

LONG-TERM STORAGE OF SPENT FUEL IN JAPAN - RESEARCH PERSPECTIVE -

PATRAM 2010

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INTRODUCTION

- In Japan, spent fuel shall be stored for 40 to 60 years until reprocessing.
- What knowledge has been accumulated on long-term integrity of the metal cask and the internals?
- How can we secure transport safety of the metal casks and the internals for pre-shipment inspection after interim storage ?

LONG- TERM INTEGRITY OF SF AND ITS INSPECTION METHOD (1)

- Deterioration by chemical factor
 1. Dryness of the cask cavity, inert gas filled in the cavity, and confinement of the cask shall conform to the design conditions when the spent fuel is installed at reactor.
 2. Measurement of pressure between two lids of the cask shall not show any abnormality during the storage period.

LONG- TERM INTEGRITY OF SF AND ITS INSPECTION METHOD (2)

○ Deterioration by thermal factor

1. Heat removal function of the cask shall conform to the design conditions when it was manufactured at factory.
2. There shall not be any abnormality (in SF integrity, burnups, etc.) in the reactor core, cooling state in the reactor pool, loading record of SF installation in the cask (including vacuum drying process), and surface temp. of the cask when the SF was installed.
3. There shall not be any abnormality in the cask surface temp. during the storage period.

LONG- TERM INTEGRITY OF SF AND ITS INSPECTION METHOD (3)

- Deterioration by mechanical factor
 1. SF shall be integral and no external force to damage the integrity is loaded when the SF was installed in the cask.
 2. The SF shall not receive any external force to damage the integrity during transport.
 3. The cask shall not receive any external force which exceeds the design condition, abnormal damage, nor deformation to the cask surface during the storage period.

LONG- TERM INTEGRITY OF SF AND ITS INSPECTION METHOD (4)

○ Deterioration by irradiation

1. SF will not be damaged by irradiation during the storage period. However, by way of precaution, it shall be confirmed that the irradiation is not abnormally large to the SF.
2. Inspection to confirm the above is made by measurement of radiation dose at and 1 m apart from the cask surface.

LONG-TERM INTEGRITY OF DUAL PURPOSE METAL CASK AND ITS INSPECTION METHOD (1)

Cask body (shell, bottom plate, neutron shielding material, etc.)

- There was no abnormal appearance when SF was installed at reactor.
- There was no abnormal external force to the cask during transport.
- There was no abnormal damage, deformation, external radiation, and surface temperature of the cask during storage.

LONG-TERM INTEGRITY OF DUAL PURPOSE METAL CASK AND ITS INSPECTION METHOD (2)

Basket

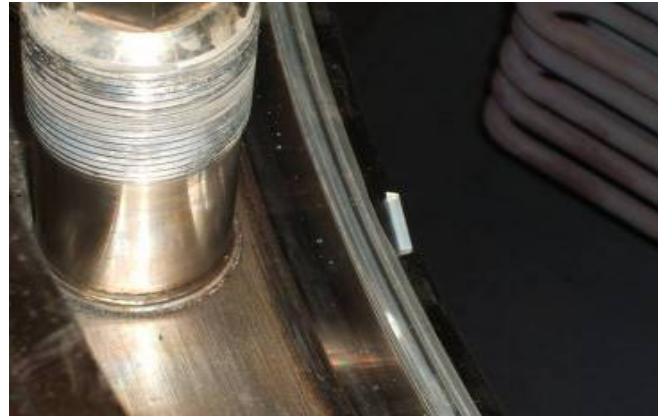
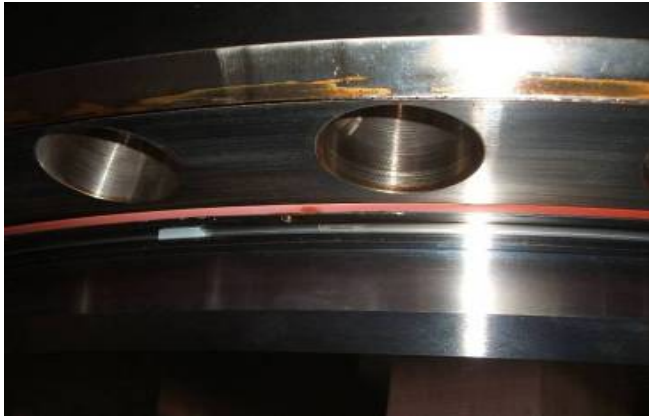
- Basket in the cask is to secure geometrical layout between spent fuel assemblies so as to install SF safely and keep sub-criticality.
- The basket was designed and manufactured in order to secure structural integrity.
- There was no abnormal appearance when SF was installed at reactor.
- There was no abnormal external force to the basket during transport.

