SAFETY AND SECURITY IN NUCLEAR POWER SECTOR

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ABSTRACT: Nuclear safety is aimed at preventing accidents while nuclear security is aimed at preventing intentional human acts that might cause accident in the nuclear facility. Consequently, safety is mainly a technical issue while security is mostly connected with intelligence. Both of them have the same goal which comprises protection of the nuclear facility, public and environment. However, safety and security in nuclear power sector have been treated separately. In recent years there is an initiative for their integration. The idea of combining safety and security is not very new but neither is straightforward to be achieved.The paper deals with some commonalities and differences between nuclear safety and nuclear security concepts and argues the roomfor their possible integration

KEYWORDS: nuclear safety, nuclear security

Introduction

Operation of nuclear facilities requires careful attention to safeguards, safety and security.The overall approachis well known as the 3S conceptthat has been established in nuclear power sector over several decades.

Safeguards are aimed at preventing the diversion of nuclear materials for nuclear weapons purposes, safety is aimed at preventing nuclear or radiological accidents and security is

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aimed at preventing intentional human acts that might harm nuclear facility. That is why safeguards have political implications principally, safety is mainly a technical issue and security is mostly connected with intelligence services. Although these activities have a different focus, they overlap with each other. All of them contribute the overall goal which comprises protection of the nuclear facility, public and environment. Protective measures that are taken in these different but connected fields have a number of common features. They require a similar discipline and culture that are built on years of experience. So, there must be synergies in approaches, particularly in the regulatory area.

Safeguards relate to the protection against misuse of nuclear facilities and the diversion of significant quantities of nuclear material[3] from peaceful use. In 1953, US President Eisenhower announced the Atom for Peace program to promote the peaceful use of nuclear energy while demanding non-proliferation i.e. preventing and discouraging any further military use[4]. In 1968 the Treaty on the Non-Proliferation of Nuclear Weapons was opened for signature and entered into force in 1970. So, the application of safeguards is a consequence of a political choice of a state to be party to the Non-Proliferation Treaty.

This paper focuses on the interface between safety and security at nuclear power sector with the aim of ensuring that, as security framework matures, safety and security obligations serve to reinforce each other. Measures related to safeguards also contribute to the overall goal of protecting public and environment but have not similar interfaces with safety and security. This is the main reason why safeguards hereafter are not discussed. The majority of thoughts and

[3] Significant quantities of nuclear material are: 8 kg for plutonium and uranium 233; 25 kg of high-enriched uranium 235 (20% or more); 75 kg for low-enriched uranium 235; 10 t for natural and 20 t for depleted uranium and thorium [1].

[4] USA (1948), Soviet Union (1949), UK (1952), France (1960), China (1964), India (1974), Pakistan (1998), Republic of North Korea (2006) are proven nuclear weapons states. Upon the break-up of the Soviet Union in 1991 there were nuclear weapons in Belarus, Kazakhstan and Ukraine but were returned to the Russian Federation as the successor of the former Soviet Union by 1996. Israel is believed to possess nuclear explosive devices but has never carried out a nuclear test. South Africa had a nuclear weapons program but dismantled all nuclear devices before joining the Non-Proliferation Treaty in 1991 [1].

ideas shortly described in the paper are taken from [3] and INSAG[5]-24 Report [4].

Safety and Security Definitions

Nuclear safety encompasses all technical and organizational measures taken during planning, design, construction, operation and decommissioning of nuclear facilities to protect public and environment against technological risks.On the other hand, nuclear security indicates measures to protect public, facilities and nuclear material against unauthorized human interface. Examples are negligence, theft, sabotage and terrorist acts.The following definitions of nuclear safety and nuclear security are found in the IAEA Safety Glossary [2]:

1. Nuclear safety - 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.

2. Nuclear Security - The prevention and detection of, and response to theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.

Safety and Security Regimes

The global nuclear safety regime is made up of complex relationships that serve to enhance safety in nuclear power sector. It started at the early beginning of nuclear power sector development, which may be placed in early sixties of the last century. The global nuclear security regime is not as mature as the global nuclear safety regime.Its onset coincides with the adoption of the Convention on the Physical Protection of Nuclear Material, which falls in the early eighties of the last century.

