Development of a Tsunami Observation and Prediction System at Hamaoka NPS : Performance Evaluation and Tsunami Prediction on Oceanographic Radar

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At Hamaoka Nuclear Power Station, we are developing a "tsunami monitoring system" that observes and predicts a tsunami figure. In the system, a tsunami is monitored using real time data observed offshore, the height and the arrival time at Hamaoka NPS are predicted. With regard to tsunami monitoring technology, we focused on DONET (Dense Oceanfloor Network system for Earthquake and Tsunamis) and GPS buoy system to obtain data from external organizations such as the government. Currently these data are obtained in real time, and the tsunami monitoring prototype system was constructed in FY 2016 and we are testing its operation. In addition, we decided to independently observe the tsunami, and installed an oceanographic radar and a high sensitivity camera system. Now we are considering adding these to the prototype system.

Oceanographic radar transmit radio waves towards the sea surface and utilizes its reflected radio waves to observe the flow velocity of the sea surface in a wide range. However, in the case of one radar station, the flow velocity in and out from the beam direction can be radially obtained. At Hamaoka NPS, one station of oceanographic radar (HF radar, shorten one observation time to only one minute) is installed on the roof of Unit 5. The maximum observation distance is 60 km, while the distance for practical use is about 40 km. If the observation time is shortened, it is likely to be affected by noise and the detection accuracy of the flow velocity may be lowered, and the magnitude of the flow velocity generated by the tsunami depends on the scale of the tsunami and the depth of the sea.

In actual operation of oceanographic radar, it is important to evaluate the possibility of tsunami detection and examine the furthest detection distance. For this purpose, the virtual tsunami observation experiment, which superimposes the flow velocity data of the numerical analysis result and the flow velocity data of the actual observation at the signal level, is effective. We targeted Level 1 tsunami (Ansei-Tokai tsunami) and Level 2 tsunami (Nankai trough tsunami model case 1 by the Cabinet Office), and we visually confirmed the propagation of the tsunami from near the trough axis. Regarding verification of the furthest detection distance, we used two methods, two points correlation and VR (Variance Reduction) index, and the cases where the observation time was changed to 1, 2 and 4 minutes were also examined. In this area, we can detect high accuracy with east side beam for one minute or two minutes observation, the furthest detection distance is slightly smaller for level 1 tsunami, but it was over 30 km or so.

There is no established method to predict tsunami figure using observation data by oceanographic radar. In this study, we investigated the inversion analysis, taking advantage of the feature that it is possible to obtain data planarly and widely with oceanographic radar. In the linear superposition method, it was possible to predict the height of the tsunami with a good accuracy, but the prediction of the arrival time

tended to be delayed. As a solution, we performed a forward analysis to predict from the initial sea level rise distribution by nonlinear analysis, and the accuracy was improved in arrival time. Since it takes a lot of time, it’ s necessary to consider hardware and software for real time prediction systems.

Keywords: tsunami, real time prediction, oceanographic radar, virtual tsunami observation experiment, inversion analysis