Nuclear energy in Malaysia – closing the gaps

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Abstract. This article is prepared by the Malaysian Nuclear Society (MNS) to present the views of the Malaysian scientific community on the need for Malaysia to urgently upgrade its technical know-how and expertise to support the nuclear energy industry for future sustainable economic development of the country. It also presents scientific views that nuclear energy will bring economic growth as well as technically sound industry, capable of supporting nuclear energy industry needs in the country, and recommends action items for timely technical upgrading of Malaysian expertise related to nuclear energy industry.

1. Background

Nuclear energy, over the last decades, has shown its resiliency in meeting the shortfall of energy demand from fossil fuel. Apart from its natural abundance in nature, with Kazakhstan, Canada, and Australia together accounting for 63% of world uranium production, Namibia, Russia, Niger, Uzbekistan, and the United States producing in excess of 1000 tonnes per year, the “yellowcake,” the dry powder-form material consisting of natural uranium $U_3O_8$, the price of uranium remains stable in the world market [1]. In contrast, the prices of petroleum and coal were driven by market speculation and shortage of supply due to political instability in the gulf region.

While Malaysia continues to subsidize its domestic oil consumption with billions of ringgit per year, the oil resources in Malaysia would not be bottomless (this is true worldwide, as Arab countries known for its richness in oil such as United Arab Emirates (UAE) is investing USD20 billion for four 1,400MW civil nuclear power reactors of Generation-3 APR-1400 of type), the conservative use of Malaysian oil could be further enhanced through the use of economically proven of nuclear-based electricity generation to cover the expected ~30% energy supply-demand gap by 2020.

The use of civil nuclear power reactors for electricity generation needs long term commitment from all parties involved i.e. the regulatory bodies, the government, the utility bodies, the human capital development sectors, the research and development agencies, the nuclear related industrial sectors etc., as a sound nuclear-based industrial sectors could not be built overnight as it requires a technically matured community to sustain and maintain its operation with the safety and operable limit, and further to develop into a technologically driven industry able to generate spin-off industries in Malaysia.

For Malaysia to emulate Japan and other countries practicing nuclear-based electricity generation, it has to leap jump ahead technically in terms of nuclear standardization and practice. The dormant state of its nuclear science and technology for the past 30 years has to be revitalized to produce more experts in nuclear science and technology, and upgrade its current industrial standards further to

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nuclear standard. It will also need to beef up its regulatory bodies to better implement the nuclear standardization in the practicing industry, and thus protecting the public at large from the folly of an incompetent management of the nuclear power industry. The supply of expertise in related nuclear science and technology should be sufficient and well educated enough to cater for the stringent needs the nuclear power industry in Malaysia. The stringent need of nuclear power industry would require the Malaysian education system to upgrade its teaching capability to produce qualified nuclear engineers and scientists to support and sustain the nuclear energy industry in Malaysia.

2. Implementation of Nuclear Energy Programme in Malaysia: Issues and Recommendations

While the introduction on nuclear energy is expected to drive the economic growth of Malaysia to another level, the cascade effect will also unleash high technology industrial development for Malaysia [2]. Time has proven that countries such as France, Japan, China and recently Korea that uses nuclear for its energy generation have emerged stronger economically, despite the turbulence of world oil prices. Not only that, the industrial development in high-tech industry related to the nuclear energy industry, such as automotive, ITC, heavy industry, robotics, semiconductor etc., has also propagated and its products has become more competitive in the world market.

Looking back, Malaysia has been lagging behind 30 years in terms of nuclear science and technology, as compared with Korea when it was almost at the same level with Malaysia in 1960s, when Korea started to commission its first nuclear research reactor. The gap now between Korea and Malaysia, in terms of nuclear science and technology, for the latter to start building its first nuclear power plant for electricity generation, is so wide. Such contrast requires that Malaysia re-examine itself to realign all its resources for effective implementation of nuclear power program in Malaysia. The following chapters will give the results of such re-examination.

2.1 Research and Development (R&D) / Technical Aspects

One of the basic requirements in for establishing and implementing quality assurance programmes for nuclear power plants is the need for research and development (R&D) to enhance nuclear safety by continuously improving the methods employed to achieve quality [3]. The R&D preparedness to support the nuclear power industry requires a matured workforce able to carry out effective R&D programmes towards enhancing the nuclear safety. The personnel needs to be trained so that they are competent and qualified enough to perform their assigned work and understand the safety consequences of their activities.

As Malaysian has been lagging behind, in terms of R&D infrastructure to support the nuclear power industry per se, it needs to catch up very fast what it has loss for the past 30 years. Preparing for the right technical support for the nuclear power industry in Malaysia to prosper in the future needs capable personnel in the right number. If Malaysia were to venture into R&D in nuclear power programmes, it needs to identify some critical issues and gaps facing the R&D community.

One of the critical issues is finding the right manpower to undertake R&D projects related to nuclear energy development programmes. The following actions are suggested to be taken in order to meet the demand of nuclear international codes and practices:

- Training of manpower related to nuclear energy development programmes has to be carried out outside the country. This would give Malaysia disadvantages such as it need a bigger capital investment needed to finance the course in foreign countries, thus limiting the time spent for the course stint, with limited number of trainees that could be send, as compared if the course were to be carried out locally.
- As technology and procedures improved over the times, training programmes has to be carried out continuously to meet the demand of international nuclear standards and practices, more capital investments needed for carrying out such retraining programmes overseas.
- Experts in nuclear science and engineering need to have a hands-on experience before they are certified good enough to become operators of a nuclear power plants, run regular integrity assessments of the plants and carry out operation and maintenance according to international
nuclear standard and practices. Experience has shown that such experts need at least 3 to 5 years of hands-on training on actual site before they are qualified and skill enough to be certified as having skills in compliance with international nuclear standard and practices.

