Abstract 2009-08-12/ Lennart Agrenius

Burnup Credit in the Canister for Final Disposal of Spent Nuclear Fuel

In the planned Swedish repository for disposal of spent nuclear fuel the fuel assemblies will be placed in disposal canisters made of cast iron and copper.

A canister consists of an insert of cast iron with a diameter of 949 mm with a 49 mm thick outer shell of copper. The outside diameter of a canister is 1050 mm. In the BWR-insert twelve storage compartments are formed with the inner measures of 160 mm x 160 mm. In the PWR-insert there are four storage compartments are formed with the inner measures of 235 mm x 235 mm.

Calculations show that the effective neutron multiplication factor exceeds 0.95 if fresh fuel is assumed. In order to meet the criticality criterion burnup credit has to be used.

Burnup requirements for the fuel were developed for the limiting fuel types taking into account uncertainties and other effects:

Material compositions
Position of fuel assemblies in the canister
Dependence on temperature
Effect of integral burnable poison
Effect of burnable poison rods
Uncertainty in declared burnup

Axial temperature distribution
Axial burnup distribution (end effect)
Control rod history
Horizontal burnup distribution

Calculational uncertainty
Uncertainty in isotopic prediction

Demolition of fuel assemblies

Manufacturing tolerances
Long term reactivity change

Change in geometry due to burnup
Defects in the canister

The study shows that burnup credit is an acceptable way to control the reactivity in the disposal canisters for BWR- and PWR-fuel using a minimum set of nuclides, actinides only. If selected fission products also are credited more margin is achieved.