Review Guide for Safety Evaluation of Light Water Nuclear Power Reactor Facilities

August 30, 1990
Decision of the Nuclear Safety Commission

I. Introduction

This guide, "Review Guide for Safety Evaluation of Light Water Nuclear Power Reactor Facilities," hereinafter referred to as "Review Guide for Safety Evaluation," defines the bases in the safety review process to judge the adequacy of the safety evaluation submitted by the applicant for permission of installing (or modifying) "light water nuclear power reactors," hereinafter referred to as "light water reactors (LWRs)."

The safety review of LWRs necessitates a confirmation that the safety evaluation fully meets the requirements specified in this guide. The safety evaluation shall cover (a) the evaluation related to the safety design policy of the nuclear reactor facilities, "hereinafter referred to as "safety design evaluation," and (b) the evaluation related to distance of the reactor from the public as siting condition, hereinafter referred to as "siting evaluation."

Review Guide for Safety Evaluation was originally instituted in September 1978 by the then Atomic Energy Commission for safety review on the application for LWR installation permit. More than 10 years have passed since then, and considerable progress in LWR technology has been made and useful experience and findings have been accumulated. These have led to updating "Review Guide for Safety Design of Light Water Nuclear Power Reactor Facilities" (hereinafter referred to as "Review Guide for Safety Design"). At the same time, "Review Guide for Classification of Safety Function Importance in Light Water Nuclear Power Reactor Facilities" (hereinafter referred to as "Review Guide for Safety Importance Classification") has been newly instituted. Accordingly, the Review Guide for Safety Evaluation subjected to thorough review and revised to coordinate with the updated Review Guide for Safety Design and the new Review Guide for Safety Importance Classification as well as to make its contents more specific and systematic.

While this guide is primarily intended to deal with LWRs currently in use, it is believed that the fundamental concept in this guide will be helpful as well for safety review of other types of nuclear reactor facilities.

It should be recognized that the inconformity of part of the contents of the application to this guide will not preclude approval of the application if the deviation is justifiable. This guide should be subject to revision as required when more experience and design improvement become available.

II. Safety Design Evaluation

1. Objective of Safety Design Evaluation

The adequacy of the basic safety design concept proposed for the nuclear reactor facilities is reviewed in accordance with the Review Guide for Safety Design. The Review Guide for Safety Design requires that some of the structures, systems and

components in nuclear reactor facilities be to function not only during normal operation but also in abnormal conditions to ensure safety.

In confirming the adequacy of the basic policy for the safety design of nuclear reactor facilities, it is therefore essential to perform an analytical evaluation concerning any abnormal conditions, i.e., “anticipated operational occurrences” and “accidents”. Described below are the events to be postulated, criteria for judgment and matters to be taken into consideration in analysis for the safety design evaluation.

2. Scope of Evaluation

2.1 Anticipated Operational Occurrences

Evaluation shall be performed as to the events during reactor operation which may lead to abnormal states caused by single component failures, single component malfunctions or single erroneous operations that are anticipated to occur during the facility lifetime or by disturbances with a similar probability of occurrence.

2.2 Accidents

Evaluation shall be performed as to the events beyond anticipated operational occurrences which have quite small probabilities of occurrence and yet may potentially lead to the release of radioactive materials from the nuclear reactor facility and thus have to be postulated from the standpoint of evaluating the safety of the nuclear reactor facility.

3. Selection of Events for Evaluation

The events for evaluation shall be appropriately determined for anticipated operational occurrences and accidents in the nuclear reactor facility based on the objective and scope of the safety design evaluation described above,.

3.1 Anticipated Operational Occurrences

Representative events shall be selected, based on the requirements in section 2.1 for evaluations from among events which may potentially lead to excessive damage to the core or to the reactor coolant pressure boundary if the nuclear reactor facility is left uncontrolled. Also, to confirm the adequacy of the design of structures, systems and components belonging to abnormal mitigation systems, or simply referred to as “mitigation systems (MSs),” such as the safety protection system and the reactor shutdown system.

