Outline of “Reports about the study regarding current earthquake-proff safety and reinforcement of reactor buildings at Fukushima Daiichi Nuclear Power Station (2)”

July 13, 2011
Tokyo Electric Power Company

[Orientation]
This paper is the report of the study we have implemented regarding current earthquake-proof safety and reinforcement of reactor buildings at Fukushima Daiichi Nuclear Power Station, based on the “Collection of report pursuant to the Provisions of Article 67, paragraph 1 of the Act on Regulation of Nuclear Source Materials, Nuclear Fuel Materials and Reactors” (April 13, 2011). For Unit 1 and 4, for both of which we have completed the evaluation, we summarized the results into a report (1) and submitted it to Nuclear and Industrial Safety Agency, Ministry of Economy, Trade and Industry on May 28, 2011. As we completed the evaluation of Unit 3, which has been damaged severely, we summarized the results into this report and submitted it to the Agency today (July 13, 2011).

[Outline of evaluation]

- As for the reactor building of Unit 3. the parts above the operating floor on the 5^{th} floor was destroyed by the event what is believed to be hydrogen explosion occurred on March 14, 2011. The situation of most parts of the building above 5^{th} floor is that steel beam and concrete member which were collapsed after explosion were piled up. The northwestern part of 5^{th} floor was damaged. Parts of collapsed steel beam and concrete member were piled up on the 4^{th} floor. Most of 4^{th} floor’s walls were damaged. Reflecting these information to the model of mass point system, we conducted the analyses of time history response against design basis ground motion “Ss”, and decided to evaluate totally whether the seismic walls reach terminative condition of shear failure. Then, we implemented local evaluation including spent fuel pool by 3 dimension FEM analysis using the maximum earthquake load which has been obtained from the time historical response analysis and other load such as temperature load (Fig 1).
- As a result of the time history response analysis with mass point system against design basis ground motion, shear strain occurred on remaining seismic wall below 5th floor was estimated 0.14×10^{-3} (Ss-2, NS direction, 1st floor) at maximum and the figure falls much below the criteria, 4.0×10^{-3}. Therefore we evaluate that the reactor building has adequate structural integrity (Fig2).

- As a result of seismic safety evaluation by 3 dimension FEM analysis (Fig 3), combining with earthquake load occurred by design basis ground motion Ss and other load, the maximum strain of rebar is 1303 x 10^{-6}, therefore we evaluate it has an adequate margin against 5000x 10^{-6} the plastic limit strain. And regarding out-of-plane shear force at the minimum part was 1689 (N/mm) against the criteria, 3130 (N/mm). ,therefore we estimate the SFP has the adequate structural integrity.
- We evaluated the shell wall which locates outside the Primary Containment Vessel in similar way. The maximum strain of rebar is 469 x 10^{-6}, therefore we evaluate the shell wall has an adequate margin against 5000 x 10^{-6} the plastic limit strain. And at the point where out-of-plane shear force has minimum margin, the shear force was 2475 (N/mm) against the criteria, 3270 (N/mm), therefore we estimate it has the adequate structural integrity.

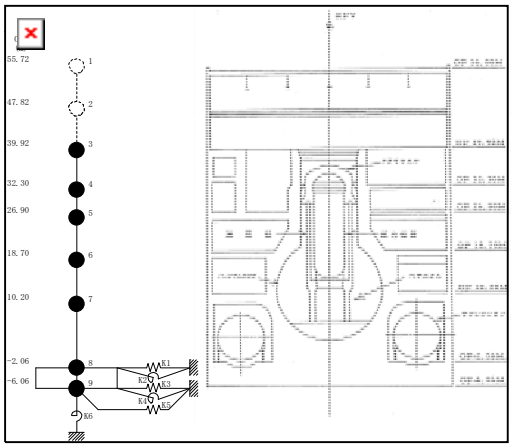

Fig 1. Reactor Building of Unit 3
Earthquake analysis earthquake response (NS direction)

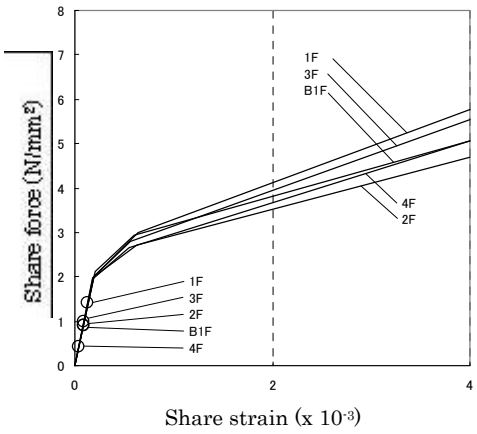

Fig 2. Maximum response values on the shear skeleton curve
(Unit 3, Ss-2, NS direction)

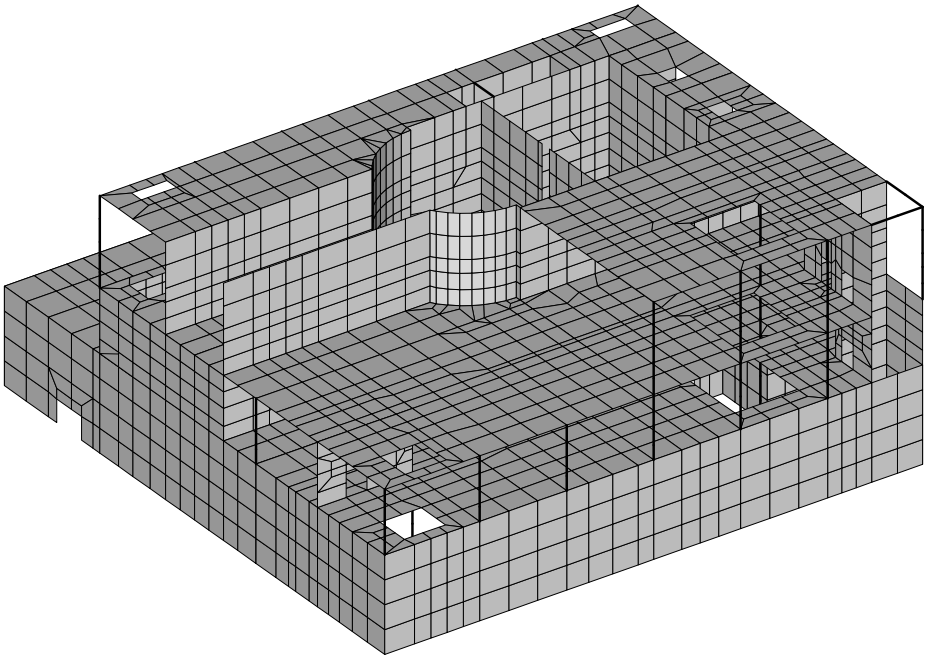

Fig 3 Local evaluation model by 3 dimension FEM (Unit 3)