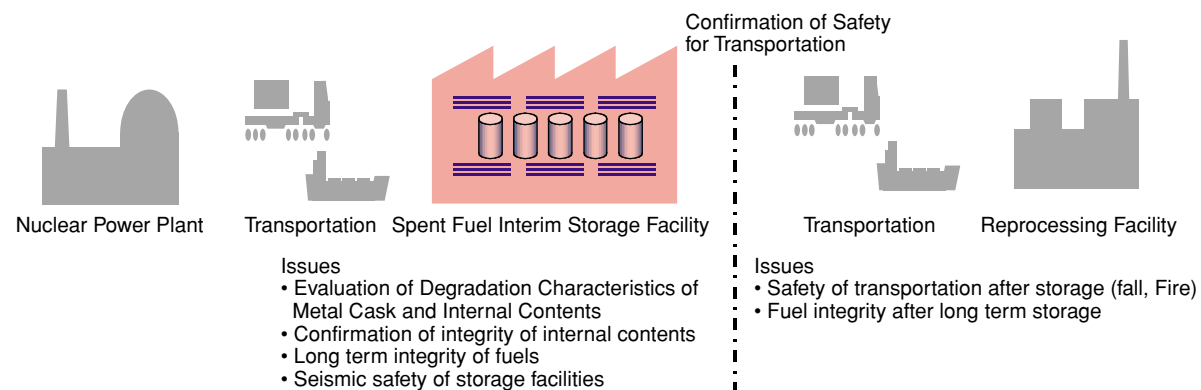


Technical study of interim storage facilities storing spentfuel (1)

Interim Storage of Spent Fuel

Background

- Considering the storage capacity of spent fuels in nuclear power plants, the prospective of future quantity of spent fuels and the processing capacity of the reprocessing facility now under construction, it is desirable that interim storage facilities storing spent fuels outside nuclear power plants are to be realized by 2010.
- The interim storage method in Japan is a metal cask type at the initial period, and it is necessary to confirm the safety functions (tight seal, shielding, prevention of criticality and heat removal,) of the metal cask for long term period from transportation before storage to transportation after storage including the interim storage period of 40 to 60 years. Since the lid of the metal cask will not be opened during this period and there is little experience on long term storage of spent fuels in the metal cask, the degradation characteristics of the metal cask and internal contents including spent fuels are to be understood in order to clarify the long term integrity of the metal cask and internal contents including spent fuels, and the safety assurance during transportation. In addition, it is also necessary to establish confirmation methods for the integrity of internal contents without opening the lid of the metal cask before the transportation after storage. Since interim storage facilities are likely to be built on the quaternary deposit, it is also required to confirm their seismic safety from this point.



Research to Confirm Safety of Interim Storage

Research on integrity of metal cask and internal contents

- So as to evaluate the degradation characteristics of the metal cask and internal contents in storage, SCC characteristics and corrosion test of the metal of a main body and aluminum alloy under the simulated condition of internal conditions, thermal aging and creep test of aluminum alloy, degradation characteristics test of neutron shield material due to heat and irradiation and degradation characteristics test of metal gasket due to heat were conducted. And, the inspection method to confirm the integrity of internal contents was studied.
- In order to verify the effect of the safety at the transportation after storage, the drop test of a mock up cask was carried out, assuming of the degradation of metal gasket and a fire test was also implemented. And these analysis methods were verified by using the results of these tests.

Spent Fuel Integrity Test for Long Term Dry Storage

- The creep tests were performed to verify the spent fuel integrity during storage and at a time of transportation after long term storage and its results were reflected on safety analysis codes.

Research on Seismic Safety of Storage Facilities

- For the establishment of seismic safety evaluation methodologies and the improvement of safety analysis codes for a storage facility, the test using a scaled model of pile foundation was conducted. Evaluation methods of soil properties, earthquake ground motion and stability of foundation ground at the quaternary deposit were established.