LONG-TERM INTEGRITY OF DUAL PURPOSE METAL CASK AND ITS INSPECTION METHOD (3)

Cask lid

- The cask lid is to confine internals in the cask and to maintain the inert environment. The cask shall be designed to secure the containment function **taking account of the ageing effect.**
- The state of vacuum dry, being filled with inert gas, and containment shall conform to the design conditions, and residual water in the primary lid area shall be adequately removed when the SF was installed in the cask **at reactor.**
- There were no abnormal measurements on the pressure between lids **during storage.**

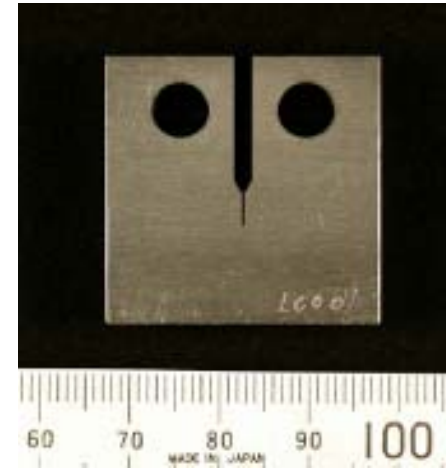
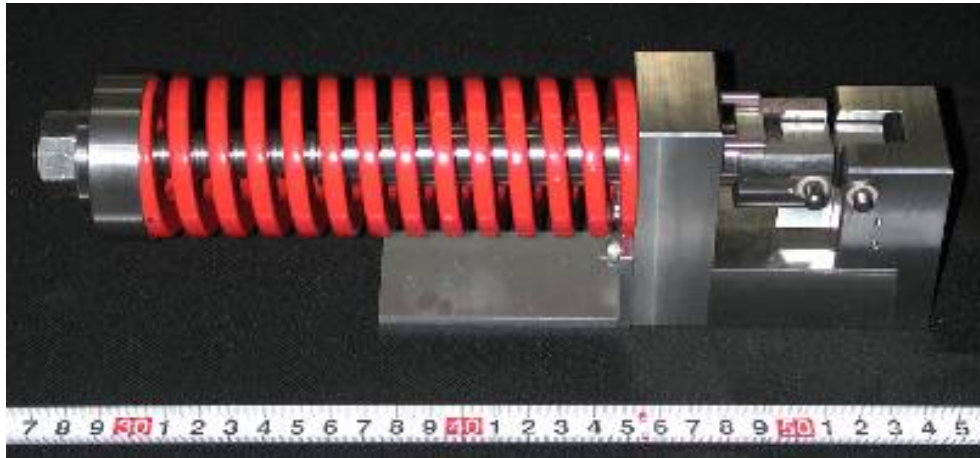
RESEARCH ON LONG-TERM INTEGRITY OF METAL GASKET