The events for evaluation shall cover the following possible abnormal states. If there may be two or more similar events, the severest event in comparison with the criteria specified in section 4 may be selected as a representative event of them.

(1) Abnormal change in reactivity or power distribution in the core

(2) Abnormal change in heat generation or heat removal in the core

(3) Abnormal change in reactor coolant pressure or reactor coolant inventory

(4) Other events necessary for evaluation depending on the design of the nuclear reactor facility

3.2 Accidents

Based on the requirement in section 2.2 above, representative events shall be selected for evaluation from among the events in which radioactive materials released from the nuclear reactor facility may potentially affect the surrounding area of the site, from the standpoint of confirming the adequacy of the design of structures, systems and components mainly belonging to MSs such as engineered safety features. The events for evaluation shall address the following abnormal states. If there are two or more similar events, the event which is severest in comparison with the criteria specified in section 4 can be selected as the event that is representative of the others.

(1) Loss of reactor coolant or considerable change in core cooling

(2) Abnormal reactivity insertion or rapid change in reactor power

(3) Abnormal release of radioactive materials to the environment

(4) Abnormal change in pressure, atmosphere, etc. in the reactor containment

(5) Other events necessary for evaluation depending or the design of the nuclear reactor facility

4. Criteria

4.1 Anticipated Operational Occurrences

It shall be verified that the nuclear reactor facility is designed such that a postulated event does not result in damage to the core and that the event can be accommodated in a state which allows the resumption of normal operation. The criteria for this verification are as follows:

(1) The minimum critical heat flux ratio or the minimum critical power ratio shall be larger than the acceptable limit.

(2) Fuel cladding shall not be mechanically damaged.

(3) Fuel enthalpy shall not exceed the acceptable limit.

(4) Pressure on the reactor coolant pressure boundary shall not exceed 110% of the maximum allowable working pressure.

4.2 Accidents

It shall be verified that the nuclear reactor facility is designed such that a postulated event does not lead to melting or considerable damage of the core, such that the event, in its event sequence, does not cause secondary damage which could lead to another abnormal condition, and such that the function of the barriers against the release of radioactive materials in the event is adequate.

The criteria for these are as follows:

(1) The core shall not be considerably damaged, and can be sufficiently cooled.

(2) Fuel enthalpy shall not exceed the specified limit.

(3) Pressure on the reactor coolant pressure boundary shall not exceed 120% of the maximum allowable working pressure.

(4) Pressure on the reactor containment boundary shall not exceed the maximum allowable working pressure.

(5) There is no significant risk of radiation exposure to the surrounding public.

4.3 Principles for Application of Criterion

In cases when multiple criteria are applied to one event, parameters for analyses shall in general be specified such that the set of parameters will bring the severest possible result with respect to each criterion. If it is evident that the results of the analyses are not significantly affected by the variation in parameters or the rest of the criteria are satisfied by the representative case, only one representative analysis for a parameter set which gives the severest result with respect to one criterion can be acceptable.

5. Considerations in Analysis

5.1 Scope for Analysis

The initial conditions for the analysis of a postulated event shall be specified to give the severest possible result with respect to the applied criteria, taking into consideration the whole range of normal operation and operating period of the nuclear reactor facility including long-term physical change with burnup in the core during various cycles and with refueling and anticipated change in operational modes. The analysis shall in general cover the time range up to the point where the event terminates and it can be reasonably inferred that the reactor could reach a cold shutdown state safely.

5.2 Assumptions on Safety Functions

(1) Of safety functions designed to address postulated events, those which are allowed to be taken into account in the analysis, shall in general be limited to safety functions to be performed by structures, systems and components belonging to MS-1 and MS-2 specified in the Review Guide for Safety Importance Classification. Safety functions of structures, systems and components belonging to MS-3 may be taken into account in the analysis only if taking credit for these functions is proved to be justifiable.

