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Contesting Fukushima

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Abstract: *The legacies of the Fukushima nuclear accident remain hotly contested in the media, academia, the courts and public debate because various actors have much at stake in contemporary battles over the future of nuclear energy, the national economy, decommissioning of the stricken reactors and public memory. Here I examine some aspects of this vibrant discourse and how the trauma of Fukushima is evolving.*

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Undated photo of 4 reactors, here with Reactor 1 (at right) covered. The cover was installed in October 2011 but the roof was removed in 2015, while the wall panels were removed in 2021 in preparation for installing a new building cover in 2023 to facilitate spent fuel rod removal. The other three reactors are now all shrouded (see below). Credit: The Great East Japan Earthquake and Nuclear Disaster Museum.

Reactor 1 before cover installed in October 2011. Credit: TEPCO

Daiichi Tour

In 2022, TEPCO is mounting a PR campaign to normalize the Fukushima disaster and assert that everything is more or less under control, the nuclear plant is safe, and decommissioning is making good progress. Apparently, the government encouraged TEPCO to arrange public tours as a way of regaining trust and demonstrating transparency. Based on my April 16th tour, transparency and forthrightness remain a work in progress.

Water storage tanks at Fukushima Daiichi, April 2022. Credit: TEPCO

Surreal is the only way to describe how it felt to be standing on a viewing platform about 100 meters from the four crippled reactors at the Fukushima Daiichi nuclear power plant as the chilly winds gusted in from the ocean. Our TEPCO guide briefed us before we arrived at the security check and then reboarded the bus, passing by a phalanx of water storage tanks, water treatment plants, cherry blossoms, parking lots of abandoned radiation-contaminated vehicles and construction work until we reached the reactors. Fukushima Daiichi is an immense site covering 3.5 sq km, just a bit bigger than Central Park in Manhattan, New York City. Our guide provided

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numerous handouts and gave an informative PowerPoint presentation that focused on the positive and progress made, but much was not covered, and her answers were sometimes evasive or misleading.

TEPCO Briefing on Fukushima Daiichi. Credit:TEPCO

Upon reaching the viewing platform the scene of devastation triggered memories of the televised March 2011 hydrogen explosions and served as a reminder of what could go tragically wrong. As we gazed on the ruins and debris our guide fielded questions and herded our group of eight into photos against this eerie backdrop. No hazmat suits or protective gear, just a light vest with a pocket for a radiation monitor and thin gloves TEPCO required as an anti-Covid measure. At the end of the tour my radiation monitor recorded a mild dose of 0.02 mSv, similar to a typical chest x-ray. TEPCO asserts one can safely access 96% of the plant complex in normal clothing.

Reactor 1 at Fukushima Daiichi Nuclear Power Plant April 16, 2022. Credit: TEPCO

Despite an abundance of reassuring facts, the tour may not succeed in dispelling everyone's concerns. Unit 1, the only reactor still without a shroud and closest to the viewing platform, is a shattered shell of a structure still partially buried under radioactive debris eleven years on. The silhouette of twisted metal and shredded walls evokes the iconic Hiroshima atomic dome. A cover for this reactor is under construction that will stretch 66 meters long, 56 meters wide and 68 meters high. A considerable amount of nuclear fuel remains in the spent fuel pool but that and the debris can't be removed safely without a shroud; the removal is scheduled for 2027-2028 while removal of the nuclear fuel in the sheathed Unit 2 is scheduled from 2024-2026. All the nuclear fuel was removed from Unit 3 by February 2021 and Unit 4 by the end of 2014. Unit 4 has the most imposing cover with a 53 meters high steel structure that uses about the same amount of steel as in the 333-meter-high Tokyo Tower. (Mainichi 2022)