Example of Aging Inspection

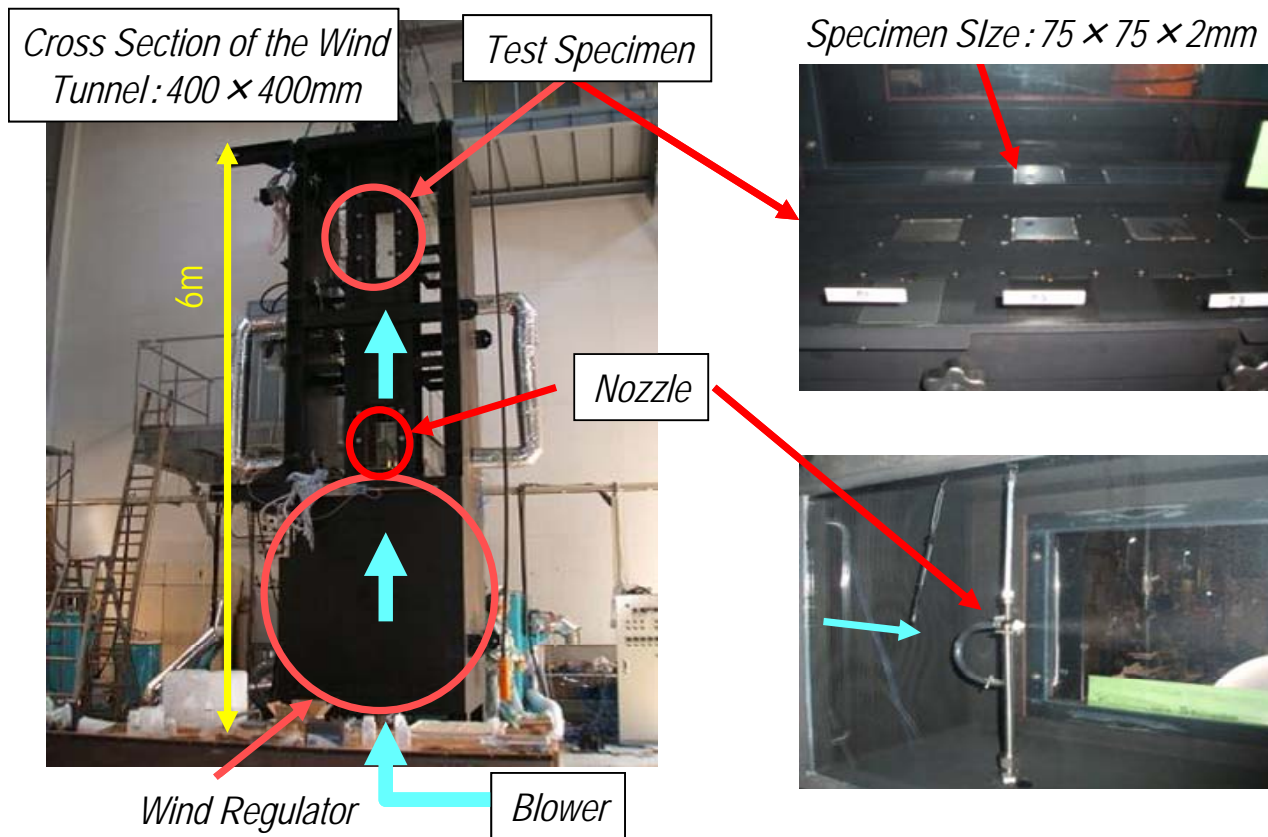
RESEARCH ON LONG-TERM INTEGRITY OF SF CANISTER