(2) The analysis shall, in addition to a postulated event for the systems and components necessary to deal with an accident, assume a single failure of a component that could give the severest possible consequence for each

of the fundamental safety functions such as reactor shutdown, core cooling and radioactivity confinement. For a short-term period after occurrence of an accident, a single failure on an active component shall be assumed, while for a long-term period, a single failure on an active component or a passive component shall be assumed. The failure may not generally be assumed on a component which is operated before the occurrence of the event and will be operated after that. The failure of a passive component may not be assumed, if a single failure is assumed and when the system which includes the said component is designed to fulfill its required safety functions, or when the failure can be removed or repaired within time so as not to impair the safety, or when the probability of the failure is sufficiently low.

(3) The analysis shall take into account an appropriate margin of time for manual operations by operators to cope with the postulated event.

(4) If functions of the safety protection system are expected in the analysis, the kinds of signals to actuate it and the timing that the signals are issued shall be defined. The same requirement shall also be applied to other systems if their expected performance affects the result of the analysis.

(5) The analysis of an accident shall take into account unavailability of off-site power if functions of the engineered safety features are expected.

(6) If in the analysis the effect of reactor scram is expected, the kinds of signals to initiate the scram shall be defined, and appropriate delay times for effective scram initiation shall be considered. In addition the shutdown effect shall be evaluated on the assumption that a control rod (or a group of control rods connected to a common drive mechanism) with the maximum reactivity worth in the postulated conditions is held at the fully withdrawn position.

5.3 Calculation Programs, Models and Parameters Used for Analysis

The calculation programs, etc. used for the analysis of a postulated event shall be verified with respect to their applicability.

The models and parameters for the analysis shall be specified such that they give a severe result. The use of reasonable models and parameters, however, may be allowable within the context of the evaluation purpose. If there can be uncertainty in the parameters, appropriate safety margins shall be taken into account.

III. Siting Evaluation

1. Objective of Siting Evaluation

The reactor siting conditions is reviewed in accordance with the “Review Guide for Nuclear Reactor Siting and Reference Criteria Concerning its Application” (hereinafter referred to as the “Review Guide for Reactor Siting”). It is required in the Review Guide for Reactor Siting that an exclusion area, a low population zone and distances to densely populated regions surrounding the reactor be adequately established so that the evaluated radiation doses to the public by a postulated “major accident” or

"hypothetical accident" may be lower than the specified criteria. In judging the suitability of the reactor siting conditions, it is therefore essential to perform an evaluation concerning "major accidents" and "hypothetical accidents." Described below are the events to be postulated, criteria and matters to be taken into consideration in the analysis for siting evaluation.

2. Scope of Evaluation

Evaluation shall address the events which have to be postulated in the context of evaluating the suitability of the siting conditions pursuant to the Review Guide for Reactor Siting.

3. Selection of Events for Evaluation

3.1 Major Accidents

Based on the requirement in section 2 above, the Applicant shall select events from the list of the accidents treated in section 3.2 of Chapter II, the "Safety Design Evaluation," that could enlarge the release of radioactive materials, and assume the largest amount of radioactive materials released that could be technically possible. The Applicant shall assume both types of accidents, one in which radioactive materials are released into the reactor containment and the other in which radioactive materials are directly released at the outside of the reactor containment.

3.2 Hypothetical Accidents

Based on the requirement in section 2 above, the Applicant shall assume a larger amount of radioactive materials are released than the accidents identified as Major Accidents.

4. Criteria

The results of the evaluation shall satisfy the criteria specified in the Review Guide for Reactor Siting.

5. Considerations in Analysis

The analyses of Major Accidents and Hypothetical Accidents shall be performed conforming to the intent of the Review Guide for Reactor Siting.

Commentary

I. Purpose of Revision for This Guide

The Review Guide for Safety Evaluation was originally instituted on September 29, 1978 by the then Atomic Energy Commission for safety review concerning the applications for permission to install LWRs, and had since been applied in the process of safety review to judge the adequacy of the evaluation related to the safety design policy of the nuclear reactor facility and the evaluation related to distance of the reactor from the public as a siting condition in accordance with the Review Guide for Safety Design and the Review Guide for Reactor Siting. Later, the guide was revised in part on March 27, 1989 along with other safety review guides to reflect the recommendations of the International Commission of Radiological Protection (ICRP) issued in 1977. (This original version will be referred to as the "former guide" hereinafter).

