Methodology for Establishing National Strategy for Radiation Safety of Nucleonic Gauges in Cambodian Industry

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1. Introduction

Nucleonic gauges (NGs) have been widely used in many countries by various industries to improve the quality of products, optimize the process, and save energy and materials. Generally, NGs consist of a suitable radioactive source and detector, and it is a kind of measuring and analysis instrument using the interaction between ionizing radiation and matter.

Each country has its own unique legislation framework and national regulations, because they have to reflect domestic conditions in order to implement a strategy or a policy. In case of radiation safety, almost of all national standards for radiation protection comply with the hierarchy of rulemaking as shown Figure 1.

Although, Cambodia does not a large use of radiation facilities, but we need to regulate radiation protection and manage occupational exposures in our country because radioactive sources have been used in the field of nuclear medicine, industry, construction, and agriculture etc. Particularly we have used the NGs in a few of our industrial fields, we need to ensure safe operation and to protect the radiation workers from the risk of ionizing radiation by formulating and implementing effective regulations.

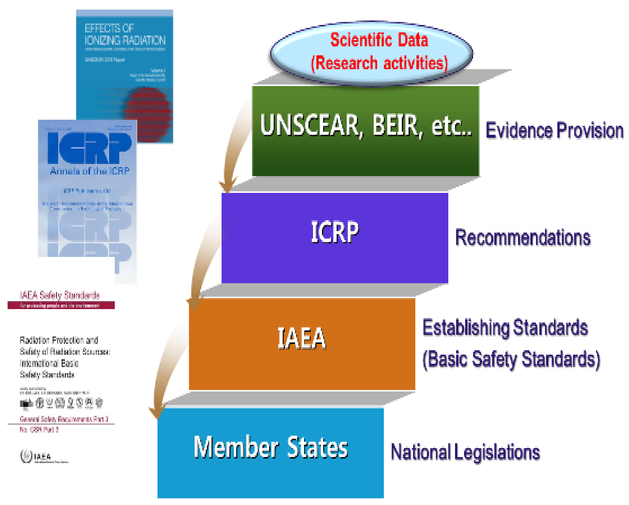

Fig.1. Hierarchy of national legislations

2. Principles and Materials

2.1. Principles of Radiation Protection

The primary safety objective is to protect radiation workers and the surrounding environment from harmful effects of ionizing radiation while operating NGs. The principles of radiation protection relevant to NGs are as follows:

- System of radiation protection: justification, optimization, and dose limitation (ICRP 103),
- Regulatory requirements (IAEA/GSR Part 3),
- Designation of controlled areas and of supervised areas (national regulations),
- Dose limits and investigation levels,
- Other related principles.

2.2. Current Status of Radioactive Material in Cambodia

Cambodia has not yet used much of radioactive materials as shown Table 1, but a sharp increase in usage is expected in near future. Also, more and more NGs are used in various industries with the development of research in the field of nucleonic control systems as used: civil engineering, beverages industry, cement industry, and tobacco industry.

Table 1: Radioactive materials used in Cambodia

Industry	Applications	Sources	Activity
Hospital	brachytherapy	^{137}Cs	1.70 GBq
	Tele-therapy	^{60}Co	198 TBq
	linear accelerator	6 MeV	-
Construction	soil density	^{137}Cs	0.33 GBq
	soil moisture	^{241}Am/Be	1.48 GBq
Company	liquid level	^{241}Am	1.57 GBq

2.3. Categories of Radioactive Sealed Sources

It is very important to understand all the categories when planning, handling, and management of a disused radioactive sealed source (RSS). Table 2 shows the five categories of RSSs.

Table 2: Categorizations of RSSs based on its risks

Cat. No.	Degree	Risks
1	Extremely dangerous	Even relatively short exposure (a few minutes ~ an hours) to materials may very well cause permanent damage including death
2	Very dangerous	Short exposure (an hours ~ days) to materials may very well cause permanent damage including death.
3	Dangerous	Exposure (days ~ weeks) to materials may very well cause permanent damage including death.
4	Unlikely to be dangerous	It is unlikely that anyone would be permanent fatal accident by this source. Nevertheless, this amount of radioactive material still dangerous if not safely managed or securely protected, the relatively exposure (up to many weeks).
5	Most unlikely to be dangerous	No one could be permanently damaged by this source. This amount of radioactive material, if dispersed, could not permanently injure anyone.

The categories 1, 2 and 3 are dangerous and used as irradiators for radiation processing. On the other hand, some less dangerous are categories 4 and 5 contain radionuclides with long half-lives, such as ^{226}Ra at 1,600 years and ^{239}Pu/Be at 24,100 years.

There are many different kinds of industrial gauges that use radioactive material with the most common being level and thickness gauges which are used in process control. These RSSs used in industrial applications are mostly in Category as 3 and 4.

3. Results and Discussions

3.1. Design the National Strategy and Policy

Cambodia does not exist a nuclear law and regulatory body. The Ministry of Mines and Energy (MME) is being drafted a nuclear law of the Kingdom of Cambodia by having the facilitating term from IAEA. Regulating radiation safety is a national responsibility, many countries have adopted the IAEA's safety standards for use in their national regulations. According to the fundamental safety principle 2 of IAEA/SF-1, an effective legal and governmental framework for radiation safety must be established.

