For the completeness of the PRA Implementation standard

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Abstract: Risk Technical Committee in the Standards Committee of Atomic Energy Society of Japan has formulated the standards related to PRA procedure, data, and its utilization. It provides the standards for the internal events in every operation condition usable for the risk assessment up to environmental effects (Level 3). As for the external events PRA also, the standards are expanded to earthquake, internal flooding, and tsunami. Also fire PRA or complex events PRA, which are especially induced by earthquake, are being examined for standardization. While accumulating the formulated content of the standards, usage experience and noticed matters of the PRA standards are to be feedback to the process of standard formulation.

Keywords: PRA, PSA, Standard, Japan.

1. INTRODUCTION

The paper presents a current situation of the Standards for related to the Probabilistic Risk Assessment (hereafter, PRA) procedure and its utilization undertaken by the Risk Technical Committee (hereafter, RTC) in the Standards Committee of Atomic Energy Society of Japan (hereafter, AESJ). The RTC has been positively promoting the formulation of various kinds of PRA Standards to provide “technical basis” which plays an important role in ensuring the quality of PRA. In addition to this, the RTC occasionally holds the workshops for the Standards to enhance understandings of PRA Standards and widely inform PRA method and its concept, while developing The task group on risk assessment study to share their discussion among researchers and technical experts about risk.

2. BACKGROUND AND PURPOSE OF DEVELOPING PRA STANDARDS

2.1. Background of the academic society standards development

In European countries and the US, nongovernmental standards are developed in various technical fields by members publically fairly selected from neutral organizations including academy, associations, and international conventions, so as not to benefit only a specific organization.

In Japanese nuclear energy field, for the purpose of swiftly reflecting new findings and operation experiences on the regulations, Nuclear Safety Commission (hereafter, NSC) has examined the formulation of the guideline performance and public utilization of the standards through the discussion on the systematization of the guideline. Nuclear and Industrial Safety Agency (hereafter, NISA) has also worked on the formulation of the technical standards performance and public utilization.

In the AESJ, Japan Society of Mechanical Engineers, and Japan Electric Association respectively developed the organizations aimed to formulate nongovernmental standards and began to define them. This approach was practiced with the principle of fairness, impartiality, and transparency. In September 1999, the AESJ developed the Standards Committee to formulate “standards” describing the consented matters about techniques used in a wide range of activities of design, construction, operation, and decommissioning measures for the nuclear power plants. Four Technical Committees (see Fig.1) including the RTC are organized under the Standards Committee according to the specific fields.

2.2. Organization of the Risk Technical Committee

The development of PRA Standards was originally conducted by Power Reactor Technical Committee, but after revision of the organization in 2008, the RTC was founded to specifically work on the PRA Standards.

The organization of the Standards Committee of the AESJ is shown in Figure1. Under the Standards Committee, the RTC is organized. Currently nine subcommittees are organized for the RTC. Each subcommittee is responsible for development, maintenance, revision and education of the individual standard. Also involved is the Steering Taskforce for planning the future development of standards.

Here, the title of the standard in the RTC is explained. The RTC has decided to use PRA, not PSA (Probabilistic Safety Assessment), since the development of Tsunami PRA Standards in 2011. Both PRA and PSA have the same meaning. However, both titles are used parallel for the moment as a transitional period, because existing standard titles will be changed when they are revised. Thus, in this paper, PRA is used for all standard titles except the existing standards.

The PRA was a distinctive method to show comprehensive safety by means of quantitative indexes with uncertainty. Each PRA standard has some specific steps of methodology, e.g. seismic fragility analysis in Seismic PRA. These were causes of developing separated subcommittees. Thus, the effects of separated subcommittee were to incorporate more expertise and to speed-up the process, and to perfect the discussion. On the other hand, because the initial events used in the PRA procedure include not only internal hazards, such as facility malfunction and human error, but also external hazards, such as earthquake, tsunami, and fire, the technical experts related to these events were also requested to precipitate to the subcommittee. Such kind of a variety of special knowledge is necessary for the discussions in the meeting, architecture and fuel cycle facility specialists were also called. As a result, the RTC include almost 30 members.

