

Safety Strengthening for On-Site Spent Nuclear Fuel Dry Storage Facilities

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1. Introduction

Intentional aircraft crashes on containment and fuel buildings of new NPPs are regulated to be assessed as raising protection issues of national key facilities including nuclear power plants (NPPs) since 911 terrorist attacks in the United States, but the regulatory requirements for on-site spent nuclear fuel (SNF) dry storage facilities are not yet provided. Each country is preparing measures to cope with aircraft crashes at SNF dry storage facilities. Here, regulations and regulatory policies to strengthen the safety of on-site SNF dry storage facilities against intentional aircraft crashes were analyzed.

2. Subject

2.1 Intentional aircraft crash

Anxiety about large-scale human damage, economic loss and severe environmental pollution to accidents of NPP facilities caused by terrorism is very high, but vulnerable facilities to actual terrorism are oil refineries or chemical plants that are weaker structures and security than NPPs. Terrorists select targets with a high probability of success (success means total number of casualties or scale of building destruction), but it is estimated that NPP facilities including SNF dry storage facilities are unlikely to be selected as a terrorist target due to strong structures made of reinforced concrete with high security. Aircraft crash resistance to the SNF dry storage facilities is relatively advantageous compared to other NPP facilities because it is difficult to hit correctly by an aircraft, only some SNF storage casks are destroyed, the damage to facility is local and the accident is easy to catch. Whether or not to assess aircraft crashes against NPP facilities differs from country to country, and Europe often assesses the crash of light aircraft or military aircraft. Since 911 terrorist attacks and Fukushima accidents, there is a

growing concern about Beyond Design Basis Accident (BDBA) or Beyond Design Basis Threat (BDBT), so there is a growing demand for increased safety against aircraft crashes.

2.2 United States

NRC requests an assessment of aircraft crashes against new NPPs, although BDBA including aircraft crashes are unlikely to occur unlike Design Basis Accident (DBA) and is not reflected in the design. However, since the SNF dry storage facilities are not to be assessed, NRC investigated problems of NPPs and notified them of Security Order for NPP's storage facilities in 2002. In addition to the requirements of 10CFR72 and 10CFR73, it is regulated under Security Order. In 2003, NRC carried out Security Assessment of NRC-regulated facilities to review the necessity of measures or safeguards in addition to Security Order. The assessment includes large commercial aircraft strikes against SNF dry storage facilities and various ground attacks. There is no urgent need to add to the security requirements of existing SNF dry storage facilities. As the security requirements of SNF dry storage facilities are complex and confusing, NRC has arranged through Federal Registers 72FR12705 (Design Basis Threat) and 74FR13935 (NPP Security Requirements). NRC added aircraft crash to Design Basis Threat (DBT) at 72FR12705 and said that there is no possibility of serious leakage of radioactivity due to aircraft crashes and there is no need for additional measures such as barrier installation. Regarding the requests for installation of external barriers for SNF dry storage facilities, NRC noted at 74FR13935 that aircraft crashes are military issues that the government must respond to and that it is possible to respond due to the Security Order to mitigate damage to NPPs. And NRC noted that it is not the duty of NPP operators. NRC said that as attacks to NRC-regulated facilities is not a responsibility of NPP operators, measures for aircraft crashes are not regulatory requirements and the regulation stipulates the actions

of NPP operators in order to minimize the damage of SNF dry storage facilities against aircraft crashes. NRC requires to establish a mitigation strategy for operating NPPs against aircraft crashes and specifies mitigation strategies and response procedures for aircraft crashes at 10CFR50.54(hh) in 2009. This provision includes NPP's mitigation strategies and precautionary measures for large fire and explosions when NPPs are subjected to potential aircraft crashes. 10CFR50.150 requires that structural/impact/fire assessments for the impact of aircraft crashes to new NPPs built after July 2009 shall be carried out. In this regard, NRC provided guidance and procedure on assessment of aircraft crashes.

2.3 Germany

Although the license for NPPs requires guarantee of suitable protection system, the responsibility of NPP operator is exempted because the war is the responsibility of national defense. It is not clear, however, whether terrorism by aircraft is regarded a war action. In the 1980s, the regulatory authority prepared guidelines for evaluation of aircraft crashes, basically a phantom-type military aircraft crash was assumed and collision-relate missiles, aviation fuel fire and vibration was considered.

2.4 IAEA

IAEA Safety Series No.SSR-2/1 subdivides the accident classification system, introduces Design Extension Conditions including intentional aircraft crashes that cover BDBA and major accident areas to exceed DBA, and requires accident prevention, accident mitigation, accident management, radiation mitigation measures and emergency response outside NPPs.

2.5 Domestic

Aircraft crash as an artificial accident to NPP facility is included in the design criteria for external factors in Article 13 of Reactor Rules. For intentional aircraft crashes, criteria for new NPPs are preparing and criteria for existing NPPs were established in accordance with 10CFR50.54(hh). Operators of NPPs shall submit Accident Management Plan including severe accident management plan for disasters in accordance with Article 20 of Nuclear Safety Act, and the scope of accident management is in accordance with Article 85-19 of Reactor Rules.

According to NSSC Notice No.2016-2 (Detailed criteria for scope and assessment of accident management) accident management scope covers natural and artificial disasters including intentional aircraft crashes. Therefore, as on-site SNF dry storage facilities are the NPP-related facilities, Accident Management Plan shall be prepared and submitted in accordance with NSSC Notice No.2016-3 (How to prepare an accident management plan, published in June 2016) and precautionary measures and accident mitigation for aircraft crashes shall be taken.

Table 1. Regulatory requirements for aircraft crashes

Items		Domestic	US
Artificial aircraft crash		To assess according to crash probability	
Intentional aircraft crash	New NPPs*	Preparing	10CFR10.150
	Existing NPPs*	NSSC Notice No.2016-3	10CFR50.54

* including NPP-related facilities

3. Conclusion

In order to strengthen the safety of NPP facilities against intentional aircraft crashes, regulations for new domestic NPPs have been made like the United States, and operating NPPs shall establish Accident Management Plan for disasters including aircraft crashes against NPP-related facilities like on-site SNF fuel dry storage facilities and submit it to the Nuclear Safety and Security Commission in accordance with NSSC Notice No.2016-3.

REFERENCES

- [1] US National Research Council, Making the Nation Safer : The Role of Science and Technology in Countering Terrorism, 2002.
- [2] US National Academies of Science, Safety and Security of Commercial Spent Nuclear Fuel Storage, 2005.
- [3] US Federal Register 72 FR 12705, Design Basis Threat, 2007.
- [4] US Federal Register 74 FR 13935, Power Reactor Security Requirements, 2009.
- [5] IAEA SS No.SSR-2/1(Rev.1), Safety of Nuclear Power Plants : Design, 2016.
- [6] IAEA NSS No.4, Engineering Safety Aspects of Protection of Nuclear Power Plants against Sabotage, 2007.