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Assessment in the area of infrastructure for
a newcomer country for sustainable NES
using INPRO Methodology: Malaysia

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Malaysia - Nuclear Energy Background

- **Nuclear Malaysia** formed in 1972 as **R&D Agency** to prepare Malaysia for the Deployment of NE for electricity generation
- HCD program started and **research reactor** commissioned in 1982
- Drafted the 1st atomic energy bill
- Atomic energy bill enacted in 1984 (Act 304) and **Regulatory Body AELB** formed (key staff from Nuclear Malaysia)
- NE program scaled down due to **oil and gas found offshore** and later Chernobyl reduced further interest
- Continue to actively participated in **HCD program on NE** especially those conducted by IAEA, regional collaborative projects, supplier countries and vendors
- **Renewed interest on NE from 2006** onwards and Nuclear Malaysia submitted position paper to the government on NE
- June 2009: Government considered **NE as one of the option** for electricity generation post 2020
- January 2011: Establishment of **Malaysia Nuclear Power Corporation (MNPC)** as a Fully dedicated NEPIO to undertake comprehensive study for NE deployment (a few key personnel from Nuclear Malaysia)
- **Nuclear Malaysia** prepare itself to be a **TSO** due to the fact that no other organization in Malaysia has similar facilities and experience.

Desktop assessment on readiness of Malaysia to assume a sustainable NES based on INPRO methodology area of infrastructure

Basic principle:

A country shall be able to adopt, maintain or enlarge a NES for the supply of energy and related products without making an excessive investment in national infrastructure

- UR1 Legal and institutional infrastructure
- UR2 Industrial and economic infrastructure
- UR3 Political support and public acceptance
- UR4 Human resources
- UR5 Minimization of infrastructure
- UR6 Regional and international arrangement.

User Requirement 1 – Legal and institutional infrastructure (INPRO)

User requirements	Criteria	Indicator (IN) and acceptance limit (AL)
<p>UR1: Legal and institutional infrastructure:</p> <p>An adequate legal framework should be established to cover issues of nuclear liability, safety and radiation protection, environmental protection, control of operation, waste management and decommissioning, security and non-proliferation</p>	<p>CR1.1: Legal aspects</p>	<p>IN1.1: Status of legal framework</p> <p>AL1.1: Legal framework has been established in accordance with international standards</p>
	<p>CR1.2: Institutions</p>	<p>IN1.2: Status of State organizations with responsibilities for safety and radiation protection, environmental protection, control of operation, waste management and decommissioning, emergency preparedness and response, security and non-proliferation</p> <p>AL1.2: State organizations have been established, in accordance with international standards</p>

User Requirement 1 – Legal and institutional infrastructure (assessment)

User Requirements	Criteria	Indicator and acceptance limit
UR1. Legal and institutional infrastructure	CR1.1 Legal aspects	<p>IN 1.1: Atomic Energy Licensing Acts (A 304) was enacted in 1984 to control and ensure safety security and safeguard on handling and use of radioactive and nuclear materials as well as operation of nuclear and radiation facilities. A new more comprehensive Nuclear Bill that include all current guide and recommendation of IAEA has been drafted and to be tabled in parliament. The bill was drafted together with foreign consultant.</p> <p>-----</p> <p>AL 1.1 The current act has functioned well to regulate and promote current nuclear activities that meet international requirements.</p>
	CR1.2. Institutions	<p>IN 1.2 Atomic Energy Licensing Board (AELB) was established in 1984 to enforce the law (A 304). AELB has been strengthen from time to time to respond to the legal requirements and personnel were trained according to international standard especially through IAEA program as well as other bilateral arrangements with advance countries. Further strengthen will be made if the government is committed on the development of NPP. A Law school in one university has included nuclear law in it's curriculum.</p> <p>-----</p> <p>AL 1.2 AELB has been regulating nuclear activities to ensure safety, security and safeguard by following IAEA and other international guidelines</p>

User Requirement 2 - Industrial and economic Infrastructure (INPRO)