Currently, there are nine subcommittees, as each subcommittee formulates one standard respectively. However the scope of the Level 1 PRA subcommittee was expanded to formulate the level1 PRA standard, the PRA parameter estimation standard, and the shutdown PRA standard. The purposes of this irregular role sharing are two advantages. One of them is sharing opinions or information about three PRA standards among one subcommittee. Other one is revising three standards sequentially.
As for the seismic PRA procedure, it is not effective to assemble all experts into one subcommittee for discussion, because, for example, seismic PRA procedure is comprised of three processes of seismic hazard evaluation, building/components fragility evaluation, and accident sequence evaluation, and because the seismic hazard evaluation requires the experts from earthquake and geotechnical engineering, etc. for the discussion and the fragility evaluation does architectural and mechanical engineering experts. To cope with this problem, three working groups are organized to share the formulation activities. Their smoother cooperation is enhanced through participation of some members in multiple subcommittees.

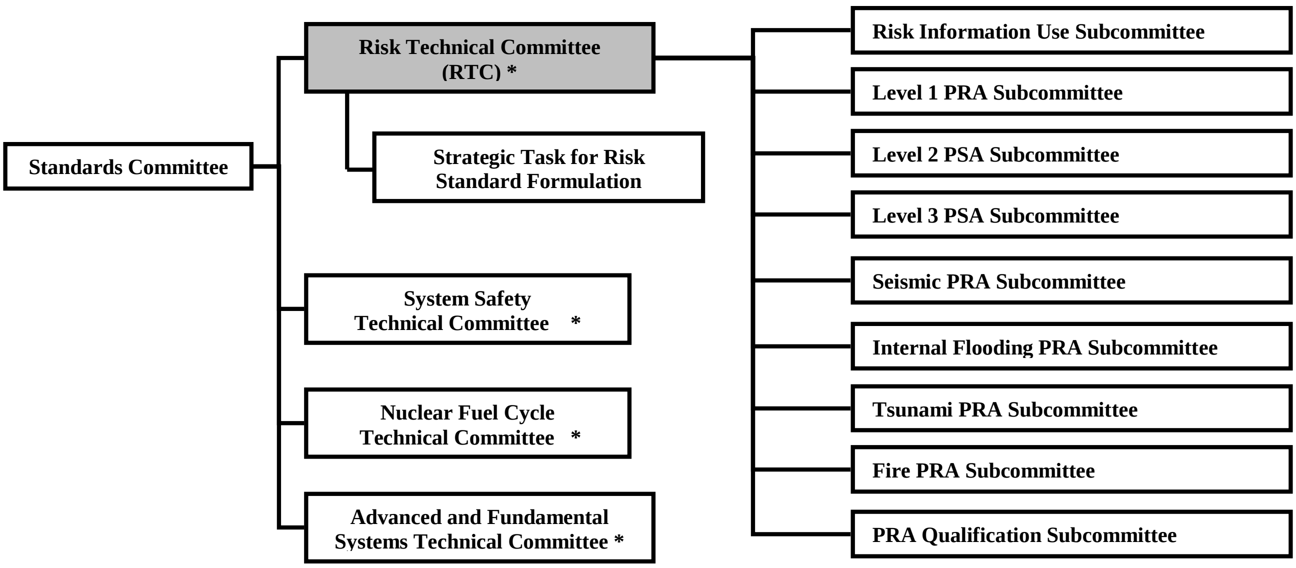

Figure1. Standards Committee organization chart for PSA standards development
*: These committees were "Four Technical Committee"

2.3. Purpose and Position of PRA Standards

The first Standard undertaken by the Power Reactor Technical Committee (of the day) was the shutdown PSA procedure (the title of the day). At that time, the implementation of the shutdown risk assessment was being introduced in the Periodic Safety Review (PSR), so that the standard was formulated to ensure its quality. Later, along with the NSC's examination on safety goals[1] and then performance objectives[2], the formulation of Level 1 PSA Standard (evaluation on up to the core damage, hereafter referred to as "L1 PSA Standard") and Level 2 PSA Standard (evaluation on up to emission of radioactive substances, here after "L2 PSA Standard") was undertaken, and then Level 3 PSA Standard (evaluation on up to environmental effects assessment, hereafter "L3 PSA Standard") followed to those. In this way, the standards have been developed preferentially from the required fields. When the standards were extended to L3 PSA Standard, the PRA methods for the internal events ranged from core damage to emission of radioactive substances causing environmental influence in all operation status (during power generating operation, shutdown) were developed.

