Chapter 4

Policy Proposal for Countries Considering the Introduction of Nuclear Power

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Chapter 4

Policy Proposals for Countries Considering the Introduction of Nuclear Power

Considering the findings obtained through the literature survey and overseas interview surveys, the IEEJ analysed the ideal ways of communication amongst stakeholders, including regulators and operators, and then made policy proposals. The purpose of the proposals is to suggest to the EAS member states to consider the possibility of including nuclear power in their power portfolio as part of energy policy and to smoothen the operation of nuclear power generation after introduction.

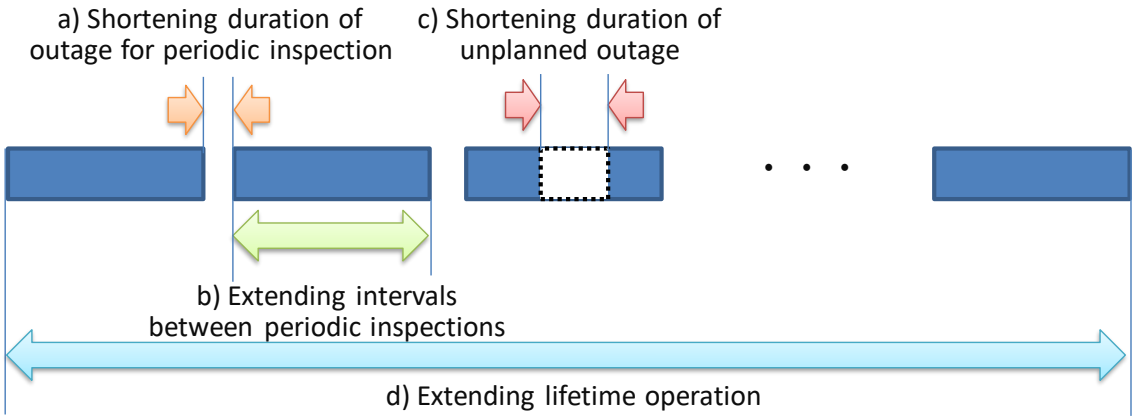
1. Policy Analysis

1) Contributing factors to improve both nuclear safety and effective use

Four initiatives need to be realised (Figure 4.1) to improve the capacity factor of the NPPs:

a) Shortening the duration of outage for periodic inspection
b) Extending the intervals between periodic inspections
c) Shortening the duration of unplanned outage due to a trouble, including response to regulations
d) Extending the lifetime operation as much as possible.

Figure 4.1: Contributing Factors to Improve Effective Nuclear Use



Source: Authors.

The following are discussions on each initiative.

a) Shortening the duration of outage for periodic inspection and b) extending the intervals between periodic inspections

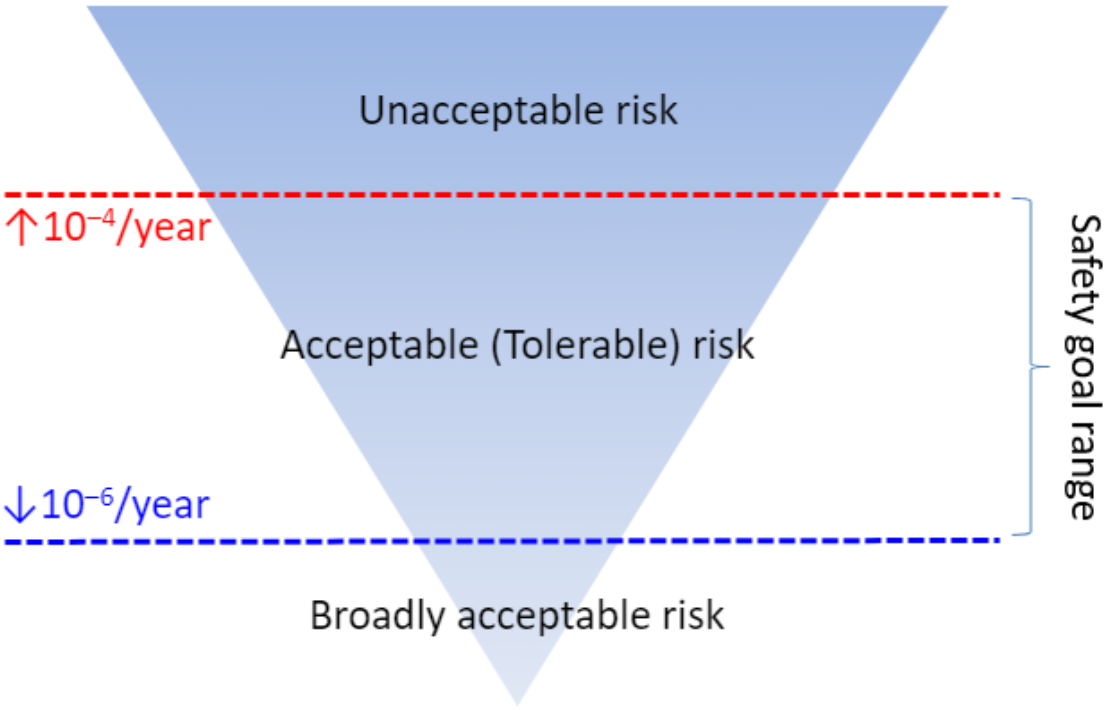
For these two initiatives, the OLM carried out in the US may be a model. The larger the number of subjects of maintenance that can be inspected during operation, the shorter the duration of outage for inspection, and the longer the intervals are between periodic inspections.

