Nuclear Disaster

Comparison of Estimated Amounts of Released Radionuclides between Chernobyl and Fukushima Daiichi NPS Accidents

Nuclides	Half-life[a]	Boiling point[b] ℃	Melting point ℃	Release into the environment: PBq*		Fukushima Daiichi/ Chernobyl
				Chernobyl[d]	Fukushima Daiichi[e]	
Xenon (Xe)-133	5 days	-108	-112	6500	11000	1.69
Iodine (I)-131	**8 days**	**184**	**114**	**～1760**	**160**	**0.09**
Cesium (Cs)-134	**2 years**	**678**	**28**	**～47**	**18**	**0.38**
Cesium (Cs)-137	**30 years**	**678**	**28**	**～85**	**15**	**0.18**
Strontium (Sr)-90	29 years	1380	769	～10	0.14	0.01
Plutonium (Pu)-238	88 years	3235	640	1.5×10^{-2}	1.9×10^{-5}	0.0012
Plutonium (Pu)-239	24100 years	3235	640	1.3×10^{-2}	3.2×10^{-6}	0.00024
Plutonium (Pu)-240	6540 years	3235	640	1.8×10^{-2}	3.2×10^{-6}	0.00018

Ratio of radionuclides accumulated in the reactor core at the time of the accidents that were released into the environment

Nuclides	Chernobyl[f]	Fukushima Daiichi[g]
Xenon (Xe)-133	Nearly 100%	Approx. 60%
Iodine (I)-131	Approx. 50%	Approx. 2-8%
Cesium (Cs)-137	Approx. 30%	Approx. 1-3%

*PBq equals 1015Bq.

Sources: a: ICRP Publication 72 (1996); b and c (except for Np and Cm): Rikagaku Jiten 5th edition (1998); d: UNSCEAR 2008 Report, Scientific Annexes C, D and E; e: Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety (June 2011); f: UNSCEAR 2000 Report, ANNEX J; g: UNSCEAR 2013 Report, ANNEX A

This table shows a comparison between major radioactive materials released into the environment due to the Chernobyl accident and the Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS accident.

Among them, Cesium-134 and Cesium-137 are the major radionuclides that could pose health threats. The table shows the melting and boiling points of the respective nuclides.

Cesium has a boiling point of 678°C and is therefore in a gaseous state when the nuclear fuel is in a molten state (its melting point is 2,850°C). When cesium in a gaseous state is released into the atmosphere, it goes into a liquid state when the temperature within the containment vessel drops below its boiling point, and it further becomes particulate at temperatures below its melting point of 28°C. Thus, cesium is mostly in a particulate form in the atmosphere and will be diffused over wide areas by wind. This was roughly how radioactive cesium was spread to distant areas in the Fukushima Daiichi NPS accident.

Although it is difficult to directly compare the released amount between the Chernobyl accident and the Fukushima Daiichi NPS accident, the larger amount released at the time of the Chernobyl accident is considered to have been partly due to the fact that the core exploded and was directly exposed to the atmosphere. In contrast, a relatively small amount was released from TEPCO's Fukushima Daiichi NPS as extensive destruction of the containment vessel was barely avoided, making it possible to curb temperature declines and reduce leaks and releases of radioactive materials.

However, some noble gases such as Xenon-133 that are easily released into the atmosphere are considered to have been released also from the reactors at TEPCO's Fukushima Daiichi NPS at a high percentage (Fukushima Daiichi: approx. 60%; Chernobyl: up to 100%). The large power capacity (Fukushima Daiichi: total of approx. 2,000,000 kW; Chernobyl: 1,000,000 kW) and the large amount of noble gases remaining in the core at the time of the accident are considered to have caused the release of large amounts of noble gases from TEPCO's Fukushima Daiichi NPS.

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