On the other hand, NISA and Japan Nuclear Energy Safety Organization (hereafter, JNES) published the quality guideline [3] which defines technical validity of PRA to prepare for the utilization of risk information. This guideline describes the requirements regarding the quality provided in PRA, so that the AESJ's PRA Standards become the specification code which materializes the performance codes described in this guideline. There are several ways to utilize PRA. If the utilities desire to assess the safety or to know the weak points of NPPs, the objective validity of the assessment can be ensured by conducting PRA according to the AESJ PRA Standard procedure. Regulating authority can also examine the conformity to PRA standards and demonstrate the achievement of technical evaluation/endorsement in PRA reviews.

In the revision of NSC's "Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities (revised on September 2006)", necessity of quantitative risk assessment on earthquake was discussed, and as the result of this, Seismic PSA subcommittee was developed to extend PRA Standards to the external events.

The purpose consistent to these PRA Standards is "to demonstrate the matters examined and consented under the principles of fairness, impartiality, and transparency for the purpose of utilizing PRA procedures and risk information obtained from them". By using the PRA Standards developed according to this purpose, the following advantages can be obtained.

(1) The latest PRA technique having the suitable quality will be available.

(2) The validity of conducted PRA can be demonstrated objectively by demonstrating its conformity to the academic society's standard.

(3) When reviewing the PRA validity, the part conformed to the Standard can be simplified in the review.

(4) If newly developed or revised methods or data are available, standardization can be achieved by submitting to the subcommittees.

3. KINDS OF PRA STANDARDS AND OVERVIEW

3.1. Kinds of PRA Standards

Currently, ten standards have been developed or revised and three standards are being developed through the Risk Technical Committee and Power Reactor Technical Committee (of the day).

Since the accident at Fukushima Daiichi Nuclear Power plant caused by the 2011 off the Pacific coast of Tohoku Earthquake, there has been growing demands for assessing the effects of external hazards, such as earthquake and tsunami, and taking counter measures to address those external hazards. The newly developed Japanese regulatory requirements claim design considerations associated with external hazards. The primary objective of the risk assessment for external hazards is to develop countermeasures against such hazards rather than grasping the risk profile. Therefore, applying detailed risk assessment methods, such as

probabilistic risk assessment (PRA), to all the external hazards is not always required. Risk assessment methods can vary in types including qualitative evaluation, hazard analysis (analyzing hazard frequencies or their influence), margin assessment, and deterministic core damage frequency (CDF) evaluation.
The Risk Technical Committee comprehensively identified the external hazards which had potential risks, and has developed “the implementation standard for the identification of assessment methods for risks associated with external hazards.” This implementation standard will help to understand plant safety against all the objective external hazards and develop appropriate countermeasures against individual hazards.

The list of the AESJ standards regarding the PRA methods and the risk informed approach is given in Table 1.

Table 1. AESJ Standards regarding risk assessment methods and the risk informed approach