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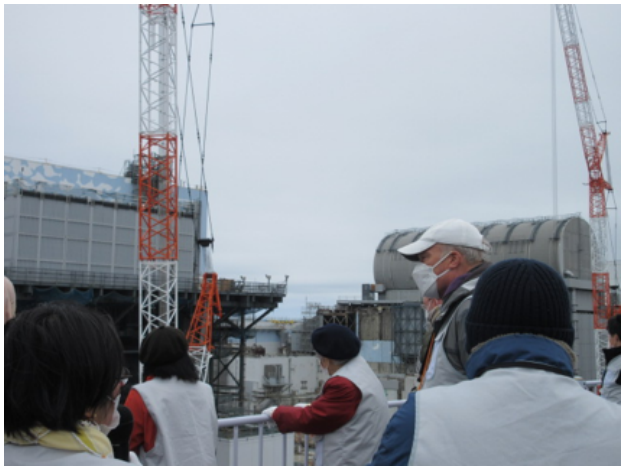

Reactors 2 & 3 at Fukushima Daiichi April 2022 (above) and Reactor 4 (below). Credit:TEPCO

Amidst the debris scattered between the viewing platform and the Unit 1 reactor is a large cylindrical tank that bears the names of GE and Hitachi, the firms that designed and built the reactors. One imagines the corporate branding professionals might find this an awkward reminder, but there are now new opportunities in the multi-billion dollar, four-decade long decommissioning of the reactors so GE and Hitachi are again collaborating to build robots designed to help in the clean-up and retrieve melted-down nuclear fuel from the primary containment vessels where levels of radiation remain deadly for human beings.

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Signs showing levels of radiation are ubiquitous in Fukushima. The level is low on the public road outside the plant, quite a bit higher on the bus inside the plant compound and much higher on the reactor viewing platform. Credits:TEPCO

Mismanaging Risk

The Fukushima Daiichi reactors were based on a GE boiling water reactor design from the early 1960s and were built from the late 1960s and put into operation in the 1970s. Controversially, the backup generators were installed in the basements of the reactor turbine buildings that are closer to the ocean than the reactors, leaving them vulnerable to inundation in the event of a large tsunami. This placement was further jeopardized by the decision to lower the original elevation of the bluff where the reactors are located from 35 meters to 10 meters above sea-level to lower the costs of construction and operating seawater pumps. The plant was built to withstand a 3.1 meter tsunami based on the 1960 Chilean earthquake that triggered a tsunami of that height on the Fukushima coast. That risk assessment, however, was updated in 2002 to 5.7 meters based on a new methodology developed by the Japan Society of Civil Engineers, but TEPCO made no safety improvements in response to the new estimate. (Acton and Hibbs 2012) What is stunning to see at the Fukushima Daiichi plant is the absence of a proper seawall; there is only a low breakwater that creates a small harbor for loading and unloading ships. It did not provide any protection from the 13-meter tsunami that engulfed the plant on March 11, 2011. TEPCO considered building a 15-meter wall in response to a 2008 in-house study warning of the possibility of a monster tsunami, but the $1 billion price tag was considered excessive. (McCurry 2012; O'Connor 2018). In light of the >$600 billion estimate for decommissioning the plant over four decades, it is another example of how short-term focusing on the bottom line came at the expense of public safety. (JCER 2019) And TEPCO is not alone, as it came to light after the 2011 accident that all of the utilities operating nuclear reactors had falsified repair and maintenance data. (Clenfield 2011) The Onogawa Plant about 80 km north, also located on what is popularly known as the "tsunami coast", was closer to the epicenter of the 2011 earthquake but did not suffer catastrophic damage, indicating the advantage of siting the plant at a higher elevation, not underestimating risk and a corporate culture of safety at Tohoku Electric. (Ryu and Meshkati 2014)

Is It Safe?

The Fukushima Daiichi station blackout (loss of all power) triggered by the combination of the magnitude 9 earthquake and massive tsunami caused the cessation of reactor cooling systems and the three meltdowns that are the reason why the name Fukushima has entered the global lexicon as shorthand for a cascading nuclear disaster, lax safety and poor oversight. This negative image annoys some of the prefecture's residents who told me that now the overall situation is not so bad, and they resent the negative hyperbole propagated in

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some media such as the lame Netflix series Dark Tourism (2018). In one segment focusing on Fukushima, a snarky Kiwi journalist smirks his way through the evacuation zone, hyping the dangers he faced while managing to get his guide into trouble with the police in his desperation to generate a simulacrum of drama.