○ Corrosion and Crack Growth Test



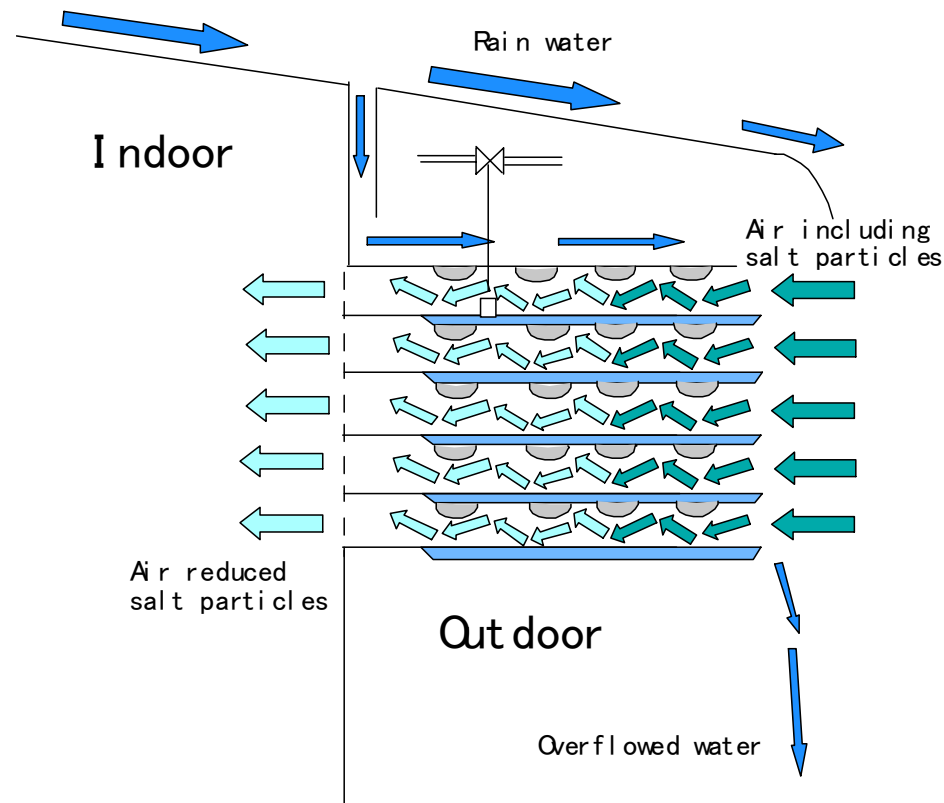
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○ Chloride Deposition Velocity Test



RESEARCH ON LONG-TERM INTEGRITY OF SF CANISTER

○ Salt Particle Collection Test

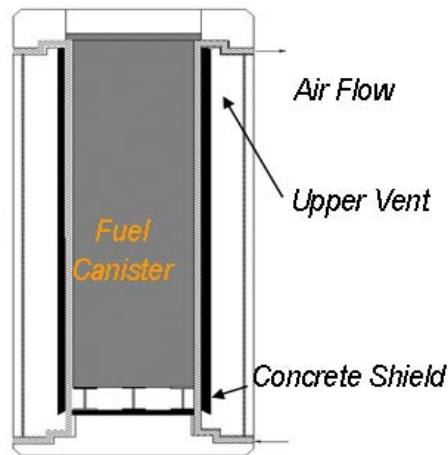


RESEARCH ON LONG-TERM INTEGRITY OF SF CANISTER

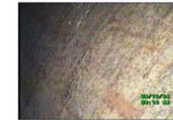
○ Canister Surface Inspection Test



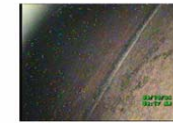
(at INL, 2004. Dec.)



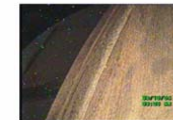
① Annulus top



② MPC top



③ MPC middle



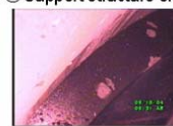
④ MPC bottom



⑥ Support structure plate



⑦ Support structure side



⑧ Annulus air inlet

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CONCLUSIONS

- Long-term integrity of SF and metal cask, and their inspection methods for pre-shipment inspection after long-term storage were investigated and established.
- The first interim storage facility using dual purpose metal cask in Japan was licensed and being constructed for the operation in 2012.
- Research on long-term containment of metal gasket demonstrated its performance for more than 60 years.
- Long-term integrity of candidate canister materials showed a superior SCC resistance.