Standard	The Date of Issue
The Standard for Procedures of Probabilistic Risk Assessment of Nuclear Power Plants during Power Operation (Level 1 PRA):2013	December 2013
The Standard for Procedures of Probabilistic Safety Assessment of Nuclear Power Plants during Power Operation (Level 2 PSA):2008	March 2009
The Standard for Procedures of Probabilistic Safety Assessment of Nuclear Power Plants (Level 3 PSA):2008	March 2009
Standard for Procedures of Probabilistic Safety Assessment of Nuclear Power during Shutdown State (Level 1 PSA):2010（revision 1）	November 2011
Implementation Standard Concerning the Estimation of Parameters for Probabilistic Safety Assessment of Nuclear Power Plant：2010	June 2010
A Standard for Procedures of Seismic Probabilistic Safety Assessment for nuclear power plants:2007	September 2007 (Under revision)
The Standard of Implementation on Use of Risk Information in Changing the Safety Related Activities in Nuclear Power Plants:2010	October 2010
Implementation Standard Concerning the Tsunami Probabilistic Risk Assessment of Nuclear Power Plants: 2011	February 2012
Implementation Standard Concerning the Internal Flooding Probabilistic Risk Assessment of Nuclear Power Plants:2012	November 2012
Terms and Definitions used Commonly in the Probabilistic Risk Assessment Standards for Nuclear Power Plants:2011	January 2012 (Under revision)
Implementation Standard Concerning the Internal Fire Probabilistic Risk Assessment of Nuclear Power Plants:201*	Under development
Implementation Standard Concerning the Risk Analysis Methodology Selection for the External Hazard:201*	Under development
A Standard for Ensuring the Quality of Probabilistic Risk Assessment for Nuclear Power Plants:2013	March 2014

3.2. Contents of PRA Standards

AESJ Standards are comprised of the “Main body” and “Annex (normative)”. In addition to this, “Annex (informative)”, which describes evaluation examples as a reference, and “Description”, which describes discussion background and commentary, can be added in some cases.

The sections of “Scope”, “Normative references”, “Terms, definitions, and abbreviated terms”, and “Documentation” are described in the main body of all PRA Standards as a common section of PRA Standards (AESJ Standards use the term of “Section” as “Clause”). The section of “Scope” specifies the scope of PRA defined in the PRA Standard. The section of “Normative references” enumerates the title of other standards cited in the main body and the annex (normative). The section of “Terms, definitions, and abbreviated terms” describes the terms and their definitions used in the Standards in addition to the list of abbreviations such as LOCA. In PRA Standards, there are terms commonly used in plural PRAs, like “event tree”. Such terms are defined in each Standard, but their definitions may differ due to kinds and an developed period of the standards. Accordingly, PRA common glossary was formed in 2011 so as to avoid confusion and inconvenience to the users and organizations (hereafter, users) of PRA Standards. Since then, the terms uniquely used in a specific PRA are defined in each PRA Standard, which will possibly enhance better understandings to PRA terms.

As the beginning of the Section specifying the content of PRA procedure, the PRA process is defined. Though there is a basic order in each PRA process, feedback and particularization of the already evaluated results may be necessary for the repeated adjustments. This kind of practical process is specified in this section to cope with various types of usages. Next, the section of “Surveys of the configuration and characteristic of the plant” is developed. It is necessary in PRA to comprehend not only the specifications of components in a nuclear power plant but also the system configuration, properties, and functions. The practice of plant walk down is also stipulated in addition to the internal survey and collection of flow diagrams, layouts, and operation manuals. Actual visit of the site will supplement insufficiency of drawings and procedure manuals, because relative positioning or difficulty in operation of the site facility cannot be recognized only from the drawings. Especially in Tsunami PRA and Internal Flooding PRA, checking and comparing the inlet port of water flow at a drawing and an actual site, for example, may help to find out the serious scenarios.

The last section of “Documentation” stipulates for not only the content to be described in PRA reports but storage of documents to facilitate easy understanding in PRA usages and reviews.

Moreover, three items of exploitation of experts’ opinions, peer review, and quality assurance activity are described in the annex (normative) as the provisions to ensure PRA validity. Though these items are defined as the provisions conducted to demonstrate PRA validity, they are currently attached to all PRA Standards as a form of annex (normative) because practical experiences are still insufficient.

3.3. Characteristics of PRA Standards

In general, the standards prescribe specifications. PRA Standards also stipulate for the concrete method but not always do for the procedures of a specific method. PRA is used for various purposes. Preciseness of PRA may differ, for example, in the cases that their purposes are to examine which system/component is important for the risk control or to comprehend the general risk in whole plant. In the former case, modeling of the component or the part of interest is necessary, and it is desirable to use parameters including failure rate of each component. To cope with such various purposes, PRA Standard provides several measures so that users can choose, devise, and extend.