Fukushima's farmers and fishermen have struggled to overcome consumers' negative perceptions by extensive testing for radiation. They fear that discharging one million tons of treated radiation-contaminated water into the ocean, as the Japanese government has announced, will undo those sustained efforts. The government has earmarked Yen 30 billion ($250 million) to purchase seafood products if demand falls, but fishermen remain opposed to the discharge of contaminated water. There are efforts by the central and prefectural government to promote a better image for Fukushima food products and retail giants like Aeon have pitched in to promote sales, but negative sentiments remain at home and overseas. Soon after the nuclear disaster, 55 countries banned food imports from Fukushima and four neighboring prefectures, but the US ended restrictions in 2021 and in 2022 Taiwan finally lifted its ban on most food imports, reducing the number of closed markets to 13, including China and South Korea.

Retail fish shop in 2021 at Ukeda quay, 9 km from Fukushima Daiichi. Credit: Jeff Kingston

Fukushima fish for sale at Ukeda: Credit Jeff Kingston

Fishing boats at Ukeda Port April 2022. Credit: Jeff Kingston

Nuclear Momentum?

The 2012 Diet investigation concluded that the

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three reactor meltdowns resulted from a complacent culture of safety, and collusion between TEPCO and government regulators. (Diet 2012) As a result, Suzuki Tatsujiro, director of the Research Center for Nuclear Weapons Abolition at Nagasaki University believes, "people think that the industry is not trustworthy and the government that is pushing the industry is not trustworthy." (Dooley and Ueno 2021)

Fukushima devastated the global nuclear industry, as governments and utilities suspended reactor projects and announced plans to eliminate or phase out nuclear energy. This hiatus was due to greater scrutiny of safety issues. Enactment of stricter safety guidelines raised the costs of building reactors and ensured further delays in an industry notorious for cost overruns and not meeting deadlines. Indeed, a year after the Fukushima disaster in a special issue on nuclear energy the Economist concluded that it was no longer financially viable. (Economist 2012)

And yet, institutional actors have held on and used their influence over energy policy to lay the foundations for a nuclear comeback in Japan. (Hymans 2011) A decade on the so-called "nuclear village" of Japanese nuclear energy advocates (Kingston 2012) is hoping to capitalize on the Russian invasion of Ukraine and spiking oil and gas prices. The Russian attack on Chernobyl was a reminder of the dangers of nuclear energy that have lingered since the 1986 accident, but as higher energy costs batter the Japanese economy there has been a well-orchestrated PR campaign to focus on the advantages of restarting more of Japan's idled nuclear reactors to offset Japan's dependency on energy imports in a hostile regional climate, reduce trade imbalances and to reach the government's zero emissions target by 2050. The pro-nuclear PR blitz, however, confronts continued examples of TEPCO's safety lapses, and falsification of documents in restart applications for its Niigata plant. There the utility is discovering that trust is not a renewable resource. (Rich and Hida 2022) Tanaka Shunichi, before stepping down as head of the Nuclear Regulation Authority (NRA) in 2017 was so exasperated that he called TEPCO unfit to operate a nuclear power plant. (Japan Times 2017) However, later in 2017, the NRA approved TEPCOs restart application for the world's largest nuclear energy plant at the Kashiwazaki-Kariwa complex in Niigata. Yet, serious safety and lax security issues persist, undermining public confidence and delaying the utility's plans to bring the plant back online. (McCurry 2017) TEPCO's financial recovery plan depends on doing so, but in 2021 due to mounting safety concerns the government effectively postponed Niigata restarts by banning TEPCO from transporting nuclear fuel stored at the plant or loading it into reactors. (Nikkei 2021)