The nuclear safety and nuclear security regimes arebased on a number of international legal instruments (conventions,

[5] INSAG stands for International Nuclear Safety Group. It is an IAEA (International Atomic Energy Agency) group of experts with high professional competence in the field of nuclear safety. They hold periodical meetings discussing different important topics in nuclear field publishing report afterwards.

resolutions and codes of conduct).The following international instruments relate to nuclear safety:

1. Convention on Nuclear Safety, 1994;
2. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 1997; and
3. Code of Conduct on the Safety of Research Reactors, 2004.

The following international instruments relate to nuclear security:

1. Convention on the Physical Protection of Nuclear Material, 1980;
2. United Nations Security Council Resolution 1373, 2001;
3. United Nations Security Council Resolution 1540, 2004;
4. Amendment to the Convention on the Physical Protection of Nuclear Material, 2005; and
5. International Convention for the Suppression of Acts of Nuclear Terrorism, 2005.

The following international instruments are relevant to both nuclear safety and nuclear security:

1. Convention on Early Notification of Nuclear Accident, 1986;
2. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, 1986; and
3. Code of Conduct on the Safety and Security of Radioactive Sources, 2004.

Responsibilities for Safety and Security

Both nuclear safety and nuclear security are built on a legal and regulatory framework. That framework defines the responsibilities of several organizations involved. These responsibilities are divided into:

1. the State;
2. Regulatory authority or authorities; and
3. Operating organization(s).

The State must set up an appropriate legislative and regulatory framework to ensure control of nuclear power sector that includes the transport and uses of nuclear material. This requires safety and security provisions. Among others, the State must designate a regulatory body in both the safety and security fields and provide the regulator with the authority and competence, financial and human resources necessary to accomplish their objectives. Particularly the State must define rules for confidentiality and information protection in the safety and security area and carry out checks to ensure the trustworthiness of personnel. The last one has been applying in security area particularly.

The regulatory authority must define the requirements to be satisfied by the operator(s) for both safety and security. The regulatory authority must also set up and implement a licensing system as well as the inspection and enforcement system. Theregulator must ensure that an adequate emergency response system is in place,including various off-site elements that are not the responsibility of the operator(s) but the State agencies and institutions.In both the safety and security fields the regulator must also observe internationalcommitments. It is important to note here that because the close relationship between safety and security, many countries see advantages in having a single regulator responsible for both.

The operating organization has the prime responsibility for the safety and security in the nuclear power sector. In the case of safety, the operator's responsibility may be limited to defense against a design basis accident (DBA) while in the case of security, the operator'sresponsibility may be limited to defense against a design basis threat (DBT). Thisallocation of responsibility reflects the reality that operating staff are in the bestposition to identify the risks arising at the nuclear facility and to ensurecompliance with regulatory requirements. Operator should have a centralized information system and a centralized command centre for directing operations during a safety or security event.

Safety and Security Concepts

Broadly speaking, safety is concerned with protecting the environment from the nuclear facility whereas security is concerned with protecting the nuclear facility from the environment. However, both of them are applying defense in depth philosophy concept. Because of that, there is considerable overlap between safety and security approaches although the focus is different.

Many commonalities between safety and security are frequently obscured by the use of different terminology. Thus, to achieve a shared understanding of the key concepts within each field, there is a need to establish a common language.

Dependency of Safety and Security

Safety and security are interdependent, meaning there is a bidirectional relationship between them i.e. each is dependent on the other. The basic question raised here is the following: If the nuclear facility is not secure, is it safe? It is noted in [3] that stakeholders are beginning to argue that if it is not secure, it is not safe. On the other hand, it should be pretty clear that safety is an unquestionable condition for the nuclear facility to be secure.

In particular, one of the major impacts of interdependency between safety and security is that a security system needs to cope with evolving threats and changes to the environment through the nuclear facility lifetime. It is important for the nuclear facility to remain safe and secure despite such changes. In other words,it is important for the nuclear facilityto be resilient to change.