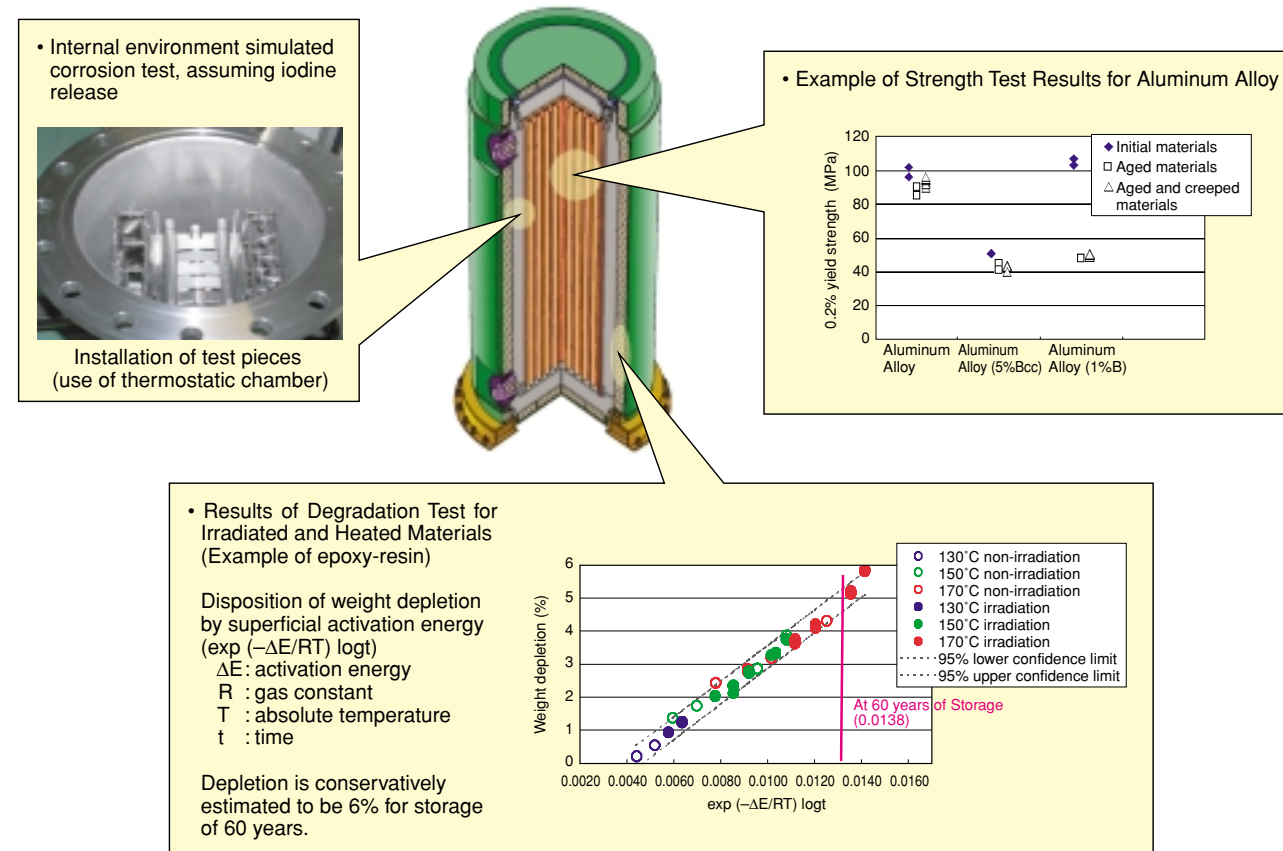
Research on Integrity of Metal Cask and Internal Contents

Evaluations of Degradation Characteristics during Storage by Elements Test

The following findings were obtained from the results of elements tests conducted to evaluate the degradation characteristics of the metal cask and internal contents during storage.