3.3.1. Provisions for offering several methods

Depending on the assessment accuracy or the purposes of PRA, it is preferable, in some cases, to provide several methods to which the users can make a decision. In other words, the evaluated results can be too conservative by using only one method, or serious scenarios cannot be analyzed enough because too much time has been spent on accident scenario analysis having small influence.

For example, fragility analysis in the Seismic PSA Standard defines to use either one of the following three methods, “method using actual fragility and actual response”, “method using actual fragility and response factors”, and “method using fragility factors and response factors”, or their combinations. Based on this, the fragility of the non risk-dominant facility can be determined by the method using factors, so that more resources can advantageously be allocated to the device having high risk importance.

In the section “6. Development of success criteria” of the L1 PRA Standard, while the use of thermal-hydraulic analysis and/or structural analysis is basically designated to the success criteria analysis (analysis to determine the conditions such as number of mitigation equipment to achieve safety function), conservative data can be used depending on the purpose and the available data can be used for the analysis in the application document for the permission of reactor installment license.

In the Tsunami PRA standard, as a method to determine actual fragility or response of the fragility analysis, four methods of those based on experiments, experience, analysis, and technical judgment are provided.

3.3.2. Provisions for users to examine/determine

Though it is important for the standards to be easily usable and understandable, the standards like an analysis manual may exclude user's judgment from PRA process. Besides, the existent findings from experiments or analysis are not always available, though the major feature of PRA is quantification of uncertainty. Wide and deep consideration is always required for users, as technical judgment is appropriately necessary for many points of the PRA process. To cope with this matter, PRA Standards provide several methods so that users can choose the best method with considering the purpose of PRA. Even in the case of showing an explicit method, they require the users to list the points to be considered before examining and making decisions.

For example, the section of “5. Selection of initiating events and evaluation of occurrence frequency” of the L1 PRA standard does not define the list of initiating events to be considered. It just requires to identify the initiating events without missing anything. Also in the hazard analysis and fragility analysis in the Seismic PSA Standard, it specifies the method of forming data from investigation results and experiment/analysis results, not by limiting the available input data.

In the section of “6.6.3 Method using fragility factors and response factors” of the Seismic PSA Standard, the calculation method to obtain a median of each coefficient and logarithmic standard deviation is specified, but it is necessary to adjust the coefficient with imagining the phenomenon, as is in the compensation of response in nonlinear field. Therefore, a number of examples are shown for users in the description for their consideration.

The Section 6 of “Identification of an accident scenario” of the Tsunami PRA Standard defines to widely extract the possible influence caused by tsunami, with estimating the process of tsunami attack and its spreading by referring the past damage.

3.3.3. Provisions applicable by users

The result obtained by the Standard should attain a certain degree of quality. However, in the case of using a method different from the one defined in the standard, it is necessary to separately demonstrate the validity. Because “PRA deals with all accident sequences theoretically considerable”, it is necessary for the users to investigate/analyze the actual facility conditions and widely comprehend the system/equipment design information and maintenance information.

For example, in the section of “5. Classification of Plant Operating State (POS)” of the Shutdown PSA Standard (rev.2), the method of grouping with using pre-POS or that of subdividing by the condition of facility configuration is usable for the POS classification. This allows the users to conduct more detailed PRA.

In fragility analysis in the Tsunami PRA Standard, for the influence of the case that flood measures are taken, step function is applicable to the actual fragility in submerged and soaked modes. In this case, it is required that the actual fragility is not just set by a water level but considering the flooding routes and the height and shape of opening ports. The users can correct the fragility curves according to the property/condition of component/system depending on the condition of flooding measures.

3.3.4. Showing a number of various kinds of examples

As mentioned in (3.3.1) to (3.3.3.), PRA Standards can be expressed as “a guidance of thinking process” for users. However, in order to ensure a certain degree of PRA quality, the standards cannot be just user-oriented. Then, a number of various kinds of analysis examples and parameter examples are described in the annex (informative).

For example, more than 400 pages of evaluation examples including hazard analysis and fragility analysis are attached in the Seismic PSA Standard for the convenience of user's reference.

