

Appendix. C. The Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities (Former Guideline, Published in 1978)

Regulatory Guide for Reviewing Seismic Design of Nuclear Power Reactor Facilities

Decision of Atomic Energy Commission

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1. Introduction

This guide for judgment for seismic design policy adequacy in Safety Reviewing for Seismic Design of Nuclear Power Reactor nuclear power reactor facilities, provided in September 1978 by the Atomic Energy Commission based on the experience of Safety Reviews and seismological and earthquake engineering knowledge from the viewpoint of engineering.

We revised evaluation of static seismic forces, etc. of the guideline to reflect new knowledge of them.

This guide shall be revised to reflect new knowledge and experience as new findings become available.

2. Scope of Application

This guide shall apply to nuclear power reactor facilities on land.

Basic concepts in this guide could be referenced by other nuclear reactor facilities.

Application contents not complying with this guide would not necessarily be excluded provided that they have pertinent reason.

3. Basic Policy

Nuclear power reactor facilities shall maintain seismic integrity against any postulated seismic force assumed so sufficiently that any earthquake would induce significant accidents.

Buildings and structures shall be rigid structure in principle and furthermore, important buildings and structures shall be constructed on rock masses.

4. Classification of Importance in Seismic Design

The importance in seismic design of nuclear power reactor facilities shall be classified as follows from the standpoint of possible radiation impact on the environment caused by earthquakes corresponding to the categories of nuclear power reactor facilities:

(1) Classification on Function

Class A

Facilities containing radioactive materials themselves or related directly to Facilities containing radioactive materials, whose loss of function may lead to the dissemination of radioactive materials into the environment, Facilities required to prevent the occurrence of these events and Facilities required to mitigate consequences resulting from the dissemination of radioactive materials in the occurrence of these accidents, and whose influence and effect are highly significant,

Class B

Facilities of the same functional categories as above Class A, but whose influence and effect are relatively small,

Class C

Facilities except for A or Class B, and those required to ensure safety equivalent to general industrial facilities.

(2) Facilities of Classes

Facilities of Classes are as follows based on the above classification of importance in seismic design,

1) Class A Facilities

- i) Equipment/piping consisting of the “reactor coolant pressure boundary” (the definition is the same that is in other Regulatory Guides for Reviewing Safety Design of Light Water Nuclear Power Reactor Facilities).
- ii) Spent fuel storage pools.
- iii) Facilities to add negative reactivity to rapidly shut down the reactor and Facilities to ensure shutdown mode of the reactor.
- iv) Facilities to remove decay heat from the reactor core after reactor shutdown.
- v) Facilities to remove decay heat from the reactor core after failures in the reactor coolant pressure boundary.
- vi) Facilities to prevent the propagation of radioactive materials directly at the pressure barrier in failure accidents in the reactor coolant pressure boundary.
- vii) Facilities, except for those in category vi, above, for

mitigating the dissemination of radioactive materials into the environment in accidents involving the release of radioactive materials.

We especially call As class Facilities limited to Facilities of i), ii), iii), iv) and vi).

2) Class B Facilities

- i) Facilities connected directly to the reactor coolant pressure boundary and containing radioactive materials themselves or having the possibility of containing radioactive materials.
- ii) Facilities containing radioactive materials, except for those whose "effect of radiological exposure to the public due to their breakage is low enough to compare to the annual exposure limit outside of the peripheral observation area, because of its small inventory of radioactive materials or the difference in the storage system type.
- iii) Facilities related to radioactive materials other than radioactive waste and having the possibility, upon breakage, of causing excessive radiological exposure to the public and operational personnel.
- iv) Facilities for cooling spent fuel.
- v) Facilities, except for those of Class A, for mitigating dissemination of radioactive materials into the environment in accidents involving the release of radioactive materials.

3) Class C Facilities

Those Facilities not belonging to Class A or B above.

5. Evaluation of Seismic Design

(1) Policy

Nuclear power reactor facilities shall be designed to fulfill the following primary policies of seismic design for Class categories:

- 1) Facilities of Class A shall withstand larger seismic force loading caused by "dynamic design maximum possible earthquake ground motion" or the static seismic force below.
Furthermore, Facilities of Class As shall maintain safety functions under seismic force caused by "dynamic design maximum probable earthquake" below.
- 2) Facilities of Class B shall bear static seismic force shown below, and, as for Facilities having possibility of resonating with earthquake, the influence of it shall be evaluated.
- 3) Facilities of Class C shall bear the static seismic force shown below.
- 4) In the items above, the integrity of upper Class Facilities shall not be impaired by damage to lower Class Facilities.