Safety and Security Principles

There are many overlaps between safety and securityprinciples, but there are also some significant differences and potential conflicts. For example, defense indepth is an important architectural principle for both safety andsecurity that depends on the use of multiple and independent barriers. However, securityconsiderations are likely to challenge the effectiveness andindependence of safety barriers.

Perhaps the most radical security principles from a safety perspective are those that are based on Kerchoffs' axiom[6]. The axiom is dealing with contraryrequirement which underline open facility design on one side,and its easy and fast recovery on the other. The axiom mentioned could have far reaching impact on the architecture of safety.

Moreover, changes to threats over the lifetime of thenuclear facility will probably mean that safety, that wasinitially adequate, will need to be taken into reconsideration. This may have significant implications to the architecture and lifecycle of embedded safety where design life may be 40 years or even more.

Safety and Security Methodologies

Risk assessment is a fundamental step in safety and security analysis, but the underlying threats modelsarecompletely different. However, they use similar techniques to identify potential failures and assess their impact. So there is a need for a unified methodology for assessing the threats to the safety and security of the nuclear facility.

Security considerations can have a significant impact on asafety case. For example, as mentioned previously, safety considerations may challenge the effectiveness and independence of safety barriers. This suggests a greater emphasis on resilience of the design.

It is also necessary to consider the potential for terrorist attackduring a safety event. A fail-safe state of the nuclear facility may not be as safe asformerly thought if the facility is under terrorist attack. So, managing asafety event during a major security event should be taken into consideration as well.

Given the importance of open designand easy recovery (Kerchoffs' axiom), it is an appropriatequestion whether

[6] Kerckhoff's axiom is the concept that a cryptographic system should be designed to be secure, even if all its details, except for the key, are publicly known. The axiom is invented in 1883 by AugusteKerckhoff, a Dutch linguist and cryptographer. The axiom, sometimes referred to as Kerckhoff'sprinciple or law, forms the basis of open security and security by design and contrasts directly with the deprecated security though obscurity model. American mathematician Claude Shannon further refined Kerckhoff'saxiom. Shannon's maxim is saying the following: One ought to design systems under the assumption that the enemy will immediately gain full familiarity with them.

security-informed safety cases should be disclosed. This question leads to the problem of sharing sensitive information about the nuclear facility.

Safety and Security Culture

Safety culture is defined in the IAEA Safety Glossary [2] as the assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance. Security culture has the same definition except for a focus on security issues.

Safety and Security culture often involve individuals of diverse backgrounds and experiences. That is, security personnel, unlike safety personnel, often have military or police backgrounds. The safety personnel have mostly engineering background and are more typical of the ordinary population.

One difference between the two cultures relates to the way information is handled. In the security field, the sharing of information should typically be restricted to a select group of individuals in order to prevent sensitive information related to protective measures or facility weaknesses. In contrast, the general rule in the safety area is to be transparent. Forexample, it may be particularly important to share feedback on experience, andthereby to prevent occurrences of incidents or accidents at one nuclear facility from being repeated at others.

Emergency Preparedness and Response

Operators as well as State authorities are required to develop plans to limitthe consequences of a nuclear or radiological accident. Such plans should encompass bothsafety and security events.

Emergency preparedness and response plans in the field of safety andsecurity need to be well coordinated with all relevant entities. These plans should be complementary and coherent.To ensure that emergency decisionsreflect an awareness of both security and safety considerations, the operatorshould centralize decision making process. It should be underlined here that emergency preparedness and response are an area where safety and security are already fully integrated.

Conclusion

Safety and security in nuclear power sector have been treated separately. These two concepts have certain commonalities but certain differences as well. Bridging the gaps and integrating these two concepts to a certain degree are challenging task nowadays in the field. With respect to degree of integration that may be achieved, according to [4]a special attention is needed in relation to:

- Differences in the State involvement - the State is directly involved in identifying a security event but has no similar role in safety event;
- Differences in the information status - security information must be kept confidential, whereas safety information is generally transparent; and
- Differences in the background of security and safety personnel - security personnel typically have a military or police background, whereas safety personnel are more typical of the general population.

Finally, it is important to emphasize here a good example for full integration of nuclear safety and nuclear security that has already been achieved in the field of emergency preparedness and response to a nuclear or radiological accident.

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