Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, October 27-28, 2016

Regulations and Strategy for a Loss of Large Area

Heok-soon Lim *
Korea Hydro & Nuclear Power Co., Ltd., Central Research Institute
70 1312 beon-gil, Yuseong-daero, Yuseong-gu, Daejeon, 305-343, KOREA
**Corresponding author: khnppro1@khnp.co.kr*

1. Introduction

The Nuclear Regulatory Commission (NRC) has issued 10 CFR 50.54(hh)(2) that requires licensees to develop guidance and strategies for addressing the loss of large areas of the plant due to explosions or fires from a beyond-design basis event through the use of readily available resources and by identifying potential practicable areas for the use of beyond-readily-available resources. These strategies would address licensee response to events that are beyond the design basis of the facility. This paper illustrates overview of Regulations and some important Strategy for a Loss of Large Area of an advanced nuclear power plant.

2. Regulations and Strategy for LOLA

2.1 Regulations

10 CFR 50.54(hh) focuses on ensuring that the nuclear power plant's licensee will be able to implement effective mitigation measures for large fires and explosions including (but not explicitly limited to) those caused by the impact of a large, commercial aircraft.

10 CFR 50.54(hh)(2) requires that Each licensee shall develop and implement guidance and strategies intended to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under the circumstances associated with loss of large areas of the plant due to explosions or fire, to include strategies in the following areas:

(a) Fire fighting
(b) Operations to mitigate fuel damage
(c) Actions to minimize radiological release [1]

2.2 Strategy

2.2.1 Phase 1 – Enhanced Fire Fighting

New Nuclear Power plants must address Phase 1 as operating plants have done; by implementing the guidance in NRC guidance document “Developing Mitigating Strategies/Guidance for Nuclear Power Plants to Respond to Loss of Large Areas of the Plant in Accordance with B.5.b of the February 25, 2002, Order” dated February 25, 2005. [2]

2.2.2 Phase 2 – Measure To Mitigate Damage To Fuel In The Spent Fuel Pool

Phase 2 consists of measures to mitigate damage to fuel in the spent fuel pool (SFP) through the use of diverse internal and external SFP makeup and spray strategies.

(a) Diverse SFP Makeup Source (Internal Strategy)
(b) SFP Makeup Capability (External Strategy)

2.2.3 Phase 3 – Measures To Mitigate Damage to Fuel in the Reactor Vessel and To Minimize Radiological Release

Phase 3 consists of measures to enhance command and control aimed at improving initial site operation response before the Emergency Response Organization (ERO) is fully activated, and implement a specific set of mitigation strategies for PWRs based on diverse methods to ensure PWR safety functions

(a) Command and Control Enhancements

The purpose of command and control enhancements is to establish guidelines for initial site operational response in a beyond design basis condition.

(b) Determination of Need for Mitigation Strategies

NEI 06-12 recommends a few PWR mitigations strategies based on PWR safety functions. Before the actual mitigation strategies are discussed, an evaluation must be performed to determine if each mitigation strategy is required. The PWR key safety functions are as follows:

- RCS inventory control
- RCS heat removal
- Containment isolation
- Containment integrity
- Release mitigation

2.3 New nuclear power plant Strategy

An applicant of a new plant design is faced with two options for Phase 3; credit design features in their Phase 3 strategies, or not. If the latter is chosen, then the applicant is directed to follow the guidance for current. Choosing to pursue the Phase 3 strategies developed for current licenses is always a permissible course of action for applicants for a new license. Both sets of guidance are documented in NEI 06-12. The fact that there is a distinction between strategies for existing plants and for new reactor designs is an acknowledgment by NEI and the NRC that new plant designs could be inherently more robust against the circumstances associated with a LOLA event than existing plants. This is because new plant design features could include such features as enhanced spatial separation between trains of safety systems, passive systems, and additional new safety systems or redundancies.