Despite these setbacks, for the first time since 2011 one newspaper poll conducted in March 2022 found 53% of Japanese in favor of nuclear energy if it can be operated safely while 38% oppose restarting idled reactors. (Oda and Reynolds 2022) That clause "*if it can be operated safely*" is a key point of contention and qualifies the headlines about majority support and it's worth bearing in mind that this survey was conducted by the Nikkei, a pro-nuclear business newspaper. Another survey conducted in October 2021 found Japanese support for nuclear energy was 18.4%. (Statista 2022) Back in 2017, when simply asked if they favor restarting nuclear reactors or not, 55% were opposed and 26% were in favor, suggesting that how the question is asked makes a significant difference. (Mainichi 2017)

More recently, an Asahi poll in March 2022 gave respondents five choices in responding to whether they felt "nuclear power stations should be immediately abolished" or "they should be retained in the future as an energy source." (Isobe 2022) Support for abolishing

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nuclear power plants fell to 32 percent from 40 percent a year earlier while 39% favored retaining them, up from 32% in 2020; 29% remained neutral on the issue. But as we have seen post-3.11 when anti-nuclear energy sentiments spiked, public opinion does not drive national energy policy and the pro-nuclear Liberal Democratic Party (LDP) is doing what it can to sway public sentiments. After all, Japan's fleet of reactors, once numbering 54, was built on its watch, and it has taken the lead on reviving nuclear energy's prospects.

Prime Minister Kishida Fumio, who visited Fukushima Daiichi on April 29, 2022, is actively promoting nuclear reactor restarts, and rallying public support, saying that due to high energy prices and a weak yen it's time to reconsider current regulatory constraints to boost Japan's flagging economy. He maintains that he will adopt a safety-first approach and gain public understanding of reactor restarts while making existing regulations more "efficient". (Oda and Reynolds 2022) The boost in support for nuclear energy may also be related to a powerful magnitude 7.4 earthquake on March 16, 2022 in Tohoku that shutdown several coal and gas-fired plants, causing some scattered blackouts in Tokyo and an electricity supply alert for the metropolitan area of 30 million residents.

Since 2015 the Nuclear Regulatory Authority (established in 2012 as the successor to the discredited Nuclear and Industrial Safety Agency) has approved restarts for 10 reactors, while 23 others remain idled and 21 are slated for decommissioning with 3 more under construction. Citizens around the nation have filed lawsuits opposing reactor reboots but mounting utility bills and fading memories of the Fukushima disaster are creating an opportunity for a nuclear renaissance. (Kingston 2021)

PM Abe laid the groundwork for this revival by reinstating nuclear energy into the national energy strategy in 2014, setting a target of 20-22% of electricity generating capacity from nuclear reactors by 2030, a target that would require restarting almost all of Japan's 33 operable reactors. (Kingston 2014) Given that many of the reactors are aging and have passed, or will soon pass, the original 40-year operating license limit, and upgrading to meet safety guidelines is prohibitively expensive for many of these smaller reactors, it is not clear how Kishida plans to prioritize safety and gain public understanding if those guidelines are relaxed.

By 2030, only 21 of Japan's 33 reactors will be under the 40-year cap. (Ogawa 2021) Some of the aging reactors in the Kansai region that gained approval to restart are likely to miss deadlines to install counter-terrorism safeguards and thus may have to shut down again. Nationwide, 5 of the 10 reactors that have been approved to restart are in operation, generating about 4% of the nation's electricity, but as of May 2022, 7 haven't yet completed required safety upgrades that are a condition for operating, perhaps leading to shutdowns and pushing back the timetable for others to late 2022 at the soonest. (Inajima and Oda, 2022) Although an energy crunch is looming, the safety guidelines enacted since the 2011 disaster will make it difficult to accelerate restarts without political intervention and that is a potentially risky gamble. Especially so since it is essential to secure support from hosting towns where many residents remain anxious about safety. (Rich and Hida, 2022)

Auto giant Toyota weighed in on the debate in late April 2022, asserting that its electric vehicle strategy depended on decarbonization. In an NHK televised special on "The Impact of the EV Shift" (4/24/2022), a chart was shown comparing the energy mix of France (75% nuclear, renewables 15%, fossil fuel 10%) and Japan (nuclear 6%, renewables 23%, fossil fuels 67%), highlighting that an EV shift in Japan will

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not reduce CO2 emissions until the energy mix changes. The nuclear village has its institutional fingers crossed that the national mood of anti-nuclear sentiment has ebbed, and much is riding on TEPCO demonstrating progress in decommissioning, part of which hinges on discharging massive volumes of contaminated water currently stored at the Fukushima Daiichi plant.

