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Nuclear safety and nuclear security synergy

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ABSTRACT

Nuclear safety and nuclear security have the same fundamental goal: protection of public and environment from undue radiological hazards. While the accidents like Three Mile Island, Chernobyl and Fukushima raised critical safety concerns, the terrorist attacks of 9/11 and other incidences of terrorism have brought the issue of nuclear power plant security to the fore. There has been considerable progress in developing a working understanding of safety and security issues in an independent manner. However, as there are a range of connections between nuclear safety and security and hence, the synergy between the two needs to be maximized. This study attempts to parse the similarities and differences between nuclear safety and security, and suggests ways and methods to enhance synergy between nuclear safety and security.

1. Introduction

Nuclear safety and nuclear security aim to achieve the same overall objective – protection of public and environment from undue radiological hazards. The risks posed by a nuclear facility to general public and environment should be the same whether the initiating event is related to safety or security. In other words, the safety related initiating events, such as, human and/or equipment failures, internal and/or external hazards should pose the same risk as the security related initiating events, such as, terrorist attack on the facility, theft of nuclear material or an event of malicious origin.

The Fukushima accident revealed the critical vulnerabilities in nuclear safety. A Fukushima-like nuclear accident need not be caused by natural disaster; it could very well be caused by terrorist attack on, for example, a nuclear power plant's emergency cooling system (Kim and Kang, 2012). The safety vulnerabilities identified post Fukushima which included inconsistent or inefficient procedures, lack of personnel training, lack of communication between authorities, lack of coherent strategy, gaps in the legal framework and inadequate equipment are applicable to nuclear security as well (Biro, 2009).

There are many common linkages between safety and security and it is important to treat nuclear safety and security as interrelated subjects, mutually reinforcing and fully integrated. Hence, the synergy between the two should be maximized. Consideration should also be given to the fact that although some safety systems can enhance security, at times security systems have been seen to interfere with safety practices and vice versa. Hence, it is essential that an integrated approach towards nuclear safety and security be adopted. This study describes the similarities and differences between nuclear safety and security. Further, it suggests the ways and methods to increase the synergy between nuclear safety and security.

2. Nuclear safety vs. nuclear security

As per the IAEA definition, nuclear safety is "the achievement of proper operating conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards" (IAEA, 2007). Nuclear security is characterized as "the prevention and detection of and response to theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear materials, other radioactive substances, or their associated facilities" (IAEA, 2010a).

In the case of nuclear safety, of foremost concern is the radiological risk posed to humans and the environment by human error, equipment failures, internal events (fire, pipe break, etc.) or external events (earthquakes, flooding or other natural catastrophes). Nuclear security analysis, for its part, focuses on two main contingencies: Radiological terrorism and the theft or illegal transfer of radioactive material.

A key difference between nuclear safety and security is intentionality. Accidents related to nuclear safety are unintentional, whereas nuclear security incidents are clearly intentional and undertaken with a specific motive.

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3. Approach for maximizing safety and security synergy

Although the realms of nuclear safety and security have much common ground between them in which to promote synergy, there are certain areas where the requirements for safety and security may be at odds. Hence, in order to maximize the synergy between the safety and synergy, firstly the contradictory requirements between the two have been identified. Nuclear safety and security have contradictory requirements in the fields of culture, emergency response, delay barriers, access control and transport of nuclear materials. These are dealt in detail in Section 4 of this paper. The resolution of such potential conflicts between nuclear safety and nuclear security is based on a philosophy of minimizing the overall risk to the public.

Next, the common areas between safety and synergy have been identified. An exhaustive literature survey had been carried out to identify the areas in which synergy between safety and security could be maximized These include Legal and regulatory framework; Responsibility; Design concepts and criteria like defense in depth, basis of design, and passive systems; Graded approach; Operating principles like testing and maintenance, operating experience feedback, periodic reviews and operating procedures; Emergency response plans such as contingency plan, and protection plan; Training and education.

Identification of the contradictory and common areas have enabled to enhance the synergy between nuclear safety and security. It would enable design and implement measures in an integrated manner such that implementation of safety measures does not compromise security and vice versa.

4. Potential contradictory requirements

To develop a complete understanding of a fully integrated approach toward nuclear safety and security, it is important to consider the potential contradictory requirements in the beginning. These are detailed as follows:

4.1. Nuclear safety and security culture

While safety culture promotes transparency and openness, security culture requires confidentiality. A well-developed safety culture requires that employees share information liberally, but a well-developed security culture requires that the employees share information with the relevant authorized personnel only. Safety culture and security culture should not be merged and yet, they should not be set in opposition to each other.

4.2. Emergency response

For emergency response in case of nuclear safety, it is required that the emergency teams should have full access to all areas of a given facility and to all operations for ensuring safety. With regards to nuclear security, however, certain areas should remain secure for security purposes. During emergency evacuation processes, the main focus of safety personnel is to evacuate all employees as soon as possible; however, for security personnel, identifying and detaining intruders is of utmost importance (Kim and Kang, 2012).

4.3. Delay barriers

The main function of a delay barrier is to delay the access of adversary to the vital areas of a nuclear power plant. On the other hand, for the emergency response team such barriers could inhibit access to critical areas within a facility in the event of an accident (Kim and Kang, 2012).

4.4. Access control

For the smooth functioning of the emergency response, facilitated access is required to all the places at the facility. However, the access to many vital areas may be required to be under access control for security purposes. During normal operations some areas within a reactor facility may be subject to special physical protection systems, however, in case of emergency these areas should be accessible to facilitate evacuation of personnel.

4.5. Transport of nuclear material

In some instances, the application of safety procedures may slow the transport of materials, while the application of security regulations may require minimization of the time duration of transport. In the context of nuclear safety, any transport vehicle is required to display a sign intended to make the public aware that nuclear material is being transported. Concerns about nuclear security, however, might dictate that transport vehicles avoid making the public aware of the presence of nuclear material, as this could attract the attention of those seeking to exploit the opportunity to commit an act of nuclear sabotage.

5. Maximizing safety and security synergy

The synergy between nuclear safety and nuclear security has to be maximized right from the design stage of the NPP. There is much common ground between safety and security in the areas of operating principles, routine testing and maintenance programs, operating experience feedback, legal and regulatory framework, training and education. Shokr, in his presentation identified areas in which synergy could be maximized (Shokr, 2011). The IAEA INSAG also brings out areas where the synergy between safety and security related issues should be increased (INSAG-24, 2010). Based on these literatures following areas have been identified in which synergy between safety and security could be maximized:

(1) Legal and regulatory framework.
(2) Responsibility.
(3) Design concepts and criteria.
(4) Graded approach.
(5) Operating principles.
(6) Emergency response.
(7) Training and education.

The ways and means to enhance synergy in these areas is described in the following paragraphs:

5.1. Legal and regulatory framework

A legislative and regulatory framework is required to ensure sufficient oversight of installations, deal with potential radiological risks and implement safety as well as security requirements. Although the same regulatory body may govern both nuclear safety and security, the regulations governing safety and security should necessarily differ. The body should be tasked with ensuring that facility managers are committed equally to nuclear safety and security. The management system should aim to establish a strong safety-security culture. Establishment of bodies with authority and competence, as well as human and financial resources, is a must in both the fields of nuclear safety and security. However, the authorities responsible for safety and security may not report to the same