For the above to be addressed effectively in as shortest time as possible, all parties related to research and development (R&D) in nuclear science/physics and engineering i.e. research institutions, institutions of higher learning, standard institutions, governing bodies and policy maker, should work together in synchronization to make sure that Malaysian R&D in nuclear science/physics and engineering would be ready to support the nuclear power industry in Malaysia, in the shortest time possible.

2.2 Human Resource Development

One of the most important aspects in the infrastructure development towards a civilian nuclear power industry in Malaysia is its quality of human resource, able to handle and maintain the nuclear power plant operation within its operation and safety limit conditions, as well as carrying out R&D works to support the nuclear power plant operation and its continuous enhancement. Professional bodies in Malaysia such as the institute of engineers (mechanical, electrical/electronics, civil), architects, advance manufacturing, consultants, chemists, environmentalists, surveyors, planners, chartered institute of building, materials, logistics, bar council, medical, etc., should seriously consider to adopt nuclear standards and practices into their charters. This would ensure that Malaysian professional bodies should have sufficient professional expertise to handle all aspects related to nuclear power industry i.e. architecture and design, construction, project management, installation, component fabrication, transportation, legal, medical etc.

On the national scale, Malaysia needs to have a relook at its education system and revamp the system where necessary, to produce a well rounded and educated nuclear scientists and engineers, able to operate and maintain nuclear power plant operation with its operating and safety limit conditions, as well as carry out R&D works to support the operation of the plant, and to upgrade the nuclear power industry to next level. Higher institution of learning offering good courses in nuclear science and engineering should be given the green lights to foster close partnership with renowned international nuclear science and engineering institutes to produced experts in science and engineering of international outstanding. The setting up centre of excellence in nuclear science and engineering to cater for the needs to produce local expertise of outstanding capability, and to carry out excellent R&D works in these areas should be considered seriously.

2.3 Industrial

While the Malaysian industrial sectors (civil, structural, M&E, architectural, design) have evolve since the 1980 from conventional to oil & gas and aviation industries, its nuclear industry is still at its infancy. The current exposure of local industry to all aspects of nuclear science and engineering is limited, as Malaysia as yet to adopt a strong stand towards the use of nuclear for its electricity generation, although it recently has established the Malaysian Nuclear Power Corporation (MNPC) last January 2011, under the auspicious of the Prime Minister’s Department.

The industry involvement in Malaysia can be divided into three stages – pre-construction, construction, and operation and maintenance. While the pre-construction would involve site feasibility study (site location, EIA study), design, economics feasibility study, funding, civil, structural, M&E, none of these have ever have components of nuclear plant development before. The construction, operation and maintenance of a nuclear power plants would add a new dimension and experience to the people involved. As nuclear power plant, construction, operation and maintenance is highly technical and specialized, the personnel involved in these key areas needed to be accredited with nuclear standards and practices recognized internationally before they are allowed to venture into construction, operation and maintenance of a nuclear power projects. Malaysia needs to enforce
adequate regulation so that these people follow nuclear standards and practices, to protect the civilians from being short-change due to the negligence in nuclear power plant construction.

2.4 Legal
One of the most important aspects in nuclear power plant construction, operation and maintenance is the legal aspects. With the Act 304 Atomic Energy Licensing 1984 currently as the sole act used in enforcing all aspect on the use of atomic energy, radiation use and radioactive sources in Malaysia [4]. This act is not as comprehensive as the Nuclear Power Laws of the USA in regulating the nuclear power industry in the country.

Malaysian jurisprudence, law makers and legal fraternity needs to be updated on current laws and regulation regarding nuclear power plant construction, operation and maintenance. The universities and education institutions should to tie up with the university from foreign countries to improve curriculum on Nuclear Power Laws.

2.5 Public Acceptance and Waste Management
For greater public acceptance, the people involved in the planning of the nuclear power plant construction needs to be transparent and able to educate the public at large, what are the steps to be taken for safe construction and operation of nuclear power plants. The public should be made known that the construction, operation and maintenance of nuclear power plants are in accordance with international nuclear standards and practice that comply with stringent standards of nuclear quality assurance programme. The public also needs to be ensured that adequate regulations and laws are being enforced to protect them from harmful effects of nuclear power plant failure. The fact that there are now a total of 442 of nuclear power plants in operation worldwide shows that nuclear power plant

Another issue is the management of nuclear from spent fuel. The fact that more 96% of nuclear spent fuel could be reprocessed and recycle for use, leaving 0.33% of high level waste to be management has securely stored until its has decay into a manageable level. Malaysia should to invest in spent fuel processing technology available in market, to manage its nuclear spent fuel effectively. This may require careful study before being implemented.

3.0 Conclusion
The nuclear power programme for electricity generation may no longer be an option but a necessity for Malaysia, if she were to be economically competitive in future due to shortage of fossil fuel. The impending use of nuclear energy for electricity generation to drive the economic development of Malaysia in the future requires carefully planning and implementation that conform to nuclear standards and practices. Due to its high technological investment and also high return, the implementation of nuclear energy for electricity generation would not only provide affordable electricity tariff, but would also bring the Malaysian socio-economic development to the next level.

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