

Fukushima Daiichi Decommissioning Time for a new long term strategic plan

Greenpeace Briefing

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Briefing on “Decommissioning of the Fukushima Daiichi Nuclear Power Station - From Plan-A to Plan-B; Now, from Plan-B to Plan-C”
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Nine months after the triple reactor meltdown at the Fukushima Daiichi nuclear plant in March 2011, Tokyo Electric Power Company (TEPCO) announced that decommissioning of the site will be completed within 30-40 years. Practically, the people of Japan were told that some time between 2041 and 2051, the site would be returned to ‘greenfield.’ In the past decade, the complexity and scale of the challenge at the Fukushima Daiichi site has become slowly clearer. The decommissioning task at the Fukushima Daiichi site is unique in its challenge to society and technology. But still, the official time frame for TEPCO’s Road Map for decommissioning remains that set in 2011.

What is the reality of current official plans, and are there alternatives?

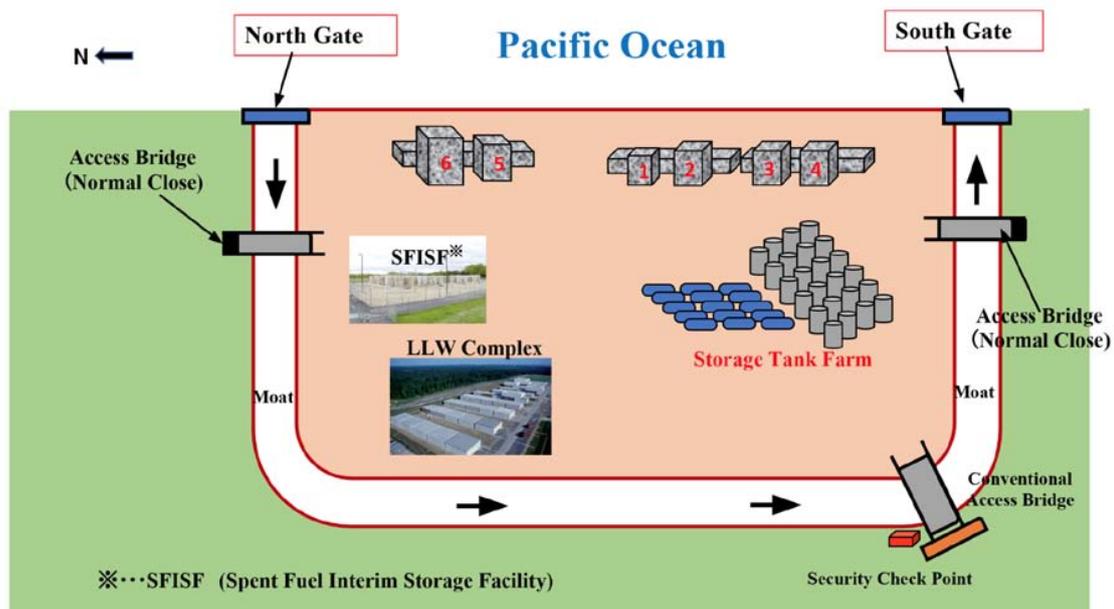
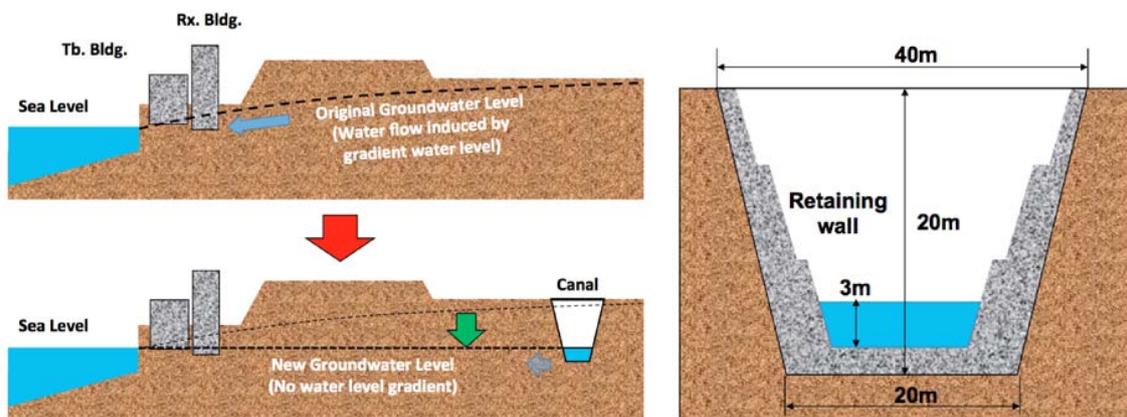
To try and understand better the progress of TEPCO and possible alternatives, we commissioned consulting engineer Satoshi Sato.¹ Having worked for General Electric (GE) for 18 years until the year 2002, including at the

