Introduction to the Institutional Strength in Depth for Nuclear Safety and its Implications

Chang Rae Kim*, Su Jin Jung, Young Sung Choi
Safety Policy Team, Policy Department, Korea Institute of Nuclear Safety
**Corresponding author: k730kcr@kins.re.kr*

1. Introduction

Nuclear safety concept, which was imperfect in the beginning, has evolved through gradual improvement. Paradoxically, how we have responded to accident, failure, and other unknown new information represents the history of safety improvements and development of regulation methods. NTTF of NRC expressed its past regulatory approaches as "patchwork"[1] while ASME suggested that we need to "forge" nuclear safety concept based on historical lessons learned (June, 2012) [2].

IAEA and NEA collected the data related to Fukushima Daiichi Accident for the past five years and published reports in order to draw lessons learned from the accident and to describe what Member States should do for future. The reports suggest actions that Member States have already carried out or will carry out including response to external event, consideration of beyond design basis (BDB) event, emergency response, etc [3, 4]. According to the basic viewpoint of theses report, the Fukushima Daiichi accident was not rooted in failure of existing safety concept or framework. Rather it assumes that the accident was rooted in our failure of faithfully following it. Provided that, as a newly adopted terminology or concept, IAEA reports mention 'Systemic Approach' to Safety, while NEA reports mentions 'Holistic Approach'.

In case of the U.S, it was expected, at first, that its regulatory framework would need significant change by taking into account the lessons learned in Fukushima accident. After five years, however, it finally decided that any changes that break bound of existing framework would not take place. In July, 2011, the Commission decided a provisional refusal to the recommendation no.1 suggested by NTTF of NRC. RMTF, which was left open considering its long-term possibility, was also decided not to pursue.

However, there remains a question: what are the lessons that we need to cherish? It is undeniable that Fukushima Daiichi accident was an epoch-making turning point to shed light on what we have neglected upon. If our failing to faithfully implement existing safety securing framework was a fundamental cause of Fukushima accident, many unsolved questions remain strong: how to define faithful implementation?; is faithful implementation possible?; and what are the methods for faithful implementation? In Korea efforts have been made an all effort to thoroughly take into account lessons learned from Fukushima accident: 1) Short-term action: drawing up and implementing 50 measures; 2) Mid-term action: stress test targeting aging NPPs, after which the test is planning to be carried out on entire domestic NPPs; 3) Long-term action: overall improvement in regulatory framework such as the legalization of severe accident that stipulates the provisions specific to BDB accident (March 24, 2016).

The International Nuclear Safety Group (INSAG), which is a group of experts with high professional competence in the field of safety working, also has considered a new concept to strengthen nuclear safety after the Fukushima accident, and will propose the "institutional strength in-depth (ISiD)". SO here is described what ISiD is and its implications

2. Institutional Strength in Depth (ISiD)

In this section the concept, proposal background, principles and layers of the ISiD which will be proposed by an INSAG report prepared by the International Nuclear Safety Group (INSAG) for the first time after the Fukushima accident are described.

2.1 INSAG's Viewpoint on Fukushima Daiichi Accident

INSAG focused on the fact that the severe accident took place in Japan, which has always opened to international community and possessed advanced nuclear industry as well as experienced regulatory personnel. Not only NPP operators but also the regulator and even stakeholder fell to believe "NPPs in Japan are safe." Such basic assumption prevented them from facing and addressing the challenges against safety level, and thus safety improvement failed to be made in a timely manner. The root cause of such problem, as pointed out by various documents, was that the safety system of Japan, the combination of culture and institution, was not effective enough. This can be defined as "Institutional Failure." [5].

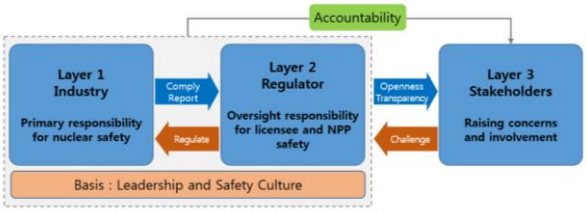
INSAG acknowledges it is true that since the Fukushima Daiichi accident, various efforts have been made to enhance safety level, most of which, however, limited in area of facility and operation. Such effort can go only so far in responding to accidents whose types and potentials vary. INSAG argues that it is time to seek ways to prevent the "institutional failure", the root cause of Fukushima accident. To this end, it suggests to establish a robust nuclear safety system through Institutional Strength in Depth (ISiD).

2.2 Concept and Characteristics of Institutional Strength in Depth

Institutional Strength in Depth (ISiD) is similar to the concept of defense in depth in that industry, regulatory body, and stakeholder are considered as its layers. Based on diversity, redundancy, and functional separation, each layer sets inter-layer independency and prevention of both single and common cause failure as its principle. It is assumed that the institutional defect lying dormant in each layer can be challenged or addressed by back-end support.