The requirements in safety review guides are continually reexamined based on technological progress and accumulated experience and findings. The Review Guide for Safety Design is thus being revised of late, and the Review Guide for Safety Importance Classification, a new guide concerning the classification of the importance of the safety function in nuclear reactor facilities, is being established. The Review Guide for Safety Evaluation has already been in use for more than 10 years since its first institution, and it has been recognized that the guide should be revised to reflect the technological progress and experience gained in the meantime and to coordinate it with the new Review Guide for Safety Design version and the newly established Review Guide for Safety Importance Classification.

In the revised version of the Review Guide for Safety Evaluation, the composition was rearranged into two separate sections: safety design evaluation and siting evaluation. Besides, Appendix I describing typical events to be postulated for evaluation along with respective analytical conditions to be taken into consideration and Appendix II describing recommended methods for evaluating radiation doses are newly added. Furthermore, the matters to be taken into consideration for the analysis of postulated events shown in Appendix I is newly provided as the "Commentary to the Appendix (August 30, 2000)."

This revised version of the Review Guide for Safety Evaluation reflects what is believed to be the standard design concepts for current LWRs in Japan. It is expected that improvement in the design of LWRs will continue along with the accumulation of experience and progress in safety research and analytical techniques.

The nonconformance of part of the contents of the application to this guide will not preclude approval of the application if the deviation from the guide is based on technological progress. Appropriate judgment are encouraged. With this progress in mind, the guide should be subject to revision as required when more experience and design improvement become available. The appendices and the "Commentary to the Appendix" can be supplemented at any time if the employment of new insights is edited with updated date.

II. Safety Design Evaluation

1. Safety Design Evaluation

Section II "Safety Design Evaluation" included in the text of this guide defines the

essential requirements necessary for evaluating the safety design policy of the nuclear reactor facility, i.e. safety design evaluation, in pursuant to the Review Guide for Safety Design. The Review Guide for Safety Design specifies various requirements for structures, systems and components in nuclear reactor facilities from the viewpoint of ensuring safety, and part of the requirements are intended for ensuring required safety functions during abnormal conditions, such as anticipated operation occurrences and accidents. In accordance with those requirements, Section II of the "Safety Design Evaluation" specifies the events to be postulated, criteria for judgment and matters to be taken into consideration in analysis upon conducting the Safety Design Evaluation.

2. Scope of Evaluation and Selection of Events for Evaluation

The Safety Design Evaluation requires to address anticipated operational occurrences and accidents in the "scope of evaluation." To properly encompass those conditions by a limited number of representative events, proper selection of evaluating events is necessary. The anticipated operational occurrences and accidents discussed herein are limited to internal events whose causes arise within nuclear reactor facilities. As to natural phenomena or external man-induced events, the adequacy of design considerations against them is reviewed separately based on the Review Guide for Safety Design and others. While internal events take various forms, most of them are caused by failures, damage or erroneous operations of systems or components belonging to abnormality prevention systems (PSs) defined in the Review Guide for Safety Importance Classification. The events extracted from these events for consideration in the safety design of nuclear reactor facilities and in its evaluation are referred to as Design Basis Events (DBEs).

When the occurrence of a certain DBE is postulated, the event sequence varies with the operating status of individual structures, systems and components in the nuclear reactor facility. A combination of one DBE with the related operating status of systems and components mainly belonging to MSs, and the status of power supply, etc. is the "event for evaluation" in the Safety Design Evaluation.

Out of the events for evaluation, those categorized as anticipated operational occurrences shall cover such events as are expected to occur once or several times during the operating life of the nuclear reactor facility (their main causes may be attributed to loss of off-site power, a single failure or malfunction of an active component, or a single erroneous operation). The "single failure," etc. referred to here (including single malfunction and single erroneous operation) include multiple secondary failures, etc. due to single cause. Those categorized as accidents shall cover such events as may potentially lead to the most sever of consequences in the nuclear reactor facility and to the public though the probability of occurrence may be smaller, and have to be postulated from the viewpoint of examining the adequacy of the safety design. In this guide, three types of anticipated operational occurrences and four types of accidents are listed, and typical events along with their basic analytical conditions are indicated in Appendix I. There can be additional appropriate events for evaluation in the actual design of a nuclear reactor facility, and the selection of such events shall be carefully examined.