In the Tsunami PRA Standard, evaluation examples will be published as a separate volume. The evaluation examples are more useful if they have taken the latest tsunami damage into consideration. Though setting examples of the parameters for use are described in the annex (informative) of Tsunami PRA Standard, to provide the latest evaluation examples reflecting the findings of the Great East Japan Earthquake is considered to be important. By separating the volume, it is expected that the evaluation examples are appropriately updated and the tsunami PRA results can be obtained based on the latest findings.

4. IMPROVEMENT PROGRAM OF PRA IMPLEMENTATION STANDARD

4.1. Selection of the schemes for Standard development

Currently, ten standards have been developed or being revised and three standards are being newly developed by RTC. These standards can cover not only the internal event PRA at-power, but also main external event PRAs. However, they have not yet covered all possible events, e.g. a fire caused by earthquake level 2 shutdown PRA, it is not necessary to develop all standard newly, because it may be able to use the existing standard by expanding or adding for assessment. Moreover, it is also thought that the risk can be guessed with the combination of other PRA results. Based on the above, RTC considered about the events or combination of events, which combined operational state, and the levels 1-3, to make a decision of the priority for development. The forty-eight schemes given in Table.2 are target of formulation and there are four internal event Standards have been developed, and also four external event Standards have been developed or under development, so forty schemes are target of consideration.

Table.2 Consideration of Standard development

		Internal Events	External Events						
			Internal Flooding	Internal Fire	Tsunami	Earthquake	Internal Flooding caused by Earthquake	Internal Fire caused by Earthquake	Tsunami with Earthquake
At-power	L1	*	*	*	*	*			
	L2	*							
	L3	*							
Shutdown	L1	*							
	L2								
	L3								

*: Have been developed or under revision
▒: Target of consideration

4.2. Prioritizing development of Standards

4.2.1 Criteria for Priority

The following thing was taken into consideration in the determination of the priority of PRA standard development. One thing is influence degree exerted on a plant. Priority is given to event, which has complicated accident scenario, and cannot judge the important sequence for finding out a risk reduction measure if not based on PRA. The other thing is workload required to develop PRA standard. Priority is given from the standard which has many workloads and requires many time for development.

4.2.2 Classification by availability

PRA is a technique which can evaluate the combination of a lot of scenarios, and can show risk quantitatively. Therefore, it is effective to adapt PRA for events which have various accident scenarios, and cannot be grasped peculiar risk of plant, without evaluation of whole accident scenario analysis.
The schemes are classified into three groups by availability for PRA evaluation. The availability of PRA means reduction effect of risk and urgency.

The scheme which have complicated risk profile, and have difficulty to be assessed without PRA classified into group “A”.
The scheme which may be able to be assessed by using other PRA assessment, classified into group “B”.
Furthermore, the scheme, which is expected more availability, classified into group “A^+”.

Moreover, in present, the scheme is classified into group "A", but it will be group "B" after development of other new standard is written as B (A). A classification result is given in table.3.

Table.3 Arrangement from validity

		Internal Events	External Events						
			Internal Flooding	Internal Fire	Tsunami	Earthquake	Internal Flooding caused by Earthquake	Internal Fire caused by Earthquake	Tsunami with Earthquake
At-power	L1	*	*	*	*	*	A^+	A^+	A^+
	L2	*	A	A	A^+	A^+	B(A)	B(A)	B(A)
	L3	*	A	A	A^+	A^+	B(A)	B(A)	B(A)
shutdown	L1	*	A	A	A^+	A^+	A	A	A
	L2	B	B	B	B	B	B	B	B
	L3		B	B	B	B	B	B	B

*: Have been developed or under revision

4.2.3 Classification by Workload

In addition to the classification by availability, schemes are classified into following four groups by viewpoint of the amount of workload.

a: What needs to decide a method newly. (Workload: large)
b: What can be evaluated by the combination and extension of the existing practice standard. However, the thing which needs to examine the concrete method newly (workload: medium)
c: What can be evaluated by adding the points of concern by basing on the existing practice standard. (Workload: small)
d: What can be evaluated by the existing practice standard.