(2) Seismic Force Calculation

Seismic forces loading caused by dynamic design

maximum possible earthquake ground motion, dynamic design maximum probable earthquake, and static seismic force mentioned in section 5. (1) shall be obtained as shown below.

1) Seismic forces loading caused by dynamic design maximum possible earthquake ground motion and dynamic design maximum probable earthquake

Horizontal seismic forces loading caused by dynamic design maximum possible earthquake ground motion and dynamic design maximum probable earthquake shall be calculated by applying design-basis earthquake ground motion (DBGM) defined in section 5. (3) "Evaluation of Design-Basis Earthquake Ground Motion."

Horizontal seismic force shall be combined with vertical seismic force, which is calculated in a condition of a half of DBGM maximum acceleration amplitude as vertical seismic coefficient, simultaneously in the most adverse direction, but vertical seismic coefficient shall be assumed constant in height.

2) Static seismic force

i) Buildings and structures

Horizontal seismic force shall be evaluated by multiplying seismic story shear coefficient by the coefficient corresponding to the importance classification of facilities shown below and multiplying the weight of concerned above story of building.

Class A: seismic story shear coefficient $3.0 C_i$

Class B: seismic story shear coefficient $1.5 C_i$

Class C: seismic story shear coefficient $1.0 C_i$

C_i of the seismic story shear coefficient shall be obtained by considering vibration properties of buildings and structures, categories of ground, etc. defining standard shear coefficient as 0.2.

For facilities of Class A, shall be considered vertical seismic force, both horizontal and vertical seismic force shall act simultaneously in the most adverse direction. Vertical seismic force shall be evaluated with vertical seismic intensity obtained by using seismic intensity 0.3 as a standard, and by considering vibration properties of buildings and structures, categories of ground, etc. The vertical seismic coefficient shall be constant in height.

ii) Components and piping

Seismic force of Classes shall be evaluated using seismic intensities obtained by using seismic story shear coefficient in I) above as horizontal seismic intensity, and by increasing horizontal seismic intensity and vertical seismic intensity in I) above by 20%, horizontal seismic force shall be combined with vertical seismic force simultaneously in the most adverse direction, but vertical seismic force shall be assumed constant in height.

(3) Evaluation of Design-Basis Earthquake Ground Motion

Ground motion in seismic design of facilities should be evaluated based on earthquake ground motion on the free surface of the base stratum at the proposed site, as follows:

- 1) DBGM shall be determined by two types of earthquake ground motions, S_1 and S_2 , based on its strength.
 - (i) As earthquake causing DBGM S_1 (dynamic design maximum possible earthquake ground motion), shall be estimated as the most effective one of earthquakes occurring in the past by historical sources and in danger of occurring again and affecting the proposed site and its neighborhood the same as in the past or in danger of occurring in the future and affecting the proposed site by possible active faults.
 - (ii) Earthquake causing DBGM S_2 (dynamic design maximum probable earthquake) shall be estimated as the most effective one of earthquakes seismologically over dynamic design maximum earthquake ground motion considered by frequency of occurrence, active faults around the site, and seismo-tectonic structure technologically.
- 2) Earthquakes causing DBGM S_1 and S_2 include those occurring close and far away. DBGM S_2 includes earthquakes caused directly above its epicenter.
- 3) In evaluating DBGM, the following must be considered:
 - (i) Magnitude, epicenter, hypocentre, fields of aftershock, and maximum motion (or estimated value), and damage by motion, including damage to buildings and structures and tombstones, etc., of earthquakes affecting the proposed site and its neighborhood in the past.
 - (ii) Statistical expectations of destructive earthquake ground motion in the past.
 - (iii) Magnitude of earthquakes and distance of the site from the center of energy discharge.
 - (iv) Observation of past, observation results at the site, and research results of character of basement.
- 4) By following the above conditions, DBGM shall show values as follows:
 - (i) Maximum amplitude of earthquake ground motion
 - (ii) Frequency of earthquake ground motion
 - (iii) Duration and change in amplitude envelope of earthquake ground motion

6. Load Combination and Allowable Limit

The basic concept of the combination of loads and allowable limits concerning seismic design considered in assessing design principle adequacy for seismic safety shall be based as follows:

