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Fuel Rod Mechanical Performance Under Dynamic Load Condition on High Burn-up Spent Fuel of BWR and PWR

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For the assessment of high burn-up spent fuel integrity in the case of a drop accident, mechanical performance of cladding and fuel rod under the dynamic load condition were examined using high burn-up spent fuels; BWR fuel rods (56GWd/t, Zry-2/Zr liner cladding) and PWR fuel rods (52-55GWd/t, MDA cladding).
In order to acquire dynamic mechanical properties of BWR and PWR fuel cladding, dynamic tensile tests (strain rate : up to 10^2 s^{-1}) using cladding coupon specimens have been performed to obtain axial tensile strength and elongation, and dynamic ring compression tests (compression speed : up to 4000 mm/s) have been performed to obtain ring compressive strength and failure flattening ratio.
In order to evaluate the dynamic behavior of BWR fuel rod, axial and lateral dynamic load impact tests using partial fuel rod specimen have been performed to obtain the threshold of fuel rod failure. After the tests, fracture area and surface were examined by metallography and SEM observation, and weight and particle size distribution of dispersed pellets were measured to evaluate the dispersed pellet characteristics.
In case of the maximum axial load of 60kN in axial impact test, not local bending (axial buckling) failure but shearing failure occurred, and spark was observed at the breakage by high speed camera record. From metallography and SEM observation, it was presumed that shearing deformation occurred diagonally to axial direction and the crack was spirally progressed and the fuel rod was broken.
The amount of dispersed pellet at the breakage by axial and lateral dynamic load impact tests was equivalent to approximately two to three pellets and about 40 to 60% of those were very fine powder.
In lateral impact tests (the dynamic ring compression test using cladding and the dynamic lateral load impact test using fuel rod), different failure mode was observed between “without” and “with” pellets. The failure flattening ratio of fuel rod with pellets was smaller than that of cladding without pellets.Axial and lateral dynamic load impact tests for PWR fuel rods will be performed in 2012 and 2013, and a part of result of those tests will also be reported.