Ocean Discharge

It was breathtaking to stand so close to the shattered reactor buildings and to see the scale of destruction up close. The plant covers an immense area, now brimming with over 1,000 large water tanks where contaminated water is treated and stored. Partly it is groundwater trickling down from nearby hills through the reactor buildings and in addition TEPCO has kept pumping large amounts of water into the reactors to cool the nuclear fuel. In 2013 it was revealed that everyday 272 metric tons of highly radioactive water was leaking into the Pacific Ocean, causing PM Abe to order government intervention to help resolve the issue and save Tokyo's 2020 Olympic bid. (Fackler 2013) This was an admission that TEPCO had mismanaged the cleanup, further undermining public confidence, and forcing the government to subsidize the construction of a $325 million ice wall to block groundwater seepage into the reactors by freezing the soil. However, there has been ongoing seepage and a government review panel found that the ice wall has only been partially effective. (Sheldrick and Foster 2018)

In 2022, the TEPCO guide did not know the annual electricity costs of maintaining the ice wall, once estimated as the equivalent of the annual electricity consumption of 15,000 Japanese households. (Fackler 2013) What is often overlooked in the greenwashing nuclear discourse is the sizeable level of CO2 emissions associated with nuclear energy, not just in the decade or more of constructing reactors, but also in processing nuclear waste and several centuries of storing and monitoring that radioactive legacy. Moreover, in the event of an accident like at Fukushima, there is a four-decade long, high carbon footprint decommissioning process.

A bottle of ALPS decontaminated water
Credit: TEPCO

Our guide did inform us that there are three ALPS (Advanced Liquid Processing System) water treatment systems being used to remove most of the radioactive contaminants except for trace amounts of tritium. We were not told, however, that in 2018 TEPCO announced that it would have to re-treat all the processed water because the ALPS system had malfunctioned. (Asahi 2021a) This blunder was a public relations disaster because now there will always be doubts about how safe the treated water really is even if proclaimed to be safe. At the end of our tour, we were handed a glass bottle filled with ALPS treated water and assured that it is safe to drink. Maybe so, but TEPCO's reassurance evoked parallels with Chisso, the firm responsible for widespread methylmercury poisoning in a small fishing port

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in Kyushu where it faked a water treatment system for its industrial effluent. (George 2001) The president invited the press to watch as he drank a glass of regular tap water passed off as treated water. Public memory in Japan has been refreshed by the recent film Minamata (2021) that focuses on the iconic photos published in *Life* by photographer Eugene Smith, played by Johnny Depp, documenting the consequences of this notorious case of industrial pollution in the 1970s.

In April 2021 the government decided that it would approve TEPCO's request to discharge the treated contaminated water into the ocean off Fukushima beginning in 2023. In its application, the utility projected that by the end of 2022 (since recalculated for some time in 2023) it would have no additional storage capacity on the plant site and thus needed to release the water to make room for a nuclear waste temporary storage facility and other decommissioning related facilities. (Asahi 2022) Fishermen are irate about the planned dumping, particularly because TEPCO had promised to gain their understanding before doing so, but the release is a *fait accompli* as construction of the 1 km tunnel for the offshore discharge is already well underway. They and others often ask if the contaminated water is so safe why not dump it into Tokyo Bay? In addition to Fukushima's fishermen and residents, China and South Korea are also highly critical of the potential environmental impact and find scant reassurance in the International Atomic Energy Agency's (IAEA) ongoing review. The IAEA mandate is to promote atomic energy thus the outcome of the review appears to be a foregone conclusion. (Kyodo 2022)