User requirements	Criteria	Indicator (IN) and acceptance limit (AL)
UR2: Industrial and economic infrastructure: The industrial and economic infrastructure of a country with an NES should be adequate to support the project throughout the complete lifetime of the nuclear power programme, including planning, construction, operation, decommissioning and related waste management activities	CR2.1: Funding of infrastructure	IN2.1: Funding needed for the infrastructure of a nuclear power programme AL2.1: Sufficiently available to cover the nuclear power programme
	CR2.2: Size of nuclear facility	IN2.2: Size of nuclear installation AL2.2: Matches local needs
	CR2.3: Siting	IN2.3: Process of siting a nuclear facility AL2.3: Siting process has taken safety, security and environmental requirements into account in accordance with international standards
	CR2.4: Support infrastructure	IN2.4: Availability of infrastructure to support owner/operator AL2.4: Internally or externally available
	CR2.5: Added value	IN2.5: Added value of a nuclear power programme to society AL2.5: Added value > infrastructure investment by government necessary to support nuclear power programme

User Requirement 2 - Industrial and economic Infrastructure (assessment)

User Requirements	Criteria	Indicator and acceptance limit
UR2 Industrial and economic Infrastructure	CR2.1 financing infrastructure	<p>IN 2.1: The budget amount for NPP is quite similar to other megaproject in the country such as New Petroleum Hub (~USD25bil), Mass Rapid Transportation (MRT) system for Kuala Lumpur (~USD15bil) and a few others shows that the banking system can finance the projects.</p> <p>-----</p> <p>AL2.1: Sufficient amount of fund is available from local financial institutions and if needed from abroad</p>
	CR2.2. Size of facility	<p>IN 2.2 The projected growth of power demand is around 3.2% per year and there are old fossil plant the need to be replaced from time to time. 17,378 MW in 2015, 19 826MW in 2020 and 22 604 1n 2025 (Academy of science, Malaysia)</p> <p>-----</p> <p>AL 2.2 Comprehensive feasibility study is being carried out by a consultant will show the need and requirements</p>
	CR 2.3 Siting	<p>IN 2.3 No comprehensive siting work has been carried out. When such work is necessary the process will take into account all int'l standard and verification system. A workshop on siting guide based on international standard has produced a guideline document.</p> <p>-----</p> <p>AL 2.3 Following int'l standard and practices</p>

User Requirement 2 - Industrial and economic Infrastructure (cont.)

User Requirements	Criteria	Indicator and acceptance limit
UR2 Industrial and economic Infrastructure	CR 2.4 support infrastructure	<p>IN 2.4 Grid systems for Peninsular Malaysia can accommodate 1000MW NPP, transportation for heavy and large structures are available from major ports and waste management and other facilities found inadequate will be developed.</p> <p>-----</p> <p>AL 2.4 Available and if found inadequate to match need can be developed</p>
	CR 2.5 Added value	<p>IN 2.5 A study in 2010 estimated that Gross Nat'l Income contributed by NPP project to be around RM212,300 Mil and projected jobs created 2,637 (ETP report). Due to recent safety requirements infrastructure investment may increase as well public information efforts require more budget.</p> <p>-----</p> <p>CR 2.5 intangible advantage such as energy security and industrial/technological advancement may compensate development cost</p>

User Requirement 3 - Political support and public acceptance (INPRO)

User requirements	Criteria	Indicator (IN) and acceptance limit (AL)
<p>UR3: Political support and public acceptance: Adequate measures should be taken to achieve and maintain public acceptance of an NES being planned or in operation to enable a government policy commitment to support the deployment and operation of the system</p>	CR3.1: Public information	<p>IN3.1: Information provided to public AL3.1: Sufficient according to national requirements, taking into account international practice</p>
	CR3.2: Public participation	<p>IN3.2: Participation of public in decision making process on a nuclear power programme AL3.2: Sufficient according to national requirements, taking into account international practice</p>
	CR3.3: Survey of public acceptance	<p>IN3.3: Public acceptance of nuclear power AL3.3: Sufficient to expect that the political risk of policy support for nuclear power is acceptable</p>
	CR3.4: Policy support	<p>IN3.4: Government policy regarding nuclear power AL3.4: Policy is supportive of nuclear power</p>
	CR3.5: Political environment and investor risk	<p>IN3.5: Long term political commitment to a nuclear power programme AL3.5: Commitment sufficient to enable a return of investment</p>

