Summary of major responses to the RFI (classified into items and categories) [Topic 2 : Treatment of contaminated water]

Particularly-Requested Technologies for Contaminated Water Issues		Responses to the RFI			Trends of technical information in the responses	Expert Review Panel's comments
Items	Sub items	Categories	No.	key words		
(1) Requirements for tritium removal technologies	Separation technology with the experience of nuclear research	1)Water distillation	66, 261, 422, 486, 609, 685	Geothermal heat, Distillation under reduced pressure	For the tritium separation technology, proposals on improvements of separation techniques with experience of the nuclear field were received. In addition, those on separation techniques based on new ideas were received. Most of the proposals received focus on the CECE method. Among them, the separation of tritium is technically feasible; there is a specific proposal of research for the application to the Fukushima Daiichi. While, some indicate that there are challenges to be solved in terms of size and cost. In this RFI, as an approach to solve some of the challenges of existing technologies (water distillation method, electrolysis method, CECE method) , use of fuel cell and ceramic electrode, distillation under the reduced pressure, and improvement of catalysts to be used for the separation were proposed. Further, for the GS method whose implementations are postponed because of handling hazardous materials, proposals on using hydrochloric acid instead of hydrogen sulfide were received. In addition to these above, there are suggestions of separation techniques based on new concepts, for example, those using a difference in the freezing point between tritiated water and light water, and the like research method using a clathrate hydrate. There remain problems to be solved for any of the methods proposed. Further research and development are necessary for the practical application to Fukushima Daiichi.	From the international experience of the comprehensive evaluation carried out by OSPAR Commission of the EU, or European countries and US, tritium could be separated theoretically, but there is no practical separation technology on an industrial scale. Accordingly, a controlled environmental release is said to be the best way to treat low-tritium-concentration water. Although there are many proposals about tritium separation technologies, there is no innovative proposal that will significantly improve the separation performance of the CECE process which is, from the past knowledge and experience, the most promising system. When reviewing these technologies for the application to Fukushima Daiichi nuclear power plant, expected development time, size and cost, as well as risk of separation should be taken into account. Although many proposals were submitted, there was no proposal that showed an immediate applicability to Fukushima Daiichi nuclear power plant. On the other hand, it is important to keep collecting information on the updates of various technologies which are in the research phase.
		2)Electrolysis	30, 135, 137, 392	Fuel cell, Ceramic electrode, 3-chamber-type Electrolysis Cell		
		3)Combined electrolysis catalytic exchange (CECE)	251, 292, 298, 301, 326, 412, 446, 646, 738			
		4)Girdler-sulfide	194	Hydrochloric acid		
		5)Gas chromatograph	46, 200			
		6)Bithermal hydrogen-water	292, 298, 301			
		7)Laser	303			
		8)LPCE	263			
	Separation technology with the experience of other research	1)Freeze concentration	48, 204, 262, 355	Progressive freeze concentration		
		2)Nanotechnology	85, 101, 287	Nano-iron, Carbon nanotube		
		3)Hydrate	616	Clathrate hydrate		
		4)Adsorbent	17, 45, 57, 294, 511, 716, 727, 772	Lithium, Activated carbon, Zeolite		
		5)Specific gravity	34, 198, 322, 458, 482	Centrifugation, Still standing, Membrane of non-woven fabric		
		6)Other	3, 65, 270, 366	MRI, Electrolytic aggregation, Plasma, etc.		
(2) Requirements for treatment technologies	Storage	1)Adsorption	57, 629		In regards to storing tritium-contained water, we received many proposals on solidification, such by plaster, gelling and freezing. In addition, much information regarding the environmental release was submitted. Diluted release to the ocean is approved internationally, and it is said that the method achieves many results. In regards to dilution, we received some specific measures, such as use of the existing plants (1F5&6, 2F), and the dilution with rainwater or groundwater. In regards to the atmosphere release, we received proposals such as using the natural evaporation, geothermal utilization, and the existing waste treatment systems. In regards to underground, the isolation from the living environment until tritium is sufficiently attenuated is mentioned as a benefit; however, understanding the underground structure is a challenge. Other proposals were about degradation and disappearance.	In order to store condensed tritiated water stably and for a long term after separation, the impact of radiolysis and Helium gas generated by the decay of tritium should be taken into account. There was no proposal that included those considerations. Moreover, since the impact of possible leak becomes larger than before the concentration, the storage of condensed triturated water must be judged carefully including the advisability of separation. Environmental release (mainly diluted discharge to the ocean) of tritiated water at a value less than the authorized limit has been carried out at nuclear facilities in and outside Japan. This method is high in technical implementability, and the risk is small to the environment. When the application of environmental release to Fukushima Daiichi is investigated, utmost consideration for prevention of a damage caused by rumors, and sufficient explanation to stakeholders are required.
		2)Solidification	35, 44, 56, 129, 160, 183, 365, 491, 518, 730	Freezing, Plaster, Resin, Ettringite, Bentonite, Gelatification, Geopolymer		
		3)Hydrate	589			
	Environmental release and related technologies	1)Ocean	114, 148, 149, 338, 389, 392, 401, 524, 541	Use of existing facilities, Well water, Seawater		
		2)Atmosphere	66, 252, 338, 453, 460, 477, 510, 541, 738	Geothermal heat, Natural evaporation, Evaporator		
		3)Underground	153, 338, 367, 427			
	Degradation and Disappearance	1)Nuclear transmutation	9, 59, 149, 168, 211, 271, 316, 396, 449	Nano-silver, Electromagnetic wave, Cold fusion, HHO gas, Brown gas		
		2)Chemical reaction	70, 190, 218, 780	Sulfuric acid, Photocatalyst, Microbubble		
		3)Biological treatment	40, 98, 583	Bioaccumulation, Microorganism		
	Other	Monitoring, etc.	47, 218, 573, 660, 754	Monitoring, etc.		
(3) Comprehensive evaluation	Recommendations		338, 369, 401, 526, 643, 748, 762, 769	Technologies and Systems, Behavior of Tritium, An environmental impact, The proposal about comprehensive evaluation such as risks.	We received proposals and support opinions from many organizations in Japan and overseas pointing out that an overall evaluation should be made for tritiated water. From Atomic Energy Society of Japan, statements were issued for risk and effectiveness of isotope separation method, and matters that must be noted when selecting the environmental release. It was pointed out that there should be a comprehensive evaluation of the following matters. -Leakage risk of storing the tritiated water as is. -Risk of explosion and leakage in the separation work of tritiated water. -Leakage risk of long-term storage of concentrated tritium water. -Reputational damage and impact on the environment for the case of environmental release.	In this request of technical information, there are many opinions and proposals suggesting that comprehensive evaluation on handling of tritiated water should be performed. Now that there is a risk of keeping the tritiated water in large quantities that exceeds the concentration limit, a comprehensive evaluation on handling of tritiated water should be started immediately together with stakeholders, by sharing international knowledge and experience. In the comprehensive evaluation, not only the applicability of separation and the technology of long-term storage of tritiated water, but also risks including natural disasters, and keeping it with the present condition should be taken into consideration. Specific techniques and risks including a damage caused by rumors in the case of performing environmental release should also be evaluated.
	Proposal of tools and services		321, 337, 383, 452, 732, 758	Environmental impact assessment tool, the evaluation model, etc.		

＊This is provisional translation