES

BENEFITS

Nuclear energy benefits all segment of the industries and the population in Malaysia. Such as in:

- Lower production costs for local industries
- Reduce import dependence on various fuel
- Reduce reliance on petroleum
- Conservation and sustainability of Earth's resources
- Preventative measures for the climate changes
- Energy safety and security

BENEFICIARIES

- All manufacturing sectors, power sectors, government, higher learning institutions
- General public



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SUGGESTION FOR FOCUS R&D

PROPOSED R&D FOR NUCLEAR ENERGY



• PROPOSED R&D 1: Source

– Nuclear Fuel Cycle

- Uranium/thorium Mining
- Uranium/thorium Milling
- Conversion
- Enrichment
- Fuel fabrication
- Power generation
- Used fuel
- Used fuel storage
- Reprocessing
- Uranium and Plutonium Recycling
- Used fuel disposal

– Wastes Management

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• PROPOSED R&D 2: Technology

□ SITING & CONTINUOUS ENV. MONITORING ENGINEERING TECHNOLOGY

□ REACTOR & SYSTEM

- Gen III++ (PWR, BWR, PHWR, AGR & Magnox, RBMK, FBR)
- Generation IV Nuclear Reactors & System (small & medium nuclear power and fixed fuel)
- Accelerator-Driven System (ADS) Nuclear Energy

□ WASTE MANAGEMENT TECHNOLOGY & DECOMMISSIONING

□ NUCLEAR HYDROGEN TECHNOLOGY

□ NUCLEAR & RELATED MATERIAL R&D

□ SAFETY & SECURITY

- Radiation Technology
- Nuclear emergency preparedness & response

□ CONSTRUCTION TECHNOLOGY

□ ASSET INTEGRITY MANAGEMENT

□ SIMULATION & MODELING

- Nuclear power, Waste



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• **PROPOSED R&D 3: Product Development**

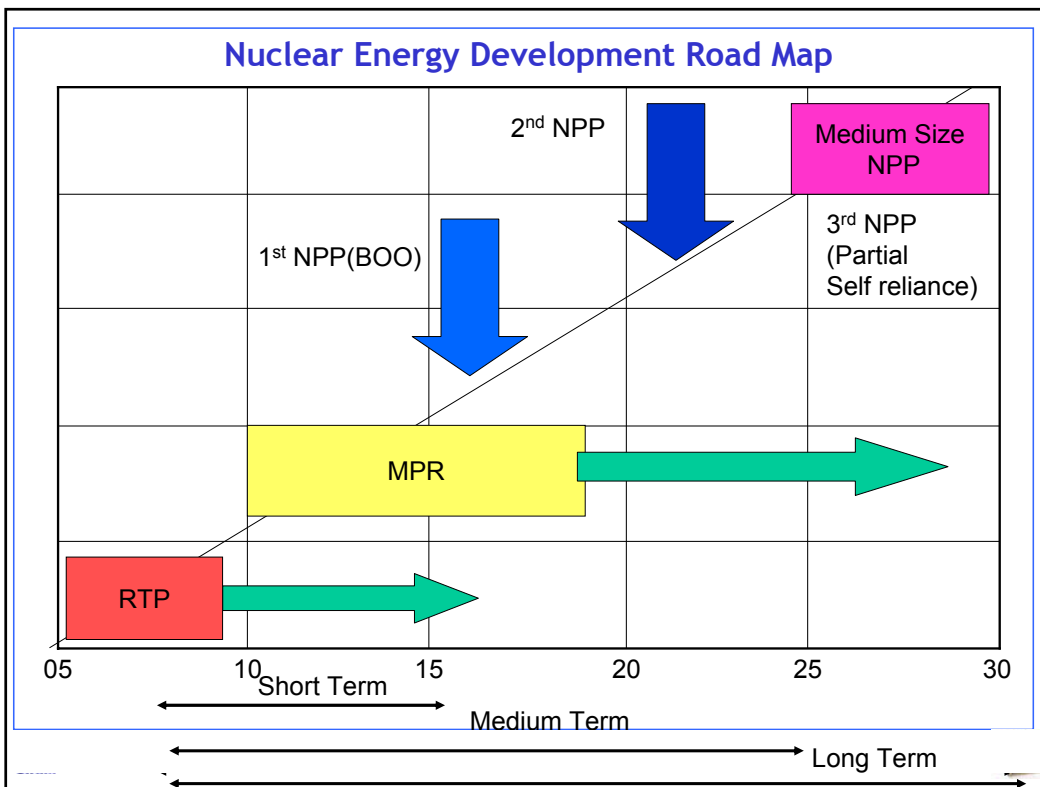
- **Product characterization, application and utilisation**
- **Product safety and quality**
- **Establishment of standard properties for the product**
- **Product transportation and logistic**
- **Establishment of market**

• **PROPOSED R&D 4 : Support and services**

- **Law and Regulation**
- **Local consultancy & services**



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Short Terms (RTP Based)

Capacity and Capability Building

- Reactor Physics and Engineering
- Nuclear Materials
- Reactor Safety Engineering
- Instrumentation, Controls and Mechatronics
- NDT and Quality Assurance
- Reactor Support and Utilization (Localization and Rx Application)
- Development of Accelerator and Linac
- Waste Treatment Technologies
- Waste Repository
- Nuclear Fuel - Uranium Based
- Thermal hydraulic



