Review of definitions and backgrounds of "capable fault" for NPP siting: constraint to age criteria

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1. Introduction

This paper reviews definitions and technical backgrounds of 'capable fault' used in the United States, Japan, China, and IAEA, constraint to age criteria, with an intension to extract a principal backbone dissolved in these definitions, eventually to apply it to the developing regulatory standard for nuclear power plant (NPP hereafter) siting in Korea.

2. Review: NPP regulatory standards for capable fault

Definitions of 'capable fault' applied to NPP siting in the major countries and IAEA are summarized in the Table 1.

Table 1. Summary of age criteria of capable fault for NPP siting

Country or Institute	Age criteria of capable fault for NPP siting
U.S.	Evidence of at least one movement in the last 50,000 years, or a recurring nature within the last 500,000 years
Japan	Evidence of movement in quaternary (approximately 1,800,000 year BP)
China	Evidence of at least one movement after late Pleistocene (approximately 100,000 year BP)
IAEA	No numerical age criteria

2.1 The United States

Selection of '50,000' and '500,000' years as the criteria for defining a capable tectonic structure is based primarily on the practical ability to date the event history of a fault. The age criterion '50,000' years for defining a capable tectonic structure is based primarily on the practical ability to date the event history of a fault. The period of 50,000 years represents the generally accepted limitation of the Accelerator Mass Spectrometry (AMS) radiocarbon dating technique (e.g., Noller et al., 1999), and conservatively brackets the reference probability such that the potential opportunity for a fault to produce an earthquake is incorporated in the assessment of risk implicit into the definition of the reference probability (Level of acceptable risk, 10^{-3}/yr ~ 10^{-4}/yr).

The age criterion '500,000' years was developed based primarily on the practical limitations of various dating methods. In particular, at the time these criteria were initially developed, the practical minimum age for K-Ar dating was about 500,000 years and for paleomagnetic dating was about 715,000 years (780,000 years now days). An age of 500,000 years is sufficient to sample the current seismotectonic setting. Any tectonic structure that has been active in the current tectonic setting should be considered a capable tectonic source. The US NRC staff judged that if more than one event has not occurred in the past 500,000 years, the fault likely is not active during the current tectonic regime (US NRC, 1997; Noller et al., 1999; Im et al., 2003).

2.2 Japan

Nuclear Safety Commission of Japan defines 'active fault' (equal to capable fault) in the regulatory standards as a quaternary fault that has a potential for the reactivation in the near future (NSC, 1981). It is preferred not to have an active fault at the projected site. An active fault located out of the site but within a certain distance should be considered in the seismic design for the NPP if the fault appears to have moved in the last 50,000 years.

2.3 China

The concept of the capable fault used in China (National Nuclear Safety Bureau, 1994) is primarily based on site-specific tectonic characteristics and practical ability to define ages of the event history of a fault. Selection of '100,000' year for defining a capable fault is partly because faults showing evidence of last movement occurred before the late Pleistocene tend to be stable, while faults showing evidence of last movement occurred after the time tend to keep moving over the time. Another reason for the '100,000' year being is because there exists a key geologic horizon, obvious, generally accepted, and approximately 100,000 years old in the eastern China where all the NPP sites are located.

2.4 IAEA

IAEA uses the definition of 'capable fault' rather qualitative and perceptive (IAEA, 1991), and hence acceptable to the member countries.

3. Concluding remarks

These concepts of capable fault widely used for NPP siting are principally based on practical ability to define age of a fault and site-specific tectonic environment. Concerning the current tectonic regime of Korea has reportedly been the same during Quaternary, it is reasonable to define 'capable fault' as a fault that shows evidence of recurring nature during quaternary period for Korean sites.

REFERENCES

[1] J.S. Noller, J.M. Sowers and W.R Lettice, 2000, Quaternary geochronology : Methods and Applications. AGU Reference Shelf 4, American, Geophysical Union, Washington DC.
[2] US NRC, 1997, Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion, Regulatory Guide 1.165, U.S. Nuclear Regulatory Commission, p. 44.
[3] C.B. Im and etc, 2003, Development of evaluation basis for the safety against earthquakes, Final study report KINS/GR-255, Vol. 1 & 2, Korea Institute of Nuclear Safety, p. 1433.
[4] NSC, 1981, Regulatory Guide for Seismic Design of Nuclear Reactor Facilities (in Japanese).
[5] National Nuclear Safety Bureau, 1994, Problems on earthquakes in selecting of NPP sites, Nuclear Safety Regulation, HAF 0101(1), p. 26 (in Chinese)
[6] IAEA, 1991, Safety Series: Earthquake and Associated Topics in Relation to Nuclear Power Plant Siting, Safety Series No. 50-SG-S1, Rev. 1, International Atomic Energy Agency, Vienna, p. 60.