

Note for the topic “Way to Ensure Safety of Long-term Operation of Nuclear Power Plants”

In recent years, the long-term operation (LTO) of nuclear power plants has become a generic issue in the world. In Japan as well, the government is considering enabling further extension of the operation period of nuclear power plants, which are set currently at 40 years in principle and 60 years in maximum. The bill has been under discussion in the National Diet that it will allow the extension of long-term outage period of nuclear power plants after the accident at TEPCO's Fukushima Daiichi NPS on top of 60 years maximum operation period.

When a nuclear power plant is operated for a long-term, various equipment and facilities are deteriorated (ageing). In considering ageing, two types of degradation conditions must be considered:

- 1) Physical Ageing of Facilities and Equipment
- 2) Obsolescence (Non-physical Ageing) - design and operation are becoming out of date in comparison with current knowledge (IAEA SSG-48 classification: a) obsolescence of technology, b) obsolescence of codes, standards and regulations, and c) obsolescence of knowledge)

In response to these “Physical Ageing” and “Obsolescence”, IAEA has formulated SSG-48 that provides basic concepts on ageing management, and IGALL Report (SRS-82) has been published to provide the basis for both ageing management programmes and ageing evaluation of individual equipment based on operational experiences and management methods in various countries. OECD/NEA has also been discussing this issue. Ageing management by licensees and regulation on ageing by regulators are carried out referring to international practices.

As for discussions on the topic, the Nuclear Regulation Authority (NRA) would like to discuss what could be suggested to be improved in ageing management by licensees and regulation on ageing by the NRA, on two sessions, 1) Physical Ageing of Facilities and Equipment, and 2) Obsolescence (Non-physical Ageing).

1) Physical Ageing of Facilities and Equipment

- What are the issues that must be addressed by a regulator (the NRA) in ensuring the safety of ageing reactors, such as over 60 years of operation? What are the ageing characteristics that should be particularly focus on?

In the U.S. license renewal of 60 to 80 years, following four areas are identified as degradation of particular concern; 1. reactor pressure vessel neutron embrittlement, 2. IASCC of reactor vessels internals, 3. Degradation of concrete and containment performance, and 4. environmental certification of electric cables, as well as its condition monitoring and

assessment.

In Japan, the following six areas are identified as major degradation what should be evaluated in the examination on ageing: 1. low cycle fatigue, 2. neutron irradiation embrittlement of reactor vessel, 3. irradiation induced stress corrosion cracking, 4. thermal ageing of duplex stainless steel, 5. insulation deterioration of cables, and 6. strength deterioration of concrete structure.

- What would be considered as the desired balance between the confirmation of the licensee's evaluation results of each system, structures, and components (SSCs) by regulator (hardware check) and the confirmation of licensee's programme by regulator (Quality Management System check)?

2) Obsolescence (Non-physical Ageing)

- How should Obsolescence such as: a) obsolescence of technology, b) obsolescence of codes, standards and regulations, and c) obsolescence of knowledge, be viewed and addressed?
- How far should regulators intervene in application and adoption of specific technologies?

Although it is not a new technology, in Japan there are voices that the NRA should require licensees to adopt storage method of spent fuels from pool storage to dry cask storage in view of long-term storage. Should the regulator require a switch to later technology if safety improvements are ensured?

- In view of continuous improvement of safety, the NRA considers that it is important to detect issues that are not recognized yet, called "unknown unknowns", how should these be captured and adopted to improve safety?

Please refer to attached supplementary document which has been shared as information only for the External Advisors Meeting held online in November 2020, explaining the purpose of establishing the study team on continuous improvement of safety and the points of discussion.