(1) Buildings and Structures

- 1) Earthquake-proof class As buildings and structures
 - i) Combination with DBGM S_1 and allowable limit
Regarding stress resulting from combining normal load and operating load imposed with seismic load caused by EDGM S_d or Static seismic force, allowable unit stress specified in standards and criteria assumed adequate for safety shall be established as allowable limits.
 - ii) Combination with DBGM S_2 and allowable limit
Regarding the combination of normal load and operating load with seismic force caused by DBGM S_s , buildings and structures shall have a sufficient deformation acceptability margin – deformation at ultimate strength – as a whole, and the adequate safety margin shall compared to the ultimate strength of buildings and structures.
- 2) Earthquake-proof class A (except for As class) buildings and structures
Apply 1) and i) “Combination with DBGM S_1 and allowable limit” above.
- 3) Earthquake-proof B, class C buildings and structures
Regarding stress resulting from combining normal load and operating load imposed with static seismic forces, allowable unit stress in 1) and I) above shall be established as allowable limits.

(2) Components and Piping

- 1) Earthquake-proof class As components and piping
 - i) Combination with DBGM S_1 and allowable limits
Yield stress or stress with safety equivalent to this shall be established as allowable limits for load resulting from combined loads in normal operation, unusual transient conditions in operation, and accident condition imposed with seismic loads caused by DBGM S_1 or static seismic force.
 - ii) Combination with DBGM S_2 and allowable limits
Functions of nuclear power reactor facilities shall not be affected by the occurrence of excessive deformation, cracks, and failures, even if most parts of structures would reach yield conditions and plastic deformation would occur, with stress due to combined loads occurring in normal operation, unusual transient conditions in operation, and accident conditions with seismic load caused by DBGM S_2 .
- 2) Earthquake-proof class A (except for As class) components and piping
Apply 1) and i) “Combination with DBGM S_1 and allowable limit” above.
- 3) Earthquake-proof B, class C components and piping
The yield stress or stress with safety equivalent to this shall be established as allowable limits for loads resulting from combined loads in normal operation.

Comments

We explain as follows the “Evaluation of DBGM,” “Evaluation of Active Faults,” “Static Seismic Force,” and “Load Combination with Seismic Force and Allowable Limit” regarding the dynamic analysis.

I. Evaluation of DBGM

1. Terminology on DBGM determination is as follows:

- (1) “Free surface of the base stratum” is defined as the free surface settled hypothetically without any surface layer or structure and as the surface of base stratum postulated to be nearly flat with considerable expanse and without eminent unevenness. “Base stratum” here is in the main hard rock mass of tertiary deposit or before it and does not damaged by weathering.
- (2) “Active faults” are defined as faults that have moved repeatedly in quaternary period (after 1.8 million years ago) and have the possibility of moving in the future.
- (3) “Seismo-Tectonic Structure” is defined as geological structure of region with some extent having same character of occurrence of earthquake in the view of scale of earthquake, depth of hypocentre, mechanism of the earthquake, and frequency of occurrence.

2. Design-based earthquake ground motion is classified into two types, S_1 and S_2 , corresponding to the importance of buildings, structures, equipment, and piping of reactor facilities.

- (1) Earthquakes to be considered when design-based earthquake ground motion S_1 is determined are those predicted to occur from an engineering standpoint. In other words, those earthquakes influencing the site or its vicinity based on historical evidence may reoccur and similarly influence the site and its surroundings in the near future. Earthquakes caused by highly active faults that may influence the site in the near future must also be considered. An earthquake applying the largest earthquake ground motion to the base stratum of the site is called the strongest earthquake for design. Assuming that it will really occur, S_1 is to be given to buildings, structures, equipment, and piping.
- (2) Earthquakes to be considered when design-based earthquake ground motion S_2 is determined are assumed to recur in the near future after they are considered from an engineering standpoint if earthquakes beyond the strongest earthquake for design occurred relatively recently from an additional seismological standpoint because the

occurrence of these earthquakes cannot be denied. The limit of an earthquake is assumed to exist for each seismic occurrence area in the seismic structure and situations where earthquakes occurred in the past, so the size of such an earthquake and the region of its occurrence can be considered based on active faults around the site and the seismic geological structure in an extensive region. An earthquake that applies maximum ground motion to the base stratum of the site among these earthquakes is the marginal earthquake for design. Assuming that it occurs, S_2 is given related to buildings, structures, equipment, and piping.