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Medium Term (MPR Based, with 1st NPP in Place)

Building Fundamentals for Self Reliance (O&M at least), Localization and Sustainability

- Fuel (Uranium and Thorium) Chemistry
- Reactor Physics and Engineering
- New Reactor Concept Design and Modeling
- MPR Application and Utilization
- Local Component and Capability Development
- Safety Engineering
- Construction and Fabrication Engineering
- Mechatronics and Virtual Reality
- NDT and Quality Assurance
- Asset Integrity Management
- I&C Development and Reliability Analysis
- Development of Linac for Transmutation R&D
- Decommissioning of RTP / Conversion to Sub-Critical Assembly
- Waste Treatment Technologies including Introduction of Transmutation Using Sub Critical Assembly
- Waste Repository
- Thermal hydraulic



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Long Term (Medium Size - Partial Localization of NPP)

Towards Self Reliance (O&M ++), Localization and Sustainability

- Fuel (mix Uranium and Thorium) Chemistry and Fabrication
- Reactor Physics and Engineering
- New Reactor Concept Design and Modeling (Intrinsically safe reactor, e.g. Pebble Bed)
- Fusion Concept
- MPR Utilization and Application
- Hydrogen Engineering and Technology
- Nuclear and Hydrogen Compatibility Materials
- Local Component and Capability Development
- Safety Systems, Engineering and Components
- Construction and Fabrication Engineering
- Waste Treatment Technologies including Regional Transmutation Facility Concept
- NDT and Quality Assurance
- Asset Integrity Management
- I&C Development and Reliability Analysis
- Waste Repository
- Thermal hydraulic



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Technology Development


Long Term	Fuel (mix Uranium & Thorium) Chemistry & Fabrication	<ul style="list-style-type: none"> •Reactor Phy. & Eng. •Fusion Concept •Hydrogen Eng. & Tech. •Const. & Fabric. Eng. •NDT & Quality Assurance •Asset Integrity Management •I&C Development & Reliability Analysis •Waste Treatment Tech. •Waste Repository •Thermal hydraulic •Superconducting material •Hybrid fuel tech. –hydrogen nuclear etc. 	<ul style="list-style-type: none"> •Instrumentation, controls & mechatronics •Fuel Processing / Fabrication •Containment Civil and Structure (C&S) •Electrical Equipment & Systems •Mechanical components of nuclear std •Vessel & Boiler (Pressure Vessel Steam Generators) • Containment Civil and Structure (C&S) •Hydrogen storage, transmission & utilisation •Energy conversion system 	<ul style="list-style-type: none"> •New Rx Concept Design & Modeling •MPR application & Utilization
Medium Term	Fuel (uranium & Thorium) Chemistry	<ul style="list-style-type: none"> •Reactor Phy. & Eng. •Safety Engineering •Const. & Fabric. Eng. •NDT & Quality Assurance •Asset Integrity Management •I&C Development & Reliability Analysis •Waste Treatment Tech. •Waste Repository •Thermal hydraulic •Mechatronic & Virtual Reality •Waste treatment tech. & decommissioning 	<ul style="list-style-type: none"> •Instrumentation, controls & mechatronics (robotics) •Fuel Processing / Fabrication •Containment Civil and Structure (C&S) •Electrical Equipment & Systems •Mechanical components of nuclear std •Vessel & Boiler (Pressure Vessel Steam Generators) • Containment Civil and Structure (C&S) 	<ul style="list-style-type: none"> •Decommissioning of RTP / Conversion to Sub-Critical Assembly •Development of Linac for Transmutation R&D •MPR application & Utilization •New Rx Concept Design & Modeling •Local Component & Capability Development
Short Term	Nuclear Fuel - Uranium based	<ul style="list-style-type: none"> •Reactor Phy. & Eng. •Nuclear Materials •Reactor Safety Eng. •NDT & Quality Assurance •Rx Support & Utilization (localization & Rx app.) •Waste Treatment Tech. •Waste Repository •Thermal hydraulic 	<ul style="list-style-type: none"> •Instrumentation, controls & mechatronics •Fuel Processing / Fabrication •Containment Civil and Structure (C&S) •Electrical Equipment & Systems •Mechanical components of nuclear std 	<ul style="list-style-type: none"> •Development of Accelerator and Linac
	Source	Technology	Machinery & Equip	Product

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Budget (RM)					
Long Term	2.5M	15M	5M	2.5M	TOTAL 25M
Medium Term	5M	30M	10M	5M	50M
Short Term	5M	30M	10M	5M	50M
Grand Total					125M
No. of ROs	5	30	10	5	50
	Source	Technology	Machinery & Equipment	Product	

**basis:
1 RO = RM 100,000.00 / year*

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- ### CHAMPION FOR NUCLEAR ENERGY
- R&D 1: Source
 - Nuclear Malaysia (leader)
 - IPT
 - R&D 2: Technology
 - Nuclear Malaysia (leader)
 - IPT
 - SIRIM
 - R&D 3: Product Development
 - Nuclear Malaysia (leader)
 - IPT
 - SIRIM
 - R&D 4: Support & Services
 - Bank
 - GOM
- 
- AGENSI NUKLEAR MALAYSIA**

THANK YOU

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