Five generic PWR safety functions have been identified in the NEI guidance: (1) RCS inventory control, (2) RCS heat removal, (3) Containment isolation, (4) Containment integrity, and (5) Release mitigation. To evaluate the survivability of a new plant's safety functions check up to verify existing design features good to credit. Four deterministic criteria were used for that.

(a) Separate Building, at least 100 yards separation, as illustrated in Figure 1.

(b) Nearby Building, at least 10 feet apart and protected by more than just external walls of the two building, as illustrated in Figure 1.

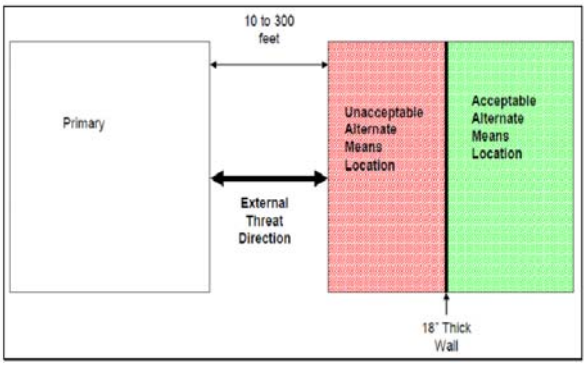

Fig.1. Nearby Building Criteria for external threat[3]

(c) Same Face Criteria: at least one 18 inches thick wall additional to the external wall protecting the alternate means in the transverse direction, as shown in Figure 2.

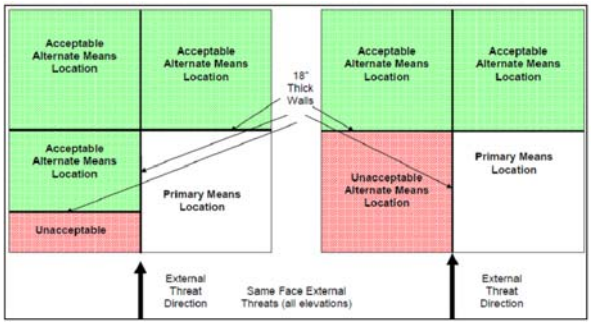

Fig.2. Same Face Criteria for External threat[3]

(d) Internal Threat Separation Criteria: separated by at least two 18 inches thick walls protecting the alternant means, as illustrated in Figure 3.

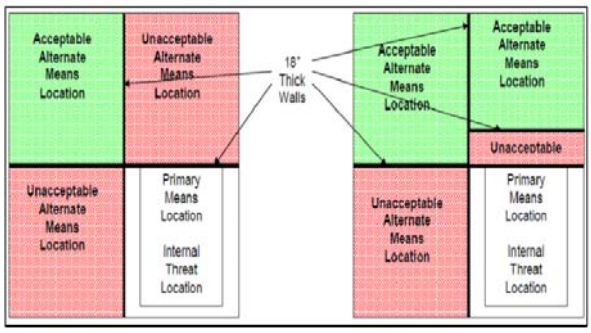

Fig.3. Internal Threat Separation[3]

3. Conclusions

Regulations and Strategy for Loss of Large Area Analysis could be overlooked during the development stage of Physical Protection System. KHNP was done the project of Physical Protection System design including LOLA to meet the criteria of U.S. NRC and IAEA requirements in INFCIRC/225/Rev.5. The New Reactor should meet the regulatory requirements for LOLA. In the future, the results of project will expect to apply new NPPs.

REFERENCES

[1] NUREG-0800, "19.4 Strategies and Guidance to Address Loss of Large Areas of the Plant Due to Explosions and Fires"
[2] NRC Guidance Document, "Developing Mitigating Strategies/Guidance for Nuclear Power Plants to Respond to Loss of Large Areas of the Plant in Accordance with B.5.b of the February 25, 2002, Order," dated February 25, 2005.
[3] Nuclear Energy Institute report, NEI 06-12, Revision 3, prepared by ERIN Engineering & Research "B.5.b Phase 2 & 3 Submittal Guideline," dated July 2009.