- SCC characteristics and corrosion rate of metal of a main body and aluminum alloy under the simulated internal environment, assuming the iodine release.
- Strength data of thermal-aged aluminum alloy and crept material (It was confirmed that the strength degradation of crept material is nearly same compared to aged material)
- Degradation characteristics of neutron shielding materials due to heat and irradiation (depletion characteristics of resin and water weight of propylene glycol)
- Evaluation of heat effect on degradation characteristics of metal gaskets

And, a study on inspection methods in order to confirm the integrity of internal contents was conducted.



Full Scale Drop Test (simulation of degraded metal gasket)

- Tight sealing capability when dropped was confirmed.
- The analytical methodology by non-linear dynamic impact for dynamic behavior of seal boundary was developed.



Fire Simulation Test with the same condition as actual cask (simulation of degraded metal gasket)

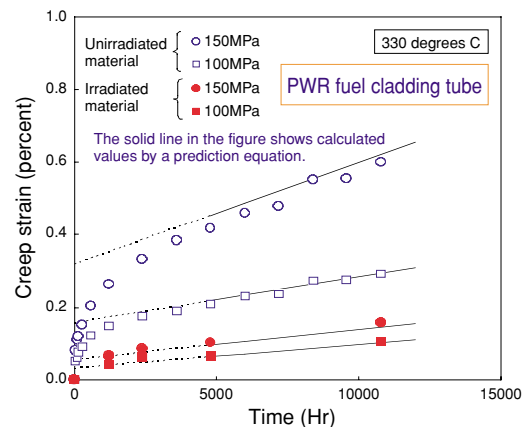
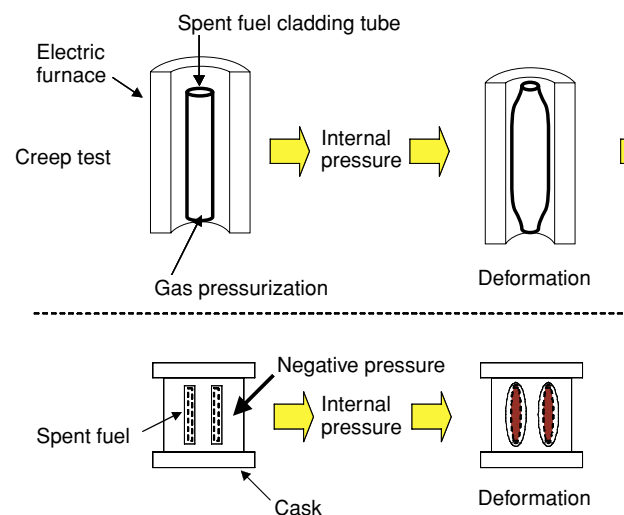
- Sealing capability at a fire was confirmed
- Thermal deformation was evaluated analytically.

Technical study of interim storage facilities storing spentfuel (2)

