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Geological issues for evaluating the seismic durability of nuclear-energy facilities in tectonically active regions

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Judging from my several years of experience as a member of the Back-Check Committee for Seismic Durability of Nuclear Energy Facilities, the most serious problem would be excess compromises between the scientific evaluation for seismic hazards and a variety of demands, such as technological, economic, and social ones (and possibly of national security), which should have been considered independently from the scientific hazards evaluation. Similar problem existed in Japan's national projects for seismic disaster prevention, in which many seismologists were involved. Setting such demands aside for a while, I discuss in my presentation potential seismic hazards to nuclear energy facilities located in tectonically active regions.

Potential sources of seismic hazards for Japan's nuclear facilities fall into four categories: (1) subduction-zone megathrusts, (2a) major intra-arc emergent active faults, and (2b) major intra-arc blind active faults, and (3) minor active faults that are, in most cases, secondary to a master fault. Sources in category (1) are the most important in that a subduction zone megathrust produces big earthquakes of Mw 8-9, which are characterized by large-amplitude and very long-lasting motions, and in that the recurrence intervals such earthquakes are short (i.e., tens to hundreds of years). A fault in categories (2a) or (2b) produces large earthquakes of Mw 7 with high acceleration and should hence be considered if proximal to a nuclear facility. The recurrence intervals of earthquakes from a fault of these categories are a few thousand to tens of thousand years. Included in these categories are very long reactivated faults that had evolved during old orogenic phases and hence whose geometries are not fully adapted to the present-day stress field. Such faults are in general weakly active in terms of recurrence interval and slip rate, but could produce big earthquakes because of their lengths (e.g., the Longmenshan Fault in Sichuan Province). Emergent active faults (category 2a) have been almost fully mapped in Japan, but blind active faults (category 2b) have not. Minor active faults of category (3), which are mostly of secondary origin, are considered only when they are located beneath nuclear facilities and capable of causing fault-offset damages. They are less important (but are not negligible) in that recurrence intervals are very long ($>$ several ten thousand years) and amounts of offset are small ($<$ several ten centimeters per event).

Keywords: geologic hazard, subduction zone, plate-boundary fault, blind fault, emergent fault, earthquake recurrence interval