Depending on the assumption of the event, some event could be related to two or more abnormal states as classified above. In such a case, analytical conditions shall be adequately specified with due consideration for the purpose of each evaluation. If two or more similar events exist for an abnormal state, they may be represented by one event that gives the severest possible result.

3. Criteria

The "criteria" to be applied in the safety design evaluation are the standards to judge the adequacy of the safety design of the nuclear reactor facility against anticipated operational occurrences and accidents. The basic principles of their criteria are as follows.

The criteria for anticipated operational occurrences basically reflect the requirement that the nuclear reactor facility is designed such that normal operation can be resumed without any significant repairs except the recovery of the failed portions that have caused the event. These criteria are basically the same as those in the former guide. As for Criterion (3), detailed requirements are specified in the "Evaluation Guide for Reactivity Insertion Events of Light Water Nuclear Power Reactor Facilities" (hereinafter referred to as the "Evaluation Guide for Reactivity Insertion Events").

The criteria for accidents basically reflect the requirements that the nuclear reactor facility is designed such that the event does not lead to melting or considerable damage of the core and that the release of radioactive materials to the environment can be limited to be as low as acceptable. In this process, consideration is made that the event does not cause secondary abnormal conditions before it is terminated.

Criteria (1) through (5) are based on this basic concept. Criterion (1), the phrase "can be sufficiently cooled" implies that the core shall keep the geometry such that the heat removal of the core can be quantitatively or at least semi-qualitatively estimated, i.e. the core maintain the "coolable geometry." The practical determination of conformance to this criterion shall in general be subject to the following requirements specified in the "Evaluation Guide for Emergency Core Cooling System Performance of Light Water Nuclear Power Reactors" (hereinafter referred to as the "Evaluation Guide for ECCS Performance").

(a) The calculated maximum fuel cladding temperature shall not exceed 1,200°C.

(b) The calculated stoichiometric amount of oxidation of the fuel cladding shall not exceed 15% of the cladding thickness before significant oxidation.

It should be recognized that other appropriate requirements can be substituted for the above, depending on the reactor coolant pressure, duration of high temperature of the fuel and other factors, if conformance to such requirements evidently ensures the prevention of considerable core damage and the maintenance of adequate core cooling.

The specific requirements for Criterion (2) is referred to the Evaluation Guide for Reactivity Insertion Events.

Criterion (5) is to judge "significant radiological risks" in consideration for the balance of the dose by an accident and the frequency of the accident. ICRP recommended 1 mSv as the annual effective dose limit to the public (recommendation in 1990), but in a special situation, if the average for five years does not exceed 1 mSv year, an effective dose that is higher than this may be permitted for a single year. This is a principle for the radiation exposure during the normal condition. This is supposed to be applied however for an accident that the frequency of occurrence is small. It is judged that the risk is small if the evaluated value of the effective dose to the public living surrounding the site does not exceed 5 mSv per accident. It can be judged

that the risk is small even if the evaluated value of the effective dose exceeds the value mentioned above to some degree for the accident with extremely small frequency. However, even if the effective dose exceeded the value described above to some degree, it can be judged that the risk is small for an accident having extremely small frequency.

A technical review was made about radionuclides that should be taken into account in the evaluation of doses to members of the public. It was found that the contribution of radionuclides other than iodine and rare gases due to open air release was small. It is therefore required that the sum of the effective dose incurred by the intake of iodine and the dose equivalent resulting from external exposure by rare gases, in general, be calculated in evaluating the effective dose induced by the radionuclides released into open air. In addition, the effective dose resulting from external exposure by direct gamma rays and skyshine gamma rays from radionuclides contained in buildings within the nuclear reactor facility shall be properly evaluated.