Water discharge system under construction. April 2022. Credit:TEPCO

When asked about discharge of water into the ocean our guide told us that TEPCO was abiding by the government's decision, without explaining that this came at TEPCO's behest. She also said it is standard practice for nuclear power plants around the world to discharge tritium tainted water, but the situation is of course quite different in Fukushima after 3 meltdowns and there is nothing standard about this upcoming release planned in stages over thirty years. Fishermen are opposed because their brand has been devastated by the accident and their livelihoods affected. They now worry that TEPCO is re-tarnishing the brand and making it even more difficult to restore public trust in Fukushima's marine products.

During the Nuclear Regulation Authority's March 2021 review of TEPCO's request to discharge the water, the utility explained that the ocean release was necessary "to safely and steadily remove fuel debris and spent nuclear fuel." (Mainichi 2022d) The area now occupied by over 1,000 water storage tanks is designated as a site for ten different new decommissioning-related facilities. On the tour, the plant was a beehive of construction activity, including a large white building for reducing

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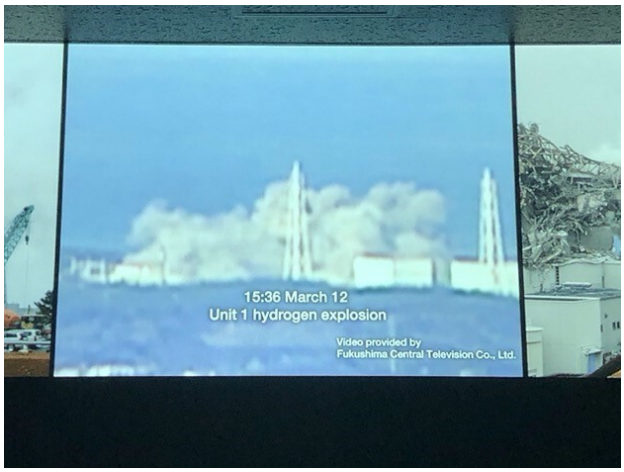
the volume of solid waste (concrete and metal debris) and another planned for storing that waste, the tenth such waste storage building in the compound. There is also a large incinerator for burning logged trees from the once forested compound much of which is now paved in concrete as a contaminated water radiation reduction measure. Removal of fuel debris is scheduled for the end of 2022, so TEPCO explains that it is imperative to build temporary storage facilities for that fuel and highly radiated solid waste. Eventually, these buildings will also become solid waste because the cycle of decommissioning generates new tasks requiring new facilities. Currently, temporary storage of nuclear waste on site is anticipated to last 20-30 years, but it is hard to be certain of this timetable because a permanent storage site has not yet been decided. (Dooley and Ueno 2021)

Our guide helpfully suggested that two towns in Hokkaido have agreed to a first phase review as potential sites for storing nuclear waste, eliciting a groan of protest from an elderly Hokkaido resident in our group. On the bus trip back to TEPCO's Decommissioning Archive Center, the guide was peppered with questions. One British woman responded to the evasive replies by suggesting that TEPCO be more transparent and forthright. Asked about accountability for the accident, the guide emphasized how much money TEPCO was using to compensate claimants and in the decommissioning, without acknowledging that it was quasi-nationalized by the government so that its debt, and accident-related expenses, are financed by taxpayers and consumers who have been paying a 10% surcharge on utility rates. (Tabuchi 2012)



Hydrogen Explosion at Fukushima Daiichi. Credit: The Great East Japan Earthquake and Nuclear Disaster Museum

Fukushima 50

At TEPCO's Decommissioning Archive Center I met Sato Yoshihiro, one of the so-called Fukushima 50, those workers who volunteered to stay on and manage the nuclear crisis at great risk to their lives. Sato is a low key, unassuming man who is embarrassed by the suggestion he saved the nation from a potential nuclear catastrophe. In a video at the Archive he speaks about his fears at the time and alludes to a brush with death.