Properties of earthquake ground motion on the free surface of the base stratum differ with the distance of an earthquake source, so the base stratum near and far was considered when the strongest earthquake for statistical purposes and the marginal earthquake for design were planned.

3. The following items are considered when design-based earthquake ground motion is evaluated:

- (1) Historical earthquakes that should be considered include those assumed to be included when earthquake ground motion of the base stratum of the site is planned, for example, those that gave or are presumed to have given an earthquake intensity scale of V or higher established by the Japanese Meteorological Agency to the site or its surroundings. As much material as possible must be studied related to past earthquakes, including information on the location of epicenters, the depth of earthquake sources, after-quake areas, and damage. The relationship between damage and the topography or base stratum of an earthquake should be studied. The seismic gap of a historical earthquake is recognized depending on the region, in which case such earthquakes shall be fully investigated.
- (2) The “expected statistical value” of the intensity of earthquake ground motion refers to earthquake intensity, i.e., the maximum acceleration or velocity presumed to occur based on statistical research such as the Kawasumi or Kanai map. This should be recalculated as needed based on the latest knowledge because it differs with the magnitude and epicenter of a destructive earthquake, the range of interest, and the investigation period.
- (3) 1) The magnitude of the strongest earthquake for design should rely mainly on the occurrence of the past base spectrum affecting the site and be determined considering nearby active faults. The magnitude of the marginal earthquake for design must be determined considering the seismic ground structure and scale of nearby active faults. Large earthquakes generally occur repeatedly in the same region, so the magnitude of the strongest

earthquake for design is basically determined based on earthquakes historically affecting a site or its vicinity. Taking into account that old materials on earthquakes may not be reliable, earthquakes due to highly active faults shall be considered based on the possibility of influencing the site in the near future taking into account hard geological evidence and engineering judgment so that the occurrence of an earthquake with a long repetitive period is not ignored, although this earthquake may not have happened to be historically recorded.

The magnitude of the marginal earthquake for design is determined considering the distribution of seismic geological structures in an extensive region and historical earthquakes, but must include nearby active faults. A significant difference exists in the nature of an active fault, such as the scale or frequency of the occurrence of an earthquake, for each fault, making it impractical to take into account all active faults equally. It is not always appropriate from an engineering standpoint, for example, to predict the reoccurrence of a big earthquake with low possibility caused by an active fault, so when an active fault is considered, its degree of activity should be evaluated and considered based on its scale.

- 2) The distance from the center of energy release of the strongest earthquake for design or the marginal earthquake for design to the site must be determined considering the center of past earthquake energy release, the location of a nearby active fault, and the seismic geological structure in the extensive region. Interaction is represented between an earthquake and site by the distance from the center of earthquake energy release to the site. If, however, sufficient distance exists between the epicenter location and the site, the epicenter distance can be used instead.
- 3) An inland earthquake of $M=6.5$ shall be postulated for a short distance earthquake considered as S_2 when design-based earthquake ground motion is planned.
- 4) Much research has found a correlation among maximum amplitude, frequency properties, and changes in the duration and amplitude envelope over time of earthquake ground motion, and the magnitude of an earthquake, earthquake source, or the quality of the base spectrum, based on results of past observations, and should be referenced as notation referencing these outcomes, however, observation materials based on them should be checked.

Results of site observations may be highly useful, but only observation records on minor earthquake ground motion are available in many cases. Referencing such materials requires full attention to differences in behavior between minor and major earthquake ground motions.

4. Planning of design-based earthquake ground motion was decided based on three elements: maximum amplitude, frequency properties, and changes in the duration and amplitude envelope. Because design-based earthquake ground motion is appropriately represented by these three aspects.

- (1) Maximum amplitude

The amplitude of earthquake ground motion is generally represented by velocity, but acceleration amplitude is generally large in a short period and tends to dominate the design of buildings, structures, equipment, and piping – a point to be taken into account.

The maximum velocity amplitude in horizontal direction earthquake ground motion on the free surface of the base stratum is determined by referencing the theoretical value based on an empirical equation based on actually measured results of earthquake ground motion or an appropriate fault model. This empirical equation has been verified in its applicability outside the source region based on the earthquake magnitude. It may generally give a larger value within the source region, and a different method is used so that the intensity of the earthquake is presumed from correction or damage with properties of earthquake ground motion in the vicinity of the source within the source region.