4. Considerations in Analysis

4.1 Scope for Analysis

The analyses of anticipated operational occurrences and accidents in the safety design evaluation shall be to demonstrate the conformity to the safety design policy by covering all abnormal events that can take place through the whole ranges of normal operation and the operating period.

The parameters for analyses shall be specified to meet this challenge. In addition, analytical results should indicate that the postulated event can be resolved into a safe state satisfying the acceptance criteria as an envelope which represents other similar events. The analyses should therefore be performed up to the point where the event terminates and it is reasonably inferred that the reactor would reach a cold shutdown state safely. There can be, however, exceptions depending on the nature of events. For a “loss of reactor coolant”, for example, Criterion (4) specified in the “ECCS Performance Evaluation Guide” should be applied.

4.2 Assumptions on Safety Functions

(1) The structures, systems and components having safety functions are classified into three levels by significance to their safety function as specified in the “Review Guide for Safety Importance Classification,” and accordingly, those having abnormality mitigation functions are categorized into MS-1, MS-2 and MS-3. The functions to accommodate abnormal states and mitigate the consequences shall have reliability as high as required for their significance. In view of this, it is considered to be necessary that nuclear reactor facilities should in general be capable of coping with an accident without depending on the mitigation functions of MS-3 whose expected reliability is almost the same as that of ordinary industrial facilities. Therefore, in the text of this guide, mitigation functions of structures, systems and components belonging to MS-1 and MS-2 only are in general accepted as those which deserve consideration in the analyses of accidents. Mitigation functions of those belonging to MS-3, however, can be taken into consideration in the analyses, provided that their reliability is sufficiently high. In other words, mitigation functions of structures, systems and components belonging to MS-3 must have reliability as high as that of MS-1 and MS-2 if credits are taken in the analyses of accidents.

Likewise, in this guide, mitigation functions of structures, systems and components belonging to MS-1 and MS-2 only are in general accepted as those which deserve consideration in the analyses of anticipated operational occurrences. Credit can be taken for mitigation functions of those belonging to MS-3, however, provided that their reliability is reasonably high.

Practical examples are provided in Appendix I and in the Commentary based on the Appendix.

(2) It is required in the Review Guide for Safety Design that systems with safety functions of especially high importance be capable of fulfilling their safety functions even assuming a single failure of any of the components that comprise the systems. The Review Guide for Safety Importance Classification delineate the systems to which the requirement applies. The idea of single failure shown in these guides is to apply the assumption of a single failure to specific systems; this concept is called “application by systems” of single failure. On the other hand, it was required in the former Review Guide for Safety Evaluation that a single failure to lead to the severest consequence assumed for a combination of systems or components that would perform a specific safety function; this concept is called “application by functions” of single failure. The single failure referred to here means the loss of the required safety functions of a component necessary for coping with an abnormal condition and includes multiple failures due to secondary causes, but it is distinct from a failure of a component as a cause for an abnormal condition.

In the present revision of this guide, the applicability of the single failure principle remains unchanged. A single failure shall be assumed to occur in a combination of systems or components in MSs that are necessary for addressing an accident with respect to each of the fundamental safety functions of reactor shutdown, core cooling and radioactivity confinement. In the case of loss of reactor coolant, for example, the safety function of core cooling is achieved by a proper combination of the emergency core cooling system (ECCS) to inject cooling water, the safety protection system to actuate the ECCS, the electric systems to supply power for the ECCS, and the systems for cooling associated components and transporting heat to an ultimate heat sink, etc. This guide requires the assumption of a single failure, which brings about the severest possible analytical result, for such a combination of systems or components for performing a safety function as above.

It is thus a basic rule in this guide that the assumption of a single failure shall be applied to every system or component, belonging to any class of MS, which is expected to address an accident by performing any of the aforementioned fundamental safety functions. The systems and components to which the assumption of a single failure is applied must include not only competent systems defined in the Review Guide for Safety Importance Classification but also the supporting systems that are directly needed by each competent system for fulfilling its safety functions. The failure of a component which would keep performing its functions from before the occurrence of an event and through the process of the event, or what is called an “on-duty” component may not need to be assumed.

