1–17 Management of Removed Fuel Debris

— A Study of Treatment Scenarios for Fuel Debris after Removal —

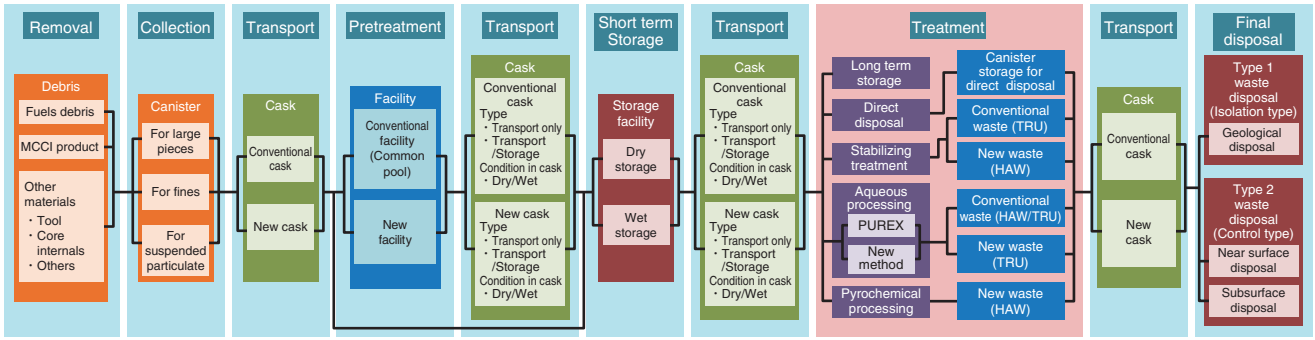

Fig.1-36 Complete scenario ideas from the removal of fuel debris to final disposal
Various options exist from removal to final disposal.

Table 1-2 Characteristics of each treatment scenario idea
The treatment scenario concepts based on several assumed methods are prioritized based on the extent to which they use existing technology.

	Long term storage	Direct disposal	Stabilizing treatment	Aqueous processing		Pyrochemical processing
				PUREX	New method	
Definition	Storage until disposal strategies are defined	Simple treatment for final disposal without U/Pu recovery	Stabilizing treatment for final disposal without U/Pu recovery	Present treatment for final disposal with positive U/Pu recovery		
Base technology	Intermediate storage of spent fuel	Direct disposal of spent fuel	Solidification of high-level waste	Aqueous reprocessing (PUREX)		Pyrochemical reprocessing (Metal electro-refining)
Outline	• Use simple treatment • Store it after selecting a suitable method from among TMI-2 experiences and short-term storage methods • Basically postpone the final disposal	• Use simple treatment • Geological disposal after storage until the decision on the final disposal site is made • Dispose as just spent fuel was removed or by adding some treatment to it	• Use simple treatment • Stabilize the waste to reduce its leaching rate assuming it is vitrified • Avoid dissolution to reduce the generation of secondary waste	Convert into a manageable form of waste based on existing disposal classification when possible		
				• Use simple processing with technical feasibility • Recover only nuclear material that can be recovered easily	Give priority to the recovery of nuclear material and to the reduction of radioactivity in waste	

The removal of fuel debris from the TEPCO's Fukushima Daiichi NPS is scheduled to begin around 2020. Treatment (processing and disposal) methods for the removed fuel debris are expected to be finalized during the 20–25 year period following December 2011, when the emission of radioactive material and its radiation dose were confirmed to have been significantly inhibited. Therefore, it is necessary to consider an approach of comparative scenario evaluation and obtain fundamental information for selecting treatment methods by the beginning of the removal. In this study, the characteristics and technological problems of each treatment scenario were extracted and put in order, in preparation for comparative scenario evaluation in the future.

Several scenarios for the removal and disposal of fuel debris are shown in Fig.1-36. Among these scenarios, "Treatment" is regarded as a pre-processing step toward the manufacturing of a stable waste form for final disposal.

The selection of treatment methods was implemented for the following policies (Table 1-2).

(1) Storage until disposal strategies are defined
(2) Simple treatment for final disposal without U/Pu recovery
(3) Stabilizing treatment for final disposal without U/Pu recovery
(4) Present treatment for final disposal with positive U/Pu recovery

Elemental technologies for each treatment scenario were evaluated in terms of economy, amount of nuclear waste, and technological difficulties, on the premise that they function in practice. Consequently, it has been found that long-term storage has more advantageous aspects than the other methods, both economically and technologically. Direct disposal, on the other hand, has been found to produce the least amount of waste.

In summary, long term storage and direct disposal are the most advantageous scenarios, though they have some technological problems. The stabilizing treatment, aqueous processing, and pyrochemical processing options are inferior to the rest in terms of economy and the amount of waste.

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Reference

Fuel Debris Conditioning Technology Development Group, Fukushima Project Team et al., Fuel Debris Characterization and Treatment Technologies Development for TEPCO's Fukushima Daiichi Nuclear Power Station –2012 Annual Research and Development Report–, JAEA-Review 2013-066, 2014, p.83-92 (in Japanese).