Moreover, in present, the scheme is classified into group "b", but it will be group "c" after development of other new standard is written as c (b). A classification result is given in table.4.
The priority of work is "a" to "c".

Table.4 Arrangement from a workload

		Internal Events	External Events						
			Internal Flooding	Internal Fire	Tsunami	Earthquake	Internal Flooding caused by Earthquake	Internal Fire caused by Earthquake	Internal Flooding with Tsunami
At-power	L1	*	*	*	*	*	b	b	b
	L2	*	c	c	c	c	c	c	c
	L3	*	d	d	b	b	d	d	d
shutdown	L1	*	b	b	a	a	c(b)	c(b)	c(b)
	L2	c	c	c	c	c	c	c	c
	L3		d	d	d	d	d	d	d

*: Have been developed or under revision

4.2.4 The Judgment of the Priority

Based on the classifications which are mentioned in section (4.2.2) and (4.2.3), the schemes are arranged as follows.

(1) The scheme which validity is especially high
(1.1) : A^+a Shutdown L1 Earthquake, Tsunami
(1.2) : A^+b At-power L2 Tsunami with Earthquake, Internal flooding with Earthquake, Internal fire with Earthquake

	$A^{+}b$	At-power	L3	Earthquake, Tsunami
(1.3) :	$A^{+}c$	At-power	L2	Earthquake, Tsunami

(2) The scheme which validity is high

(2.1) :	Ab	Shutdown	L1	Internal flooding, Internal Fire
(2.2) :	Ac	At-power	L2	Internal flooding, Internal Fire
(2.3) :	Ac	Shutdown	L1	Tsunami with Earthquake, Internal flooding with Earthquake, Internal fire with Earthquake

RTC basically undertake development of the standard earlier which has high validity, and much amount of workload. Moreover, the regular revision term in a subcommittee is also taken into consideration, and RTC advances so that two or more practice standard decision work can be performed simultaneously.

4.3. Plan for Future

4.3.1 Multiunit suffering a hazard

Moreover, this project gives some action plans for important problems, such as the multi-unit core damages caused by earthquake and tsunami, risk of multi-hazard, treatment of the uncertainty for decision making, risk literacy, and development of non-PRA methods for risk evaluation.
Since some sites are geographically close in Japan, it is necessary to assume also about a multisite simultaneous accident.

4.3.2 Treatment of Uncertainty for risk informed decision making

Occurrence of frequency of external hazards such as seismic which may affect core damage and containment failure, has large uncertainty. Then, a PRA result will also have large uncertainty.
Therefore, treatment of uncertainty is needed to be considered.

4.3.3 Non-PRA methods for risk evaluation

In The standard for Procedures of external hazard Probabilistic Risk Assessment of Nuclear Power Plant, procedure of the risk assessment technique for an external hazard is shown. It is necessary to offer the implementation standard for the external hazard assessment by include Non-PRA methodology.
Therefore, RTC search also about the Non-PRA methods, such as qualitative evaluation, hazard analysis (analyzing hazard frequencies or their influence), margin assessment, and deterministic core damage frequency evaluation.

5. CONCLUSION

The RTC has the mission to develop PRA standards including estimation of parameters using in PRA, and utilization of risk information. It has been providing the standards for the internal event PRA in every operation condition usable for the risk assessment up to environmental effects. As for the external events also, the standards are expanded to earthquake, internal flooding, and tsunami, and also fire and complex events are being examined for standardization. The method regarding system analysis, such as initiating events, human error rate, and common-caused failure, is also to be deepened further. The results of external events PRA can naturally include wide range of uncertainty. The treatment of uncertainty is to be examined because it is critical element for risk informed decision making. Further, PRA Standards which can ensure the quality high enough to be applied to the actual facility and appreciated in various kinds of decision makings are to be achieved.

Then, accumulating the content of the standards, usage experience and noticed matters of the PRA standards will be reflected to the standard formulation. RTC considered the standard preparation plan and decided the priority of standard development. By taking such a variety of measure, we expect that the standards will have completeness.

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