(3) It is a basic requirement that systems and components with safety functions should be designed to be capable of performing their necessary functions without depending on operator actions immediately after the onset of an

abnormal condition. If operator actions are needed, sufficient time and adequate information shall be available so that the operator may be able to properly judge the situation and take necessary actions with a high degree of confidence. The analysis shall take into account the time allowance of at least 10 minutes for the start of necessary operator actions after adequate information becomes available for proper judgment.

(4) If functions of the safety protection system are expected in the analysis, the types of signals for it shall be characterized including the timing of signal actuation. The actuation signals shall be approximately selected considering whole events that are encompassed by the postulated event. The same is applied to systems other than the safety protection system.

(5) The Review Guide for Safety Design and the Review Guide for Safety Importance Classification specify the systems which should be supplied with electric power by emergency on-site power systems. It shall therefore be demonstrated that those systems are designed to be capable of performing their functions even in the case of a loss of off-site power. Especially, the analysis involving the evaluation of the performance of the engineered safety features shall satisfy this requirement. It should be noted, however, that, depending on the nature of the postulated event, the assumption of availability or unavailability of off-site power may affect the severity of the consequence.

Consideration shall therefore be given to the availability of off-site power as well in determining the parameters for the analysis of an accident so that the severest result may be obtained.

(6) If reactor scram is expected in the analysis, the shutdown effect shall be evaluated on the assumption that a control rod (or a group of control rods connected to a common drive mechanism) with the maximum reactivity worth is held at the fully withdrawn position, or at a “stuck rod margin.” This is a margin that the control rod shutdown system should have in the design, and this does not mean to assume that one control rod become inoperable due to failure. Thus, it is different from the assumption of a single failure explained above.

III. Siting Evaluation

1. Siting Evaluation

Section III “Siting Evaluation” in the text of this guide defines the essential requirements necessary for the evaluation related to distance of the reactor from the public as a siting condition, i.e. a siting evaluation, on the basis of the Review Guide for Reactor Siting. The Review Guide for Reactor Siting requires that the reactor be adequately isolated from the public so that the evaluated radiation doses to the public by a postulated Major Accident or Hypothetical Accident may be lower than the specified criteria. To meet this requirement, Section III specifies events to be postulated, criteria and considerations necessary for a siting evaluation.

2. Scope of Evaluation and Selection of Events for Evaluation

The “scope of evaluation” in the siting evaluation shall cover Major Accidents and Hypothetical Accidents.

The objective of postulating Major Accidents and Hypothetical Accidents is to confirm that the reactor involved is isolated from the public at an appropriate distance. The minimum distance necessary for separation depends on the basic configuration, reactor power, safety measures including engineered safety features and other characteristics of the reactor. This point shall be taken into consideration in specifying Major Accidents and Hypothetical Accidents.

In specifying Hypothetical Accidents, for example, if assumptions are made by neglecting the functions of all multiple barriers against fission products in the core, the distance necessary for separation would be determined in effect only from the reactor power, and the effects of other important factors would be ignored.

Such assumptions may not be appropriate to the purpose of judging the minimum distance necessary for separation and thus are not required as essential conditions in the Review Guide for Reactor Siting.

In view of the above and in the light of current LWR designs (basic configurations, safety measures and other characteristics), Major Accidents shall cover two modes of accidents which may have the potential to enlarge the release of radioactive materials: one where radioactive materials are released into the reactor containment, and the other where radioactive materials are directly released at the outside of the reactor containment. With respect to each mode of Major Accidents, the largest amounts of radioactive materials released that could be technically possible shall be assumed from the viewpoint of demonstrating the reactor separation from the public, taking into consideration the consequences of the accidents treated in Section 3.2, Chapter II, of the “Safety Design Evaluation”.

As for Hypothetical Accidents, events identical to Major Accidents and with larger amounts of radioactive materials being released shall be assumed from an engineering point of view.