The key factor to realise the OLM is risk-informed activities. The capacity factor can be improved whilst properly maintaining nuclear safety (i) if the risks when the functions of the components or the system as the subject of maintenance are stopped can be accurately estimated, and (ii) if the risks are determined to be within the range of the safety goal.

As in the conservative situation in Japan at the end of chapter 2, some may say that simply properly maintaining nuclear safety is not enough to realise improved nuclear safety. Considering this point, the concept of 'reasonably practicable' that the IEEJ learned during the overseas interview surveys may be helpful. Impracticable and unreasonable pursuit of zero risks to go far below the range of safety goals may end up with excessively solemn measures being imposed on operators, and lead to safety being impaired. A cooking knife can injure, but overly fearing that risk and cooking in a set of heavy armour raise the danger of being unable to deal with other risks (e.g. fire) that may occur during cooking due to the inability to take action swiftly.

Regarding the concept of appropriate safety improvement based on reasonable practicability, the UK's graded approach concept about the relationship between safety goals and risk may be a good model. The UK's concept about safety goal range can be interpreted as in Figure 4.2:

Figure 4.2: Interpretation of Safety Goal Range



Sources: Authors, Health and Safety Executive (2001).
Office for Nuclear Regulation (2014).

- Risks are classified into three regions of acceptability: 'unacceptable', 'acceptable (tolerable)', and 'broadly acceptable'.
- The boundary between 'unacceptable' and 'acceptable (tolerable)' is roughly 10^{-4}/year (1 in 10,000 persons dies in 1 year). This value is close to the risk of an accident by car, which requires a licence to drive. Risk with a likelihood higher than this value needs to be banned, or consideration should be given to implementing regulations to reduce the risk.
- The boundary between 'acceptable (tolerable)' and 'broadly acceptable' is roughly 10^{-6}/year (1 in 1,000,000 persons dies in 1 year). This value is close to the risk of a household catching fire. Risk with a likelihood lower than this value does not require any regulations nor further improvement.

c) Shortening the duration of unplanned outage due to a trouble, including response to regulations

For troubles arising from equipment failure, the initiatives that Japan took in the 1980s to prevent abnormal operation and failures are noteworthy.

For outage that involves response to the regulator, highly predictable regulations will be required to avoid unplanned responses. Examples of bad practices of predictable regulations are inconsistent subjective regulations in the SALP programme in the US, unnecessarily detailed regulations in the QMS in Japan, and excessively conservative regulations as a reaction to the Fukushima Daiichi accident.

An example of a good practice is the objective performance–based regulations in the US in which safety goals and application of risk-informed were combined. After the Millstone issue, the vagueness in 'how safe is safe enough' was pointed out, if the regulator does not have an effective method of quantifying the safety of a plant that deviates from the design. This vagueness may be one of the factors that gave cause to regulations that rely on subjectivity and a lack of focus. Meanwhile, if safety goals are clear, they measure and identify matters that are important to safety and may have facilitate narrowing down those that require more focused injection of regulatory resources.

Once the importance of objectivity regulations has taken root, even if an accident occurred and revision of regulations became necessary to prevent recurrence, regulations added as a result are likely to have a certain level of predictability. However, realising that would warrant it important for operators to keep implementing risk-based safety improvement activities and for the regulator and the operators to keep communicating about safety improvement – even during ordinary times with no accident taking place – to enable smooth response when regulations are being revised. This point was strongly emphasised by an expert during the overseas interview surveys.

d) Extending the operation lifetime as long as possible

As for long-term operation, a bad example indicated in the literature surveys was legislative and political communication on limiting operation lifetime at 40 years in Japan. Meanwhile, the overseas interview surveys indicated that long-term operation is technically possible regardless of the number of years elapsed since the construction if safety is periodically confirmed. However, that periodic safety review must not be single special events presupposes regular safety review as part of daily routine.