As considering the above mentioned the IAEA's fundamental safety principle and radiation protection standards, our government framework for regulating radiation safety could be suggested to establish an "office of nuclear safety, security, and safeguards". Figure 2 shows the initiatives of our Cambodian government framework suggested in this study.

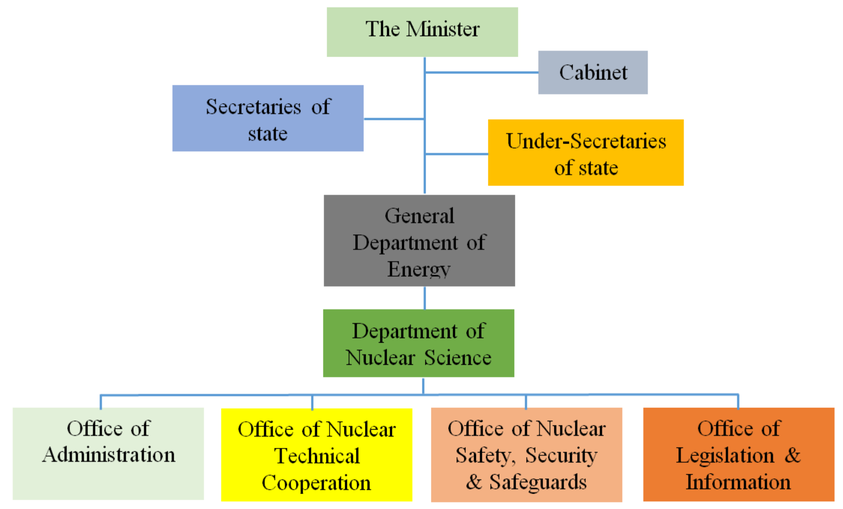

Fig. 2. Initiatives of the government framework of Cambodia

3.2. Regulatory Framework in Cambodia

Cambodia does not yet have a specific nuclear law and regulatory body. Presently, MME is play an essential role and has responsibility for regulation of radioactive sources and practices. MME has been drafted a regulation on nuclear and radiation safety. In the same time, MME has issue licensed to some industries already based on our experiences. Figure 3 show the regulatory framework and license process in Cambodia.

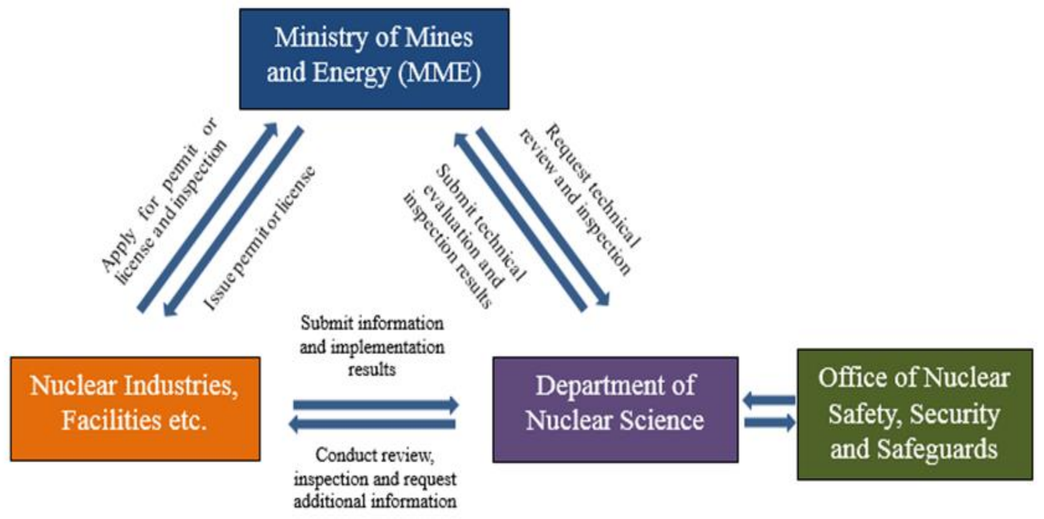

Fig 3: Regulatory framework and license process

4. Conclusion

The utilization of NGs in Cambodian industry will be rapidly increased in near future due to many advantages. Considering our domestic conditions to industrialize, Cambodian government have to establish a fundamental radiation protection regulatory framework in our country that comply with the IAEA's basic safety standards. Also, we have to a comprehensive mechanism for implementation of this framework. The structure of government responsibility and functions are based on the IAEA/GSR Part 1 and our national conditions. In a word, Cambodia has to formulate our national regulations that are consist with the international nuclear safety standards.

5. References

[1] IAEA, Technical data on nucleonic gauges, IAEA-TECDOC-1459, Vienna, 2005.
[2] ICRP, The 2007 recommendations of the international commission on radiological protection, ICRP Publication 103, 2007.
[3] IAEA, Radiation protection and safety of radiation sources: international basic safety standards, No. GSR Part 3, Vienna, 2014.
[4] IAEA, Fundamental safety principles: No. SF-1, Vienna, 2006.
[5] IAEA, Governmental, legal and regulatory framework for safety: No. GSR Part 1, (Rev 1), Vienna, 2010.