Outline of Design Approval for Nuclear Fuel Transport Package using Type JRF-90Y-950K Transport Container

■ Outline

This transport container has been used to transport new fuels for research reactors from France and other countries since 1991 (the oldest one was manufactured in 1991), and to transport low-irradiated fuels to the U.S., while taking necessary licensing procedures such as having periodically renewed the approval period and having applied for approval amendment for addition of contents (spent fuel).

With domestic adoption of the 2018 edition of IAEA's "Regulations for the Safe Transport of Radioactive Material," the regulations including those known for Off-site Transport Regulations were revised on January 1, 2021 to add considerations of aging during storage of transport containers and during use of nuclear fuel transport package (status with contents loaded in a transport container). In accordance with this revision, we have decided to add a description of the results of considerations and evaluations of aging in the attachment which explains safety (an item to be described in an attachment) and to delete the registered contents which will not be transported in future and apply for the registration. In addition, it was decided that this application was to be submitted as a new application (application for design approval) in accordance with the guidance from the Nuclear Regulation Authority.

The deletion of registered contents and the aging effects do not need to be considered in confirming compliance with the technical criteria, and therefore the results of these safety analyses (structural analysis, thermal analysis, sealing analysis, shielding analysis, and criticality analysis) remain unchanged.

1. Deletion of registered contents without a plan of transportation in the future

<table>
<tr><th colspan="2">Current Contents (16 types)</th><th colspan="2">Contents in Future (8 types)</th><th>Largest among Contents</th></tr>
<tr><td colspan="2">JRR-3 Standard Fuel Element (LEU fuel)</td><td colspan="2">JRR-3 Standard Fuel Element (LEU fuel)</td><td></td></tr>
<tr><td colspan="2">JRR-3 Follower Type Fuel Element (LEU fuel)</td><td colspan="2">JRR-3 Follower Type Fuel Element (LEU fuel)</td><td></td></tr>
<tr><td colspan="2">JRR-4B Type Fuel Element (HEU fuel)</td><td colspan="2">Deleted</td><td></td></tr>
<tr><td colspan="2">JRR-4L Type Fuel Element (LEU fuel)</td><td colspan="2">Deleted</td><td>◎ Aluminium data in the shielding analysis</td></tr>
<tr><td colspan="2">JRR-4 Fuel Element (LEU fuel)</td><td colspan="2">Deleted</td><td></td></tr>
<tr><td colspan="2">JMTR Standard Fuel Element (LEU Fuel)</td><td colspan="2">JMTR Standard Fuel Element (LEU Fuel)</td><td></td></tr>
<tr><td colspan="2">JMTR Fuel Follower (LEU Fuel)</td><td colspan="2">JMTR Fuel Follower (LEU Fuel)</td><td></td></tr>
<tr><td rowspan="2">JMTRC Standard Fuel Element (HEU Fuel)</td><td>Type A, B, C</td><td rowspan="2">JMTRC Standard Fuel Element (HEU Fuel)</td><td>Deleted</td><td></td></tr>
<tr><td>Pin Fixing Type B, C</td><td>Deleted</td><td></td></tr>
</table>

JMTRC Special Fuel Element (HEU Fuel)	Special Type A	JMTRC Special Fuel Element (HEU Fuel)	Special Type A	
	Special Type B		Deleted	
	Special Type C, D		Deleted	● Containment analysis
JMTRC Fuel Follower (HEU Fuel)		Deleted		
JMTRC Standard Fuel Element (MEU Fuel)		JMTRC Standard Fuel Element (MEU Fuel)		
JMTRC Special Fuel Element (MEU Fuel)		JMTRC Special Fuel Element (MEU Fuel)		
JMTRC Fuel Follower (MEU Fuel)		JMTRC Fuel Follower (MEU Fuel)		

◎ Though the registration as contents is deleted, parameter values of the fuel element used in the safety analysis are used as conservative design values.

● The registration as a content is deleted. The parameter values of the fuel element used in the safety analysis are taken from those of the JMTRC special fuel element (MEU fuel) and a recalculation has been performed.

2. Considerations of Aging of Nuclear Fuel Transport Package

In order to reflect the revisions of "Rules on Transporting Nuclear Fuel Materials etc. outside the Plant or Place of Business" and "Notice on the Details of Technical Standards for Transport of Nuclear Fuel Materials etc. outside the Plant or Place of Business" (for those effective by January 1, 2021), an evaluation of the assumed usage conditions during the service life and the subsequent aging was conducted and the results are described in "(II)−F. Considerations of Aging of Nuclear Fuel Transport Package" in Appendix-1.

With regard to aging, an evaluation was conducted based on the assumptions of a 60-year service life, usage frequency of three times a year for a transport container, and transportation time of 100 days at the maximum per transportation.

Aging factors considered for this transport container were heat, radiation, chemical changes, and fatigue due to repetitive loads, while materials considered for aging were stainless steel, [redacted], and [redacted].

- For materials used for the components of a transport container (stainless steel, [redacted], and [redacted]), assuming that transport packages are used 300 days per year for 60 years, even with a conservative assumption that all neutrons emitted are concentrated in an area of 1 cm^2 on a component of a transport container, the neutron irradiation dose and the absorbed dose are estimated to be in the order of 10^{11} n/cm^2 and 10^2 Gy respectively, which are lower than the irradiation dose in the order of 10^{16} n/cm^2 and the absorbed dose of 10^5 Gy, which are expected to potentially affect the mechanical properties. Therefore, there is no impact due to neutron irradiation.
- The temperature of the components of a transport container during transportation is assumed

to be 65°C at the maximum, so there is no risk of affecting the material strength of stainless steel and [redacted] or the thermal insulation function of [redacted], therefore there is no thermal impact.

- Among the materials used for the components of a transport container, the parts exposed to the air are made of stainless steel which forms a passive film on its surface and corrosion does not progress easily on it, with an estimated corrosion depth of approximately 60 μm for the expected service life, so there is no effect on the structural strength. In addition, the conditions will be checked by a visual examination or others, and they will be repaired if necessary. Also, because [redacted] are in a sealed space covered with stainless steel and there is no risk of corrosion etc., there is no impact due to chemical changes.
- It is assumed that the stainless steel used for the inner container body and the inner container lid will be subject to changes in internal pressure during transportation, while the stainless steel used for the lifting fittings will be subject to repetitive loads during handling through the expected service life. As a result of the calculation of the allowable number of repetitions for these loads, the allowable number of repetitions is well above the estimated total number of uses. Therefore, there is no impact due to repetitive loads.

3. Miscellaneous

Numbers of figures, tables and pages were modified as some of the registered contents were deleted.