User Requirement 3 - Political support and public acceptance (assessment)

User Requirements	Criteria	Indicator and acceptance limit
UR3 Political support and public acceptance	CR3.1 public information	<p>IN 3.1: sufficient information is provided on the gov't intention. However, info. on benefit to economic and society, risk, safety etc. are not well covered yet. Major decision is made after rigorously public info is carried out and support gauged.</p> <p>-----</p> <p>AL3.1: No political uncertainty or threat to stability</p>
	CR3.2. Public participation	<p>IN 3.2: Generally, elected govt./parliament represents the opinion of the people. When govt. (without public participation) made a decision all consideration has been made, which include the public aspiration. However nuclear may use different approach for public representation or to gauge support such as online survey/vote.</p> <p>-----</p> <p>AL 3.2: Support or against by public cannot be determined yet ** INPRO need to clarify int'l practice (referendum, parliament, etc.)</p>
	CR 3.3 Survey of public acceptance	<p>IN 3.3 Good support before 2011. Current- need to do public information and then survey.</p> <p>-----</p> <p>AL 3.3 credible survey has or has not been carried out</p>
	CR 3.4 Policy support	<p>IN 3.4 Generally govt. policy support nuclear power but very cautious after 2011</p> <p>-----</p> <p>AL 3.4 NEPIO was formed in 2011 to spearhead the study and planning of NPP</p>
	CR 3.5 Political environment and investor risk	<p>IN 3.5 Generally govt. will commit on all decision made for a very long time</p> <p>-----</p> <p>CR 3.5 In general, projects which are capital extensive will be guaranteed by the government</p>

User Requirement 4 - Human resources(INPRO & assessment)

User Requirements	Criteria	Indicator and acceptance limit
<p>UR4: Human resources: The necessary human resources should be available to enable all responsible parties involved in a nuclear power programme to achieve safe, secure and economical operation of the NES during its lifetime</p>	<p>CR4.1: Human resources</p>	<p>IN4.1: Availability of adequate human resources to establish and operate an NES AL4.1: Sufficient according to international experience</p> <p>(INPRO)</p>
<p>UR4. Human resources</p>	<p>CR4.1 Human resources</p>	<p>IN 4.1: Current capability</p> <ul style="list-style-type: none"> - experience in operation and maintenance of research reactor, manage safety of nuclear activities, planning and management of large projects (non-nuclear) and operation of conventional thermal plants. - Dept. of Nuclear Engineering and Dept. of Nuclear Science in universities were established apart from MSc in Nuclear Eng/Sc. - Continuous training under IAEA and bilateral program coordinated by TSO. - To further train current personnel at NEPIO, AELB, TSO and utility, once a decision on NPP is made to meet international practices and norms <hr/> <p>AL 4.1. Opportunity to be trained to international standard</p>

User Requirement 5 - Minimization of infrastructure(INPRO & assessment)

User Requirements	Criteria	Indicator and acceptance limit
UR5: Minimization of infrastructure: The NES should be designed to minimize the necessary infrastructure for a nuclear power programme	CR5.1: Personnel	IN5.1: Human resources needed for operation, maintenance and repair and decommissioning AL5.1: Amount of human resources is reduced in comparison to an existing facility
	CR5.2: Pre-fabrication of components	IN5.2: Extent of prefabrication of components AL5.2: Extent is increased in comparison to an existing facility (INPRO)
UR5 Minimization of infrastructure	CR5.1 personnel	IN 5.1: The technology selected will be the most efficient, economic and safe. Sufficient manpower will be trained to meet requirements. Further manpower reduction will increase economics (reliability) and support from public. Evidence from technology selection process ----- AL5.1: reduced number of manpower compared to older plant
	CR5.2. Pre-fabrication of components	IN 5.2 components prefabricated in factory increased in number ----- AL 5.2 Less number of local facilities needed to manufacture components

