NUSCC 47

A question was asked at NUSSC 47 about survival of off-site infrastructure following a seismic event and ability of site to maintain safety functions.

IAEA Clarification

The provision and use of external resources comprises two types of necessary and complementary measures:

- Design aspects to ensure that sufficient supplies are available and secured at the site for a sufficiently long time period before external supplies are necessary and that these supplies can be stored and effectively used once delivered to the site.
- Operational aspects through accident management measures intended to provide assurances that external supplies can be delivered and also effectively used thereafter.

As the question is more related to the accident management aspects, the answer information provided in relation to the design is more concise, but it can be further elaborated. IAEA safety standards consider these two aspects in the following way.

**DESIGN**

The design measures take into account that external resources should only be necessary in the long term and that external infrastructures, e.g. roads, cannot be practically designed to withstand the same levels of external hazards than the plant and that also some vital plant needs to be designed with sufficient margins to withstand extreme external hazards (feedback from the Fukushima Daiichi accident). NPPs are required to be designed with sufficient and secured inventories of fuel, cooling water and other consumables.

- SSG 35, Design of electrical systems addresses the consideration of the minimum time for which on-site power has to be capable of operating independently of off-site power and without replenishing consumable items from off the site: This includes, fuel, lubricants, etc.
- As for the water inventories, they are covered by req.53 in SSR 2/1 (an associated safety guides) on heat transfer to ultimate heat sink. When this sink is not the atmosphere or a huge and secured body of water, e.g. the sea, recommendations are provided for a sufficiently long time period before they need to be replenished.

After the Fukushima Daiichi accident, requirements are also in place for connection of non permanent supplies of water and electricity and adequate margins against extreme external hazards.
SSR2/2 was amended in rev. 1 to include:

5.8C. The accident management programme shall include contingency measures, such as an alternative supply of cooling water and an alternative supply of electrical power, to mitigate the consequences of accidents, including any necessary equipment. This equipment shall be located and maintained so as to be functional and readily accessible when needed.

5.8F. In developing the accident management programme and its procedures, the possibility of regional infrastructure being degraded and of adverse working conditions (e.g. elevated radiation levels, elevated temperatures, lack of lighting, limited access to the plant from off the site) for operators, as well as the possibility of operating conditions for equipment being degraded, shall be taken into account so as to ensure that actions expected for accident management will be feasible and will be able to be taken in a timely and reliable manner.

It should be noted that SSR 2/2, rev. 1 as well as SSG-54: Accident Management Programmes for Nuclear Power Plants, apply to existing and new plants alike.

Several paragraphs of SSG-54 develop these requirements, for instance:

2.18. If accident management strategies rely on non-permanent equipment after an extended loss of all AC power, steps should be taken to ensure that personnel can install and operate such equipment within the time frame necessary to avoid loss of the fundamental safety functions, taking into account possible adverse conditions on the site. Support items, such as fuel for non-permanent equipment, should be available.

2.60. In the accident management programme, external hazards should be considered with a level of severity exceeding the magnitude established in the site evaluation or its equivalent and with a mean annual frequency exceeding the probability of accidents established in the design for the plant.

2.61. The accident management guidance should also consider that, in the case of external hazards more severe than those considered for the design, derived from the site hazard evaluation, there may be extensive infrastructure damage, so that off-site resources are not readily available; examples of such off-site resources include human resources; means of communication; electrical power supplies; means of transport; and the availability of spare parts, lubricants, compressed air, water and fuel.

2.62. Accident management guidance should consider the need to remove rubble due to external hazards more severe than those considered for the design, derived from the site hazard evaluation, and consideration should be given to its removal under bad weather conditions. For example, heavy machinery may be necessary.

2.63. The non-permanent equipment should be located in diverse positions to the extent practicable so as to avoid common cause failures due to external hazards such as earthquakes and tsunamis.

2.64. Consideration should be given to the provision of multiple hook-up points to facilitate the use of non-permanent equipment during an accident caused by external hazards, taking into account the benefits and the potential negative implications.

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1 It should be noted that such damages can occur for external hazards less severe than those considered for the plant design, since it is not possible to design such external infrastructures for the same severity of hazards than the plant.