INSAG suggests the following three independent layers as ISiD target: 1) nuclear industry; 2) regulator; and 3) collection of stakeholder. First layer (Nuclear industry) has the fundamental responsibility for nuclear safety. Second layer (regulator) has the supervising responsibility over licensees and plant safety. Third layer has the role as a barrier to encourage third layer(the collection of stakeholder including the public and parliament members) to raise issues and have better involvement so that the first and second layers are able to focus on nuclear safety and also to prevent themselves from falling to complacency. In addition, in order to assure the robustness of each layer, leadership, safety culture, and consistent pursuit of safety improvement are emphasized as the cornerstone of safety system.

The following figure illustrates the concept of nuclear safety system [6].



<Figure 1> Concept of Nuclear Safety Framework

While each and every layer exists independently, the industry and regulator are responsible to be open and transparent to the stakeholder who are influenced by their activity. The issue raising and challenge made by stakeholder are the key motivator for first and second layers to consistently improve safety.

2.3 Institutional Strength in Depth for Robust Nuclear Safety System

INSAG considers the inside of each layer consists of sub-layers that require strength in depth in itself. Based on the current system, it provides the following structure, role, and components of sub-layer as an example. First layer (nuclear industry) has to play a barrier role for safety, under which four sub-layers perform the function: 1) Operation activity according to the resource, organization, and culture of operator (licensee); 2) peer pressure (national and regional level); 3) peer pressure and peer review from international industry (WANO, etc); and 4) peer review from international organization (IAEA, OSART, etc). Nuclear operators, in particular, have a fundamental responsibility for nuclear safety. Therefore, they are obliged to develop a robust ISiD system and apply the ISiD principles to the design of organization, resource planning, process and procedure, and organizational culture. Second layer (regulator) is responsible for supervision over safety. It is important to secure technical knowledge, capability, and authority to assure that the licensee maintains and manages a robust ISiD system · What matters in particular is the management leadership in charge of nurturing the culture of openness, transparency, and responsibility within organization · Regulator needs to recognize the strong impact it can have when interacting with the licensee (operator) organization, pursues self-improvement all the time, and accepts challenges not only from the inside but also from the outside, so as to set an example for licensees to avoid complacency and improve safety. Third layer can be the public, parliament members, and NGO, to name a few and is expected to make first and second layer more robust through its interface with other layers (explanation, request delivery, regular meeting, and, direct participation in decision making when necessary).

General characteristics of a robust nuclear safety system that can be achieved through such effort can be as follows : 1) Each layer remains independent but, at the same time, open and transparent to other layers to allow effective communication and to make positive relationship with other parties being influenced by them; 2) Especially the leader of each layer holds a strong sense of safety culture and nuclear value and fully understands that his/her words and actions may have impact on safety culture of other layers; and 3) Each and every layer, sub-layers and their component, and interface between them work in an effective manner.

3. Conclusions

INSAG suggested each nation to evaluate its nuclear safety system according to ISiD concept and improve insufficient areas. It also recommended IAEA to develop guidelines for implementation. It suggested that through external peer reviews regarding the industry and regulators (i.e. IAEA, WANO) the gap in leadership, nuclear values, and interface need to be found and narrowed IAEA, WANO. In addition, it recommended that the contracting parties of international conventions such as CNS (Convention of Nuclear Safety) and Joint Radioactive Waste Safety Convention perform evaluation based on ISiD guideline.

INSAG hopes ISiD to be considered as the major lesson learned from Fukushima Daiichi accident and treated as core achievement of IAEA. It also emphasizes that detailed effort is required to strengthen nuclear safety system internationally. It is important that not to mention current nuclear operating countries, nuclear

embarking countries should also be equipped with a robust nuclear safety system as early as possible. IAEA is suggested to prepare guideline for ISiD and play a role to strengthen international nuclear safety system. Regulatory body should take openness and transparency as its core value and consistently promote the effectiveness of its supervising responsibility through communication with and participation of the industry and stakeholder.

It is emphasized that a robust nuclear safety system should be based on independence between layers in order to avoid group think and activate inter-layer interface to allow each layer to consistently question about the robustness. Leadership for Safety is at the core to lead and maintain such independence and its interface-based nature. The concept that leaves room for third layer to play certain role can be somewhat unfamiliar as the third layer has never been considered when it comes to securing nuclear safety. However, it needs to be accepted as a message that in order to prevent another severe accident, we need to gather all the wisdom based on the mindset of "Keep on asking, questioning, and criticizing".

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