User Requirement 6 - Regional and international arrangements (INPRO)

User requirements	criteria	Indicator (IN) and acceptance limit (AL)
UR6: Regional and international arrangements :Regional and international arrangements should provide options that enable a country with an NES to minimize the infrastructure for a nuclear power programme	CR6.1: Options to reduce institutional infrastructure	IN6.1: Have regional and/or international arrangements to reduce the institutional infrastructure been considered? AL6.1: Yes
	CR6.2: Options to reduce industrial infrastructure	IN6.2: Have regional and/or international arrangements to reduce the industrial infrastructure been considered? AL6.2: Yes
	CR6.3: Options to reduce social political infrastructure	IN6.3: Have regional and/or international arrangements to reduce the social political infrastructure been considered? AL6.3: Yes
	CR6.4: Options to reduce human resources	IN6.4: Have regional and/or international arrangements to reduce human resources been considered? AL6.4: Yes

User Requirement 6 - Regional and international arrangements (assessment)

User Requirements	Criteria	Indicator and acceptance limit
UR6 Regional and international arrangements	CR6.1 option to reduce institutional infrastructure	<p>IN 6.1: Malaysia has signed a number of MOUs with regard to safety and energy which include nuclear activities and safety. https://www.kln.gov.my/archive/content.php?t=3&articleId=1090564</p> <p>-----</p> <p>AL6.1: Infrastructure such as training facilities can be sourced out through MOU</p>
	CR6.2 option to reduce industrial infrastructure	<p>IN 6.2 No bordering country produce or fabricate NPP components. At present no international arrangement involving NPP components that may reduce industrial infrastructure is planned</p> <p>-----</p> <p>AL 6.2 No; Some local factory may prefer to manufacture components especially those not related to nuclear island</p>
	CR6.3 option to reduce social political (geopolitical) infrastructure	<p>IN 6.3 Regional social and political arrangements related to NPP is helpful for public information and promotes mutual understanding in terms of trans-boundary issues. Currently S&T including nuclear issues are discussed in regional forum such as ASEAN TWG-S&T</p> <p>-----</p> <p>AL 6.3 Yes</p>
	CR6.4 option to reduce human resources	<p>IN 6.4 Currently regional and international arrangements related HR does include outsourcing of nuclear personnel</p> <p>-----</p> <p>AL 6.4 No</p>

What can be deduced from this assessment

- With regard to regulation and the regulator any shortcoming will be further improve to achieve international requirements and standard
- Financially the local banking system can support NPP development
- The power demand growth of around 3.2% with retirement of old fossil plants, additional power plants is justified
- The grid system and other infrastructure can support NE development and those lacking such as for high level waste will be developed at later stage
- Human resource can be developed to carry out all necessary task in NPP installation, operation and maintenance.
- Justification in terms of economic benefit, depletion of indigenous sources, green house gas and energy security is unquestionable
- International and regional networks exist for collaboration, exchange of information, training etc.
- **Public acceptance – announcement for new regulatory bill and feasibility study has been made publically; campaign against the plan for NE deployment from NGOS and opposition parties has also emerged especially over the internet and some suggest alternative plan.**
- **Need to implement public participation, survey, public acceptance and information program in a 'strategic way' whereby the minority will not hamper implementation agreed by the majority as well as locality risk and benefit well appreciated.**

Conclusion

Benefits

- Can assist in determination of objective/goal of each task in planning
- Good initial guidance in planning and for making the final decision
- Can progressively improve planning
- Can gauge current status in terms of readiness
- Good input to feasibility study

Challenges

- Availability of accurate data
- Some data may be confidential
- Acceptance criteria for public acceptance – 10% that does not agree may create enormous problems/90% that agree or the silence majority may not help
- Int'l practice for public participation - referendum, parliament, etc.
- Comprehensive feasibility study by NEPIO is still undergoing

Thank you for your attention



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