Fukushima Daiichi plant, we were looking for an expert opinion on some of the main issues. GE was the main contractor and designer of the Fukushima Daiichi reactors, in partnership with Hitachi and Toshiba. Sato’s analysis, released by Greenpeace on 4th March 2021, points to the many problems with the current plans of TEPCO and the Japanese government. In fact, he concludes that the Strategic Plan of the Mid-Long Term Roadmap is unachievable in the timeframe proposed. Sato further concludes that an alternative path is desperately needed - a new approach that acknowledges the scale of the disaster and the amount of nuclear contaminated material and land. Sato gives the opinion that returning the site to greenfield is unattainable and that instead it is acknowledged what in reality it already is – a nuclear waste storage site. Rather than desperately trying to keep to an unrealistic and unattainable timetable, the report calls for a long term strategic approach. Beyond the decommissioning Plan A (abandoned by TEPCO in 2018), and the current unworkable Plan B, Satoshi Sato proposes a new Plan C.

1. Satoshi Sato is a consulting engineer, formerly a manager of technology and field engineering with General Electric (GE) Nuclear Division. For eighteen years (until 2002) he conducted over 100 inspections and assessments at Boiling Water Reactors throughout Japan. He was a GE site representative at the Fukushima Daiichi plant. His work included flaw evaluation, repair and inspection.

Main issues in Sato's report

- Spent fuel removal
- Move to air cooling of reactor core fuel debris and consequent reduction in accumulation of contaminated water
- Creation of a 'dry island' around the entire nuclear plant site through the construction of a 7km long deep moat – one aim being to stop groundwater contamination
- Construction of steel structure containment over the main reactor buildings to prevent weathering and contamination of the wider environment
- Delay nuclear fuel debris removal for 50-100 years or longer, reducing worker exposure and potential radiation contamination off site
- Long term management of the Fukushima Daiichi site as a nuclear waste storage facility



The above diagrams show the 7km moat concept built around the Fukushima Daiichi site.

Comparison of Decommissioning Options

Option	TEPCO - Plan A	Sato - Fukushima Closure Plan	Plan B	Plan C
Status	Aborted by 2018	Disqualified by IRID in 2014	On-going plan developed by NDF	New Proposal
End State	Green Field	“Dry Island” isolated by moat as final disposal site	Green Field (?)	“Dry Island” isolated by moat as final disposal site
Target Schedule	40 Years	40 Years	40 Years	Indefinite
Method to Isolate Ground-water Flow	Frozen Wall + Pump	Moat	Frozen Wall + Pump	Moat + Enhanced Air / Water tightness
Method to Cool Fuel Debris	Water-Cooled	Air-Cooled	Decision Suspended	Air-Cooled
Method of Fuel Debris Retrieval	Flooded Top Access Extendable Mast	Underground Hot Cell Extendable Mast	Dry Lateral Access Multi-Axis Arm Robot	Humanoid Robot Human Body Motion
Method to Dismantle RPV		Not Discussed	Not Discussed	Leave As-is after Decontamination (Partially Dismantled)
Dismantling PCV, Rx. Bldg.	Not Discussed	Not Discussed	Not Discussed	Leave As-is after Decontamination (Partially Dismantled)
Achievability	Extremely Difficult Uachievable	Difficult Achievable	Extremely Difficult (Unknown)	Presumably Easy
Safety / Exposure	Unacceptably Dangerous	Less Exposure	More Exposure	Minimum Exposure

The above table shows the options for each of the main challenges at the Fukushima Daiichi site.

Global Decommissioning and Molten Fuel Debris

Decommissioning of nuclear facilities - the dismantlement of reactor buildings and removal and storage of all contaminated materials, including high level waste spent fuel, is a complex and dangerous undertaking anywhere in the world. After nearly 70 years of the commercial nuclear industry, there

remain relatively few examples of successful completed decommissioning. As of mid-2020, 189 commercial nuclear reactors have been permanently shut down, of which 169 are awaiting or are in various stages of decommissioning.² Only 20 units have been technically fully decommissioned - 14 in the U.S., five in Germany, and one in Japan. Of these, only 10 have been returned to greenfield sites.

2. WNISR 2020, “Decommissioning Status Report – Soaring Costs”, in World Nuclear Status Report 2020, September 2020, See https://www.worldnuclearreport.org/The-World-Nuclear-Industry-Status-Report-2020-HTML.html#_idTextAnchor341

None of the decommissioning projects, completed or otherwise, include a nuclear power plant site with six boiling water reactors, three of which have suffered meltdown of their reactor cores. The most complex challenge at the site is the presence of an estimated 609-1141 tons of nuclear fuel debris, often referred to as corium. This material is estimated to lie at the bottom and under the Reactor Pressure Vessels of Fukushima Daiichi Units 1, 2 and 3.³ The plans to remove even sample amounts of this material from reactor Unit 2 are now not planned until 2022. The report to Greenpeace by engineer Sato makes clear that there are no plans on how to proceed beyond this stage and that the current approach through the side of the Reactor Pressure Vessel is not credible.