Summarising the above, the following can be extracted as factors to realise improvement of both nuclear safety and the capacity factor:

a. Regulator: Practicable and reasonable regulations with high predictability
b. Operator: Prevention of abnormal operation and failures, continuous confirmation of safety as part of daily routine, continued safety improvement activities
c. Regulator and operator: application of risk-informed, mutual communications during ordinary times

Common conditions necessary for the improvement of both nuclear safety and effective use are as follows:

a) Regulator: Practicable and reasonable regulations with high predictability

To ensure safety and realise effective regulations, a regulator shall always question 'how safe is safe enough'. Meanwhile, a regulator often lacks experience and may not be able to appropriately adapt risk information at first. One possible way around this is to start focusing on check list–type regulations that rely on design basis. Even in that case, the regulator shall not implement inflexible regulations without considering what is really important for the safety operation of the NPPs. The regulator should always try to find out what level of safety is ensured by the regulations currently in place, whilst respecting the operator's voluntary activities. In finding out, the regulator shall supplement its experience by learning from precedents all over the world.

Also, to appropriately judge safety, a regulator must be independent of supporters and opponents. Leaning towards one of them may result in the regulator easily giving up in studying about safety when something becomes unsure and make a decision beneficial to supporters or opponents. These need to be avoided.

b) **Operator: Prevention of abnormal operation and failures, continuous confirmation of safety as part of daily routine, continued safety improvement activities**

Improving both safety and the capacity factor directly affects the operator's business. Therefore, it is desirable that the operator perform these activities as its initiatives whether regulations are in place or not. In so doing, whilst it is important to take measures to prevent existing equipment to break, the operator is encouraged to voluntarily study what level of influence equipment breakdown will have on the overall safety of the plant if the equipment breaks. Also, the operator should take a graded approach according to the level of influence on safety to protect what is more important, including staff and the organisation, not only the equipment.

Operators should not forget nuclear safety even after they had conducted investigations. Through the PRA and cost–benefit assessment, the operator should always seek improvement for more appropriate safety including a review of its daily routine, assuming unidentified risks still remain, and transform itself. This is the very thing that leads to realisation of a safety culture.

An operator should autonomously conduct activities like those above and inform various stakeholders on the reasonableness of its approaches to gain stakeholders' trust.

c) **Regulator and operator: application of risk-informed, communications during ordinary times**

For a regulator to identify 'how safe is safe enough' more quantitatively and implement relevant regulations, the regulator needs to educate itself about applying risk-informed and to fully master it. Only by operating a plant does it become possible to discern good outcomes and problems of the plant. For that reason, whilst keeping a plant operating, to enable inspection, carrying out safety improvement measures associated with the revision of regulations if necessary, regarding risk-information need to be realised. This also applies to the operators requested to transform themselves to improve both safety and capacity factor.

However, in so doing, if the knowledge of the regulator about the safety of a plant is different from that of the operator of the same plant, discord may emerge between the regulator and the operator. This may hinder proper management, especially such discord resulting from the regulator overly prioritising independence and becoming isolated. Communication between the regulator and the operator is essential to bridge the knowledge gap between the regulator and the operators. However, communication may fail if only the concerned parties are involved. For this reason, assessment, monitoring, and encouragement to improve by third parties, and leadership and transparent and open communication will be needed in addition to taking initiatives.

Additionally, discord may arise due to differences in the understanding of the acceptable level of safety goals. At the IAEA's conference described in chapter 3, participants stated that the overarching safety objectives to protect people, society, and environment are common, and harmonising regulatory approaches will contribute to improved common understanding. The content of regulations may be made to fit the circumstances of the country as, for example, the type of introduced reactor varies country to country. However, it is desirable to harmonise the consensus of regulatory approaches that the world considers favourable.

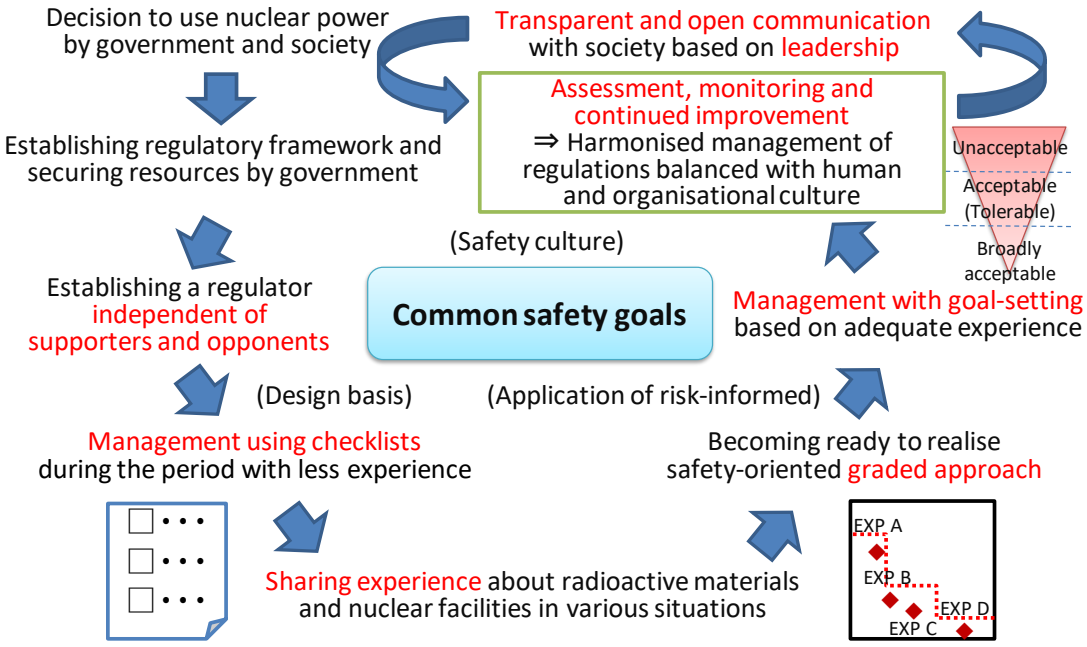
Based on the above, what is written in Table 4.1 can be extracted as common conditions. The IEEJ showed the attitude and the direction to realise these common conditions (Figure 4.3).

