Is Nuclear Power "Russian Roulette"?

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Caldeira et al., a group of four meteorologists, released an open letter to government policymakers worldwide regarding the necessity of developing nuclear power to prevent global warming driven climate change. This has drawn opposition around the world, but let us take a look that the dissent of Prof. Jusen Asuka et al. in Japan.

They conclude, "It is our sincerest hope that the international community fully realizes the severity of Japan's experience of the March 11 nuclear disaster, and reconsiders it stance on climate change measures and an energy mix that do not rely on the 'Russian roulette' that is nuclear power generation." If nuclear power were Russian roulette, how many empty chambers would there be to the one with a bullet?

Opponents of nuclear power educated in the liberal arts think the probability of a nuclear accident to be 100%, and make arguments along the lines of "If there is another accident, the business will fail, so nuclear power is illogical for energy companies." However, as one would expect, scientists think about the probability of an accident. Nuclear accidents are a tail risk, so while the probability cannot be calculated exactly, let us consider it using the Max-Min principle based on past examples.

From the fact that the cost of insurance is ¥30 billion based on a rate of ¥100 million per year per reactor, they suppose the probability of a severe accident (per reactor) at once in 300 years. In the calculations performed by the Japan Atomic Energy Commission (JAEC) during the Democratic Party government, based on past performance in Japan (severe accidents at three reactors in 1,500 reactor years), they calculated the risk at once in 500 reactor years. In other words, once in 300 to 500 years is a conservative estimate of the probability of a severe accident.

They stop their calculation there, but let us try calculating the risk of nuclear power based on this probability. If it were Russian roulette, that would mean a bullet would be fired roughly once in three hundred years for a single nuclear reactor. How many people would die as a result? In Japan, it is zero, but even if we were to suppose an accident on the scale of Chernobyl as a worst case scenario, the number of deaths confirmed by the United Nations Scientific Committee was 60. In other words, the expected number of deaths would be 0.2 persons per year.

Let us try comparing this with other risks. Since the start of nuclear power generation in Japan in the 1960s, more than 500,000 people have died in traffic accidents. Even now, close to 5,000 persons die per year, but if we were to make it proportional to the numbers for nuclear power, it would calculate to roughly 100 deaths per plant every year. It should be clear which of the two is the riskier Russian roulette.

Now, how do the global numbers look? On this point, international organizations such as the OECD are united in the conclusion that "the energy source with the greatest risk per kWh is coal-fired power generation." Looking at GW/years, as the following chart shows, the number of deaths for coal-fired power generation is 6.9 persons, while it is 0.048 persons for nuclear power. This supposes the number of deaths from the Chernobyl accident at 31 persons, but if we use the United Nations' number of 60 persons, it is 0.1 persons. The risk of coal power is almost 70 times greater than that of nuclear power.

Table 2: Summary of severe (≥ 5 fatalities) accidents that occurred in fossil, hydro and nuclear energy chains in the period 1969-2000

	OECD			Non-OECD		
Energy chain	Accidents	Fatalities	Fatalities/ GWey	Accidents	Fatalities	Fatalities/ GWey
Coal	75	2 259	0.157	1 044	18 017	0.597
Coal (data for China 1994-1999)				819	11 334	6.169
Coal (without China)				102	4831	0.597
Oil	165	3 713	0.132	232	16 505	0.897
Natural Gas	90	1 043	0.085	45	1 000	0.111
LPG	59	1 905	1.957	46	2 016	14.896
Hydro	1	14	0.003	10	29 924	10.285
Nuclear	0	0	–	1	31*	0.048
Total	**390**	**8 934**		**1 480**	**72 324**	

Note: * These are immediate fatalities only.

However, in desperation, Asuka et al. include earthquake-related deaths in their numbers, and state that the magnitude of the risk of such a secondary disaster is "enormous, and a simple comparison to risks such as that of atmospheric pollution [caused by coal-fired power generation] based on estimated increases in deaths due to illness etc. is, suffice to say, meaningless."

This is sophistry. If risks are not always simplified by abstracting their individual characteristics, it is not possible to compare them quantitatively. As the OECD also estimates, it is irrefutable that tens of thousands of people around the world die every year as a result of direct damage from coal-fired power generation. This does not include damage from atmospheric pollution, but as one can understand from looking at the recent PM 2.5 troubles, the damage affects hundreds of thousands of people around the world every year. In contrast, the cause of the secondary disaster cited by Asuka et al. was not radiation, but rather the foolish crisis management by the Democratic Party government.

They also calculate the costs, but as with former prime minister Morihiro Hosokawa, they factor sunk costs such as past energy subsidies into future costs, so it is not worthy of discussion. The Democratic Party government calculated back end costs as well, but even when these are included, the cost of nuclear power rises only about ¥1 per kWh. The cost of operating existing nuclear power plants is overwhelmingly cheap.

That said, the cost of building new nuclear power plants is high. The technical costs are low, but this most recent accident has made the cost of safety measures immense. Consequently, building new light water reactors of the existing type in Japan is not prudent in terms of profitability. The third generation light water reactors that this paper also touches upon are sufficiently safe, but are disadvantageous from a cost perspective. Until fourth generation nuclear reactors, in which core meltdown cannot occur in principle, are put into practical use, building new reactors will be difficult.

However, the practical implementation of fourth generation reactors will take another 10 to 20 years. If we cease building new nuclear reactors until then, as Caldeira et al. fear, global warming may reach an irreversible level. This risk is uncertain, but there are no certain risks in this world. Policymakers must take the many risks such as these into consideration when making energy policies.

(Published March 10, 2014)