- (2) Frequency properties of earthquake ground motion

Properties of earthquake ground motion in the base stratum are governed by the magnitude of an earthquake, the distance from the center of earthquake energy release, and vibration properties of the base spectrum. Thus must thus be determined by examining these factors and referencing earthquake ground motion on the base spectrum in the source, constant observation results of slight motion, or historical observation.

- (3) Changes in duration and amplitude envelope over time

As a time of duration, time shall be considered from the start of earthquake ground motion to when motion is considered to effectively disappear. Since a close correlation exists between the duration and amplitude envelope of earthquake ground motion and the magnitude of an earthquake, each shall be determined based on the magnitude of the strongest earthquake for design and marginal earthquake for design.

II. Evaluation of Active Faults

An earthquake considered to occur due to an active fault is classified by the degree of activity of active faults into the earthquake that gives design-based earthquake ground motion S_1 or S_2 to the base spectrum of the site. The following judgment standard applies when the active fault is evaluated for each classification:

1. The following shall be considered for evaluation as the source of design-based earthquake ground motion S_1 :
 - (i) Faults presumed based on historical records to have caused earthquakes in the past
 - (ii) Faults among Class A active faults active 10,000 years ago and after, or whose return period is less than 10,000 years
 - (iii) Those in which current fault activity is recognized by observing micro earthquakes
2. The following shall be considered for evaluation as the source of design-based earthquake ground motion S_2 :
 - (1) Faults belonging to Class A active except for 1.(ii)
 - (2) Faults belonging to Class B or C active faults active 50,000 years ago and after, or whose return period is less than 50,000 years

3. (1) The return period (years) is presumed based on historical records and geological structures over a wide region. An internal active fault in Japan is presumed based on the following expression:

$$R = \frac{10^{(0.6M - 4)}}{S}$$

R: Return period (year)

M: Magnitude

S: Mean slip velocity (mm/year)

- (2) The classification of Classes A, B, and C active faults above shall be determined by the following mean slip velocities:

Class A $1 \leq S \leq 1$

Class B $0.1 \leq S \leq 1$

Class C $S \leq 0.1$

S: Mean slip velocity (mm/year)

III. Regarding Static Seismic Force

Evaluation of static seismic force shall depend on 1) and 2) below.

1. Horizontal seismic force

- (1) Horizontal seismic force shall be obtained as the total seismic force acting on the part concerned based on the building height and the structure and be calculated using the following formula:

$$Q_1 = n Z C_1 W_1$$

$$C_1 = R_1 A_1 C_0$$

where

Q_1 : Horizontal seismic force,

n : Coefficient based on the importance classification of facilities – earthquake-proof class A: 3.0; earthquake-proof class B: 1.5;

earthquake-proof class C: 1.0.

Z : Zoning factor (to be 1.0),

C_1 : Shear coefficient

W_1 : Total load supported by the part in question.

R_1 : Value representing vibration properties of buildings obtained by the following table,:

However, if the value expressing vibration properties of buildings and structures, evaluated by the special investigation or research, is confirmed to fall short of the value calculated by the following table, it could be reduced to the value evaluated based on results of special investigation or study but equivalent to and not less than 0.7.

$T < T_c$	$R_1 = 1$
$T_c \leq T < 2T_c$	$R_1 = 1 + 0.2 \frac{T}{T_c} - 1$
$2T_c \leq T$	$R_1 = \frac{1.6 T_c}{T}$
<p>T and T_c represent the following:</p> <p>T: Primary natural period (in seconds) for design of buildings or structures that is calculated by the following expression:</p> $T = h (0.02 + 0.01 \dots)$ <p>In this expression,</p> <p>h: Height of a building or structure (in meters)</p> <p>\dots: Ratio to h, the total height of the layers that most columns and beams of a relevant building or structure are made by steel</p> <p>T_c: Value listed in the table below based on the type of ground immediately below the bottom of the foundation of a building or structure (tip of a robust supporting stake if used).</p>	

	Ground type	T_c
Type 1	Base rock, hard sand gravel beds, those composed mainly of beds before the 3rd century, or those with the same level of ground period as that recognized by the results of investigation or research on the ground period, etc.	0.4
Type 2	Those other than Types 1 and 3	0.6
Type 3	Alluvium (including banks if any) composed mostly of humic, mud, or similar soil. It is roughly 30 meters or more deep. The slough or mud-sea landfill ground is roughly 3 meters or more deep with an age of less than roughly 30 years after it was reclaimed or it is recognized as having the same cycle as one based on investigation or research results of the ground cycle, etc.	0.8