Table 4.1: Attitude for Improving Nuclear Safety and Effective Use

Regulator	- Always ask and find out 'how safe is safe enough'. - In finding out the above, learn from precedents around the world. - Be independent from both supporters and opponents (whilst avoiding becoming isolated).
Operator	- Take a graded approach according to the level of influence on safety. - Always seek, through probabilistic risk assessment and cost–benefit assessment, for potential means of improvement for more appropriate safety assurance, including review of daily routine, assuming unidentified risks remain, and transform itself. - - Tell various stakeholders the reasonableness of its approaches to gain stakeholders' trust.
Regulator and operator	- Accept assessment, monitoring, and encouragement to improve by third parties in addition to own initiatives. - Provide leadership and ensure transparent and open communication to realise the above. - Attempt to harmonise each countries' nuclear regulation with international common concept about safety goals and approaches to safety.

Source: Authors.

Figure 4.3: Direction for Improving Nuclear Safety and Effective Use



Source: Authors.

2. Recommendations

The policy proposals based on the analyses so far are listed below.

1) Approach to safety
   - The tolerable range of risks is to be determined.
   - Safety is to be judged based on whether residual risks are within the tolerable range. The tolerable range should be regarded as 'safety goal'.
   - The judgement is to be made by applying both the deterministic method and the PRA concept.

2) Approach to safety improvement measures
   - Regarding safety improvement measures, the regulator shall not enforce any specific method or equipment on operators. Since the operators are familiar with the risks, the regulator is to restrict its activities to judging the proposals of the operators according to the operator's individual circumstances.
   - Decision on whether to accept safety improvement measures will be made after evaluating the costs and benefits. In making the decision, the regulators are to provide technical grounds.
   - Long-term suspension without technical grounds is to be avoided. Only by operating does it become possible to discern good outcomes and problems about the safety improvement of a facility. Non-operating facilities could never demonstrate improvement in safety.

3) Concept of regulations
   - Regulations shall be reasonable and practicable.

4) Governmental involvement in regulation
   - The government establishes an agency that monitors unreasonable regulations, such as making regulatory orders without legal grounds and managing with legal grounds but without technical grounds.
   - When a regulation is revised, its reasonableness is to be discussed in parliament.

5) Active initiatives by operators
   - Operators are to autonomously initiate the evaluation of safety and costs and benefits in light of the safety goal, and to reflect the outcome on their management.
   - If a regulator's decision is questionable, the operator is to appeal to a monitoring agency or court for review.

As an example of responses to the policy proposals above, Table 4.2 shows actions concerning the operation period of an NPP that affects long-term capacity factor and directly influences the future business plan of the operator.

Table 4.2: Examples of Responses to Policy Proposals on Lifetime Extension

Concept	Judgement will be made technically, based on whether risks during operation are in a tolerable range.
Government	The operation period will not be restricted by law. It will be left to the judgement of the regulator, and the operation will be monitored throughout the lifetime by periodic safety review.
Operator	Safety during operation in the future will be technically assessed by the operator itself. The operation period in which safety can be ensured and the safety improvement measures needed for that will be reflected on the business plan according to the circumstances of the individual plant (e.g. period of suspension). Every safety improvement measure will be reviewed by balancing costs and benefits.
Regulator	When an operator submits a proposal (assessment and safety improvement measures, where necessary), the regulator will make a technical decision on the acceptability of the safety improvement measures, and the decision criteria will be clarified. The regulator will never decide on its own discretion without accepting proposals from the operators.
Third-party watchdog	A third party, such as the National Audit Office in parliament, will oversee the regulatory activities and warn the regulator when regulatory activities are not reasonable.

Source: Authors.