Spent Fuel Integrity Test for Long Term Dry Storage

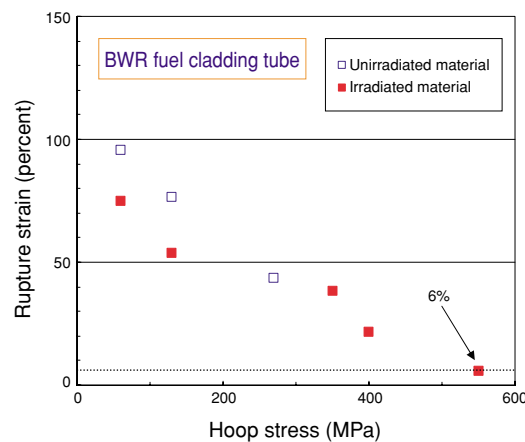
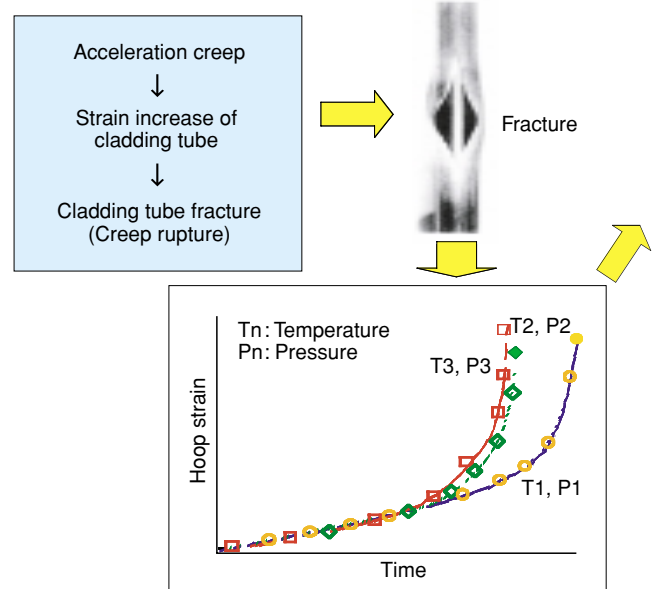
From the tests performed for spent fuels with 48 GWd/t for PWR and 50 GWd/t for BWR, data to formulate creep characteristics of spent fuel cladding tube and set creep strain criteria were acquired.

Creep Test of Spent Fuel Cladding Tube



The creep strain data were acquired to a maximum time of 10,000 hours under various temperature and stress conditions. The creep equations were expressed as functions of temperature, stress and time and the equation was reflected on safety analysis codes for crosschecking.

Tube Creep Rupture of Test Spent Fuel Cladding



The creep rupture tests were performed under various temperature and stress conditions. It is confirmed that rupture strain is larger than 1% under all test conditions, and the adequacy of 1% criteria, which is the guideline of the current technical criteria, was verified.

Reflection on safety analysis codes

The developed creep equation is reflected on improvement of safety analysis codes used for crosschecking in the Safety Review of an interim storage facility.

Research on Seismic Safety of Storage Facilities

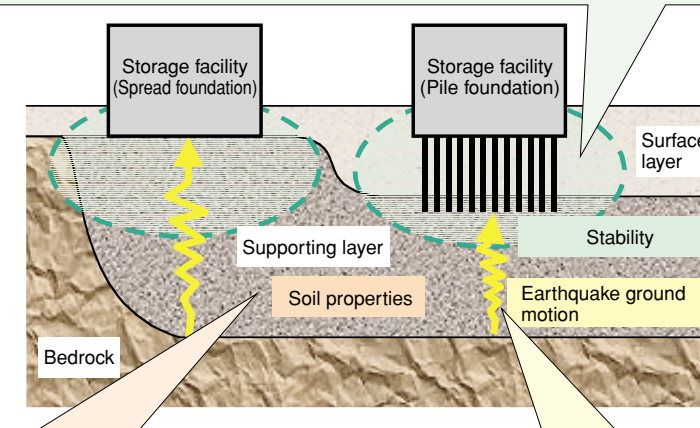
Issues on seismic safety of a storage facility

Storage facilities are likely to be built on the quaternary deposit. Considering seismically different conditions from NPP's, following three important issues were studied to establish evaluation methodologies.

Stability Evaluation Method of Pile Foundation

From the shaking table test using a scaled model of pile foundation and the ground, stability analysis methods were verified and the seismic stability evaluation method of foundation ground of a storage facility on the quaternary deposit was established.

Shaking table test using a large-scale model of pile foundation



Evaluation method of Soil properties

The evaluation method for liquefaction resistance of gravelly soils was developed with newly acquired data on liquefaction resistance of gravelly soils along with previous data.

Evaluation method of earthquake ground motion

Based on the seismic observation data in the quaternary deposit, an evaluation method of the average earthquake ground motion on the surface of the quaternary deposit was established.

Reflection on safety analysis codes

Acquired data and the developed evaluation methodologies are reflected on improvement of safety analysis codes for crosschecking in the Safety Review of an interim storage facility.