A_i : Distribution coefficient towards the height of the shearing force coefficient, calculated as follows:

If it is calculated based on the results of a special investigation or study on vibration characteristics of a building or structure, it relies on the relevant calculation.

$$A_i = 1 + \frac{1}{\sqrt{c_i}} \quad c_i = \frac{2T}{1 + 3T}$$

where

c_i : Numerical value found by dividing the sum of the fixed load and live load of a part supported with the height calculating A_i of a building or structure by those of the relevant building or structure

T: Primary natural period for design (in seconds) of a building or structure

C_0 : Standard shear coefficient (0.2),

- (2) Seismic force acting on underground parts of buildings and structures can be evaluated by multiplying the sum of the fixed load and live load of relevant part of the building or structure by horizontal seismic coefficient evaluated using the following formula:

If a part of outer side of relevant part of building or structure is not setting on the ground, propriety shall be proved to apply prescription for evaluation of seismic force based on a special research or study.

$$K = 0.1 n \frac{H}{40} Z$$

where

K: Horizontal seismic coefficient

n: Coefficient based on importance classification of facilities – earthquake-proof class A: 3.0; earthquake-proof class B: 1.5; earthquake-proof class C: 1.0.

H: Depth of each under part from ground plane; 20 (m) at depths over 20 (m),

Z: Zoning factor (1.0).

If the value is calculated in evaluating vibration properties, it would be the value calculated by this method.

2. Vertical seismic force

Vertical seismic force in the evaluation of static force for earthquake-proof class A facilities shall be evaluated with vertical seismic intensity using the following formula:

$$C_v R_v = 0.3$$

where

C_v ; Vertical seismic intensity,

R_v ; Value representing vertical vibration properties of the building, 1.0. Based on special investigation or study, if it is confirmed to fall short of 1.0, it shall reduced to a value based on results of investigation or study but equivalent to or not less than 0.7.

3. A building or structure must be checked for horizontal yield held by the relevant building or structure having an adequate safety margin for the required holding horizontal yield in order importance.

The required holding horizontal yield I_s is calculated as follows:

$$Q_{un} D_s F_{es} Q_{ud}$$

where

Q_{un} : Required holding horizontal yield of each layer (in tons)

D_s : Structural property coefficient of each layer

F_{es} : Shape property coefficient of each layer

Q_{ud} : Horizontal force occurring in each layer by seismic force (in tons) based on how to calculate the horizontal seismic force in Comments III, 1. In this case, however, the coefficient based on importance and the standard shearing force coefficient shall be 1.0.

Where D_s shall be a value calculated by appropriately evaluating the attenuation related to the vibration of the relevant building or structure and the tenacity of the relevant layer. F_{es} shall be a value calculated by appropriately evaluating the relationship between the rigidity, eccentricity, and shape properties of the relevant layer.

IV. Regarding Load Combination and Allowable Limit

The combination of loads and allowable limits concerning seismic design considered in assessing design principle adequacy for seismic safety is mentioned in 6. "Load Combination and Allowable Limit," the interpretation of the combination of loads etc. shall be based on the following:

- (1) Regarding "respective loads that occur in unusual transient operation and accidents," the load acted on the events which are feared being caused by the earthquake and the loads.

Even for "a load that occurs in an accident," if the occurrence probability of this accidental event occurs extremely low and ends in extremely brief duration, load caused by this event need not be considered combined with seismic load.

Even if the events which are not feared being caused by the earthquake but being caused by events continuing over the long term if they would occur once, shall be considered combined with seismic load.

- (2) Regarding allowable limits for the combination of buildings and structures with DBGM S_1 , etc., although it was required to be established as the

“allowable unit stress specified in standards and criteria assumed to be adequate for safety,” these standards and criteria correspond concretely to the Building Standard Law, etc.

- (3) “Ultimate strength” in terms regarding combinations of buildings and structures with DBGM S_2 means the bounding maximum bearing load in reaching the condition considered the ultimate condition of structures, where deformation and strain in structures would be increased markedly by adding the load to the structure gradually.
- (4) Regarding the allowable limit of components and piping, although the basic principle is required to maintain stress under a “yield stress or equivalent safety situation,” this situation corresponds concretely to that specified in “Technical Standards on Structures, etc., of Nuclear Power Generation Facilities, etc.” prescribed in the Electricity Utilities Industry Law.
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