The amount of crack growth must be evaluated when a crack is found in any component important for plant safety. However, an evaluation method for crack growth during seismic loading has not been explicitly stipulated in codes and standards. In recent years, Japanese nuclear power plants have experienced multiple large earthquakes, such as the Niigata-ken Chuetsu-Oki earthquake in 2007 and the Great East Japan Earthquake in 2011. For such large earthquakes that exceed the design basis seismic loading, an appropriate method is required to predict the crack growth behavior. The amount of crack growth can be evaluated using the stress intensity factor range ($\Delta K$). However, $\Delta K$ is inappropriate for the high level of loading in the case of large earthquakes. Therefore, we have studied an evaluation method for crack growth during large earthquakes, which is shown in Fig.5-10: the method is based on the J-integral range ($\Delta J$), which is applicable for a high level of loading.

At first, crack growth rate tests were performed to understand the crack growth behavior under large-amplitude cyclic loading. It was confirmed from the results that $\Delta J$ should be used instead of $\Delta K$ to evaluate the crack growth.

Next, crack growth tests were performed with cyclic loads. The load amplitude was changed stepwise, as shown in Fig.5-11. When the amplitude was increased, the crack growth rate could be predicted from the results of constant amplitude loading. In contrast, it can be seen from Fig.5-11 that the crack growth rate decreased immediately after the amplitude was decreased, and it recovered when the crack had grown to some extent. The retardation effect was also confirmed for another combination of material and load amplitude.

**Reference**