A Road Map for restarting nuclear power not decommissioning

The Fukushima Daiichi accident has been catastrophic for the prospects of nuclear power in Japan. Whereas 54 commercial nuclear reactors were available and operating in Japan in 2011, all were shutdown by 2013, and only nine have been restarted. Four are currently operating as of 1st March 2021. One direct link between the decommissioning of Fukushima Daiichi and nuclear energy are the efforts by TEPCO to restart its Kashiwazaki Kariwa reactors in Niigata prefecture. Despite being located in a high seismic zone and opposed by the majority of the public in Niigata, TEPCO are desperate to restart unit 6&7 reactors as a way of generating revenue in part to cover their annual decommissioning costs.⁴

The Basic Energy Plans of the Abe and now Suga Governments have set a target of 20-22% electricity to be generated by nuclear power by

2030 – which would require approximately 30 reactors to operate. The prospects for attaining that goal are small. Greenpeace estimates in 2014 indicated an 8% share as more likely, with an upper range of 12-14%. One of multiple obstacles to restart reactors remains public opinion. Consistent polling shows the majority of the Japanese public oppose restarting nuclear reactors.

The Fukushima Daiichi disaster shattered what remained of the safety myth of nuclear power in Japan. By setting a timetable of only 30-40 years to successfully decommission the plant, not only the removal of all nuclear wastes and contaminated material from the site but from Fukushima prefecture, the government and nuclear industry are trying to assuage a critical public. ‘Even with a triple reactor meltdown we can solve the problem and return the site to what it was before’ appears to be the simplistic thinking on display. By these means, the hope is that public opinion will shift towards supporting nuclear power. However, like the timeframe set in their decommissioning Road Map – the prospects for success with this approach are close to zero.

The threats and challenges of Fukushima Daiichi are not going to be solved in the short term, not in decades and perhaps not within the next 100 years. Through that time, they will be a constant reminder to the people of Japan and beyond that the risks, consequences and legacy of nuclear power are long lasting.

3. The IRID estimated Unit 1 - between 232 and 357 tonnes, with a nominal value of 279 tonnes; Unit 2 - between 189 and 390 tonnes, with a nominal value of 237 tonnes; Unit 3 between 188 and 394 tonnes, with a nominal value of 364 tonnes. IRID, “Estimation of fuel debris distribution by the analysis and evaluation,” Japan Atomic Energy Society Fuel Debris Research Committee, 4 October 2016, <http://irid.or.jp/wp-content/uploads/2016/10/20161004.pdf> (in Japanese)

4. Greenpeace Japan, “TEPCO’S Atomic Delusion”, Shaun Burnie, 25 June 2018, See https://www.greenpeace.org/static/planet4-japan-stateless/2019/08/3d2e8976-atomic_delusion.pdf

Conclusion

During the past decade, the official narrative of 30-40 years to decommission Fukushima Daiichi has become almost like a mantra. But it is meaningless – delusional. What is reality, is that the cost estimates for the disaster only increase. In 2019, the respected Japan Center for Economic Research projected that the total costs for managing the Fukushima nuclear site and off-site, could range from 35-81 trillion yen, or US\$330-760 billion.⁵ Ultimately, and almost certainly, the bulk of these costs will be covered by Japanese taxpayers and ratepayers. How such vast sums of money are to be spent and whether it has any prospect of being effective is a vitally important matter of public policy and accountability.

The TEPCO officials and politicians today who maintain the pretense of a several decades to manage the decommissioning of the second largest commercial nuclear disaster in history will be gone by the middle of the century. Satoshi Sato in his analysis warns that by the 2040's we will still only be in the early stages of dealing with this disaster.

For the past decade, Greenpeace, along with others, have had severe doubts about the prospects for decommissioning. The analysis of Satoshi Sato helps us to understand why it's justified to have these doubts. While it has been a long decade since the start of the Fukushima Daiichi nuclear disaster, there is no end date for when its legacy of contamination will be over.

The Fukushima Daiichi disaster has impacted many tens of thousands of lives, the people of Fukushima prefecture most especially and not least the nuclear workers who have toiled in terrible conditions at the site and in the wider decontamination program over the past decade. The Japanese government and TEPCO owe it to these workers, and the many thousands to come in the future, as well as the citizens of Fukushima prefecture and broader Japanese society, to start an honest discussion of the prospects at Fukushima Daiichi. Not another year should pass without a new credible plan for Fukushima Daiichi and one that ends all talk of 30-40 year decommissioning.

5. JCER, "Accident Cleanup Costs Rising to 35-80 Trillion Yen in 40 Years", March 2019, See https://www.jcer.or.jp/jcer_download_log.php?f=eyJwb3N0X2lkIjo0OTY2MSwiZmlsZV9wb3N0X2lkIjo0OTY2Mn0=&post_id=49661&file_post_id=49662

