Tsunami Research and Development for Nuclear Power Plants in Japan

Japan coast is surrounded by plate boundaries. So huge submarine earthquake often generates tsunami. We have many records of tsunami disaster, which history is more than 1000 years. Tsunami disaster prevention is significant issue for Japanese government and local authority. Nuclear power plant facilities (NPF) have been constructed along coast in order to pump up seawater for cooling the reactor. Then tsunami evaluation is one of important terms in safety review of NPF. In this paper tsunami research in Japanese electric power industries is introduced.

In 2002 "Tsunami Assessment Method for Nuclear Power Facilities In Japan" (in Japanese) was published by Tsunami Evaluation Subcommittee of Nuclear Civil Engineering Committee, which was supported by Japanese electric power companies. This focused to evaluate maximum and minimum water levels. Main point of this method is how to determine the design tsunami fault model by historical tsunami records and numerical calculation system. Firstly standard fault model parameters are determined by historical tsunami records and geophysics knowledge. And, the design tsunami is selected as the most effective fault parameters by numerical parametric study on the source model. The validity of it was indicated by comparison data of tsunami heights between historical records and numerical results by all standard fault models.

In CRIEPI, tsunami research has been continued after 1983 Nihonkai-chuubu earthquake tsunami disaster. We have dealt with fault model, tsunami wave propagation in ocean, and tsunami behavior at coastal zone.

We developed a tsunami assessment method using a new tsunami source model based on the crustal structure and new ideas. The model is intended to be applied to safe design basis against tsunami for important coastal facilities. In the source model, crustal deformation, that is tsunami initial condition, is calculated by a 3D finite element model. The calculation is carried out on the assumption that only hanging side of reverse faults is displaced. This method was applied to fault area, which occurred 1993 Hokkaido-Nansei-Oki earthquake. Tsunami numerical simulation gave reasonable results around Okushiri Island and indicated that the new source model can evaluate the tsunami run-up heights on the safe side.

Maximum run-up height of 1993 Hokkaido-Nansei-Oki tsunami is 31.7m at Monai coast in Okushiri Island, which is the highest record in 20th century. The Monai coast has small curved pocket beach (200m long) with small valley at left side. We have succeeded experiment to reproduce tsunami run-up distribution with maximum record

by Large Wave Flume, which is 205m long, 3.4m wide, 6m depth. The scale is 1/400. Input Wave data is calculated by numerical simulation results including source area. This experimental result shows the distribution of tsunami run-up surveyed at Monai. That is, the averaged value of run-up height along pocket beach is 20m, but in the valley the maximum is over 30m. . The run-up distribution and maximum tsunami height were caused by the peculiar topography consist of pocket beach and small valley.