The film Fukushima 50 (2020), a plodding melodrama that focuses on bravery, dedication and self-sacrifice, serves as a pat on the back for TEPCO's overcoming the crisis without probing the safety lapses and overly optimistic assumptions that left the plant vulnerable to a station blackout. The film includes heavy-handed propaganda, repeating discredited allegations blaming PM Kan for cessation of seawater injection into the reactors and for delaying the venting, falsehoods that vainly attempt to shift blame for the nuclear accident that three major investigations pin on TEPCO and lax government oversight. (Lukner and

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Sasaki 2013) TEPCO's top brass appear bumbling and shameless but get off lightly because the men on the spot fortunately ignored their orders and, despite some hairy moments, brought the situation under control. Asked about the film Sato, the deputy shift supervisor for Units 3 and 4 at the time of the accident, refrained from offering his take but pointed out that there were 69 employees who stayed on. All told, hundreds of workers laid their lives on the line to manage the triple meltdowns. (McCurry 2013). But there was an even larger exodus of workers from the compound to the Fukushima Daini plant 12 km to the south due to concerns about radiation exposure and uncertainty about how the nuclear crisis might develop. (Asahi 2014) Sato described the real-life plant manager Yoshida Masao as an "oyabun" (yakuza boss), alluding to his imperious and mercurial manner, exactly how Tanaka Ken plays him in the film. When the tsunami struck, Sato was not at the plant but the following day he went there to help since he had extensive control room experience. He confirmed that Yoshida only pretended to cease injection of sea water into the reactors on instructions from TEPCO HQ in Tokyo. There the main concern was the irreparable damage that would cause to the reactors. Yoshida's main concern was a beyond Chernobyl-level crisis, what he called a China Syndrome scenario of a triple melt-through with molten fuel penetrating the containment vessel and the release of huge doses of radiation. (Asahi 2014) He testified that on March 14, as problems mounted, "I thought we were really going to die."

Sato Yoshihiro. Credit: TEPCO Archive Center

Asked if there had been enough crisis emergency training prior to the accident, Sato acknowledged there had not been, confirming Yoshida's view that inadequate staff training and knowledge about how to operate emergency systems exacerbated the crisis. (Asahi 2014; Akiyama 2016) One of the three major investigations into the accident also concluded that poor staff training, systematic underestimation of risk and a lack of emergency preparation were key factors in TEPCO's mismanaging the crisis response. (Cabinet of Japan 2012; Hatamura 2014) But that has not stopped TEPCO and the LDP trying to shift responsibility to Kan and demonize him. There is also considerable controversy about why venting was delayed so long given that onsite staff knew the risks of a build-up of hydrogen gases emitted by fuel rods due to the cessation of cooling systems.

The Fukushima 50 film perpetuates the myth that PM Kan's visit to the plant early on March 12th forced TEPCO to delay the venting, but this is a baseless assertion. It is well documented that Kan had been demanding TEPCO start venting well before his visit and was frustrated with its evasive replies about the lengthy delay

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in doing so. (Shinoda 2013, 50-51) As a result, Kan took a helicopter to the plant just after 7 AM on March 12th to find out what was going on and again urge TEPCO to begin venting; shortly past 9 AM, an hour after Kan departed, it finally tried doing so at Unit 1 but without success. Later that day at 3:36 PM a hydrogen explosion shredded the secondary containment structure at Unit 1 sending plumes of radioactive smoke billowing into the sky.

At the Decommission Archive Center on April 16, 2022 Sato gave the standard responses about delaying venting due to PM Kan Naoto's visit, and concerns about dousing locals with radiation if it did vent, but when pressed he acknowledged inadequate training and lack of experience in manual venting. (Asahi 2014; Akiyama 2016) Venting is usually automated but had to be done manually due to the station blackout and was complicated by spiking radiation levels and the need to wear cumbersome protective gear. Sato said he tried opening the vent manually, something nobody had practiced, but the venting system was not viable. Apparently, TEPCO had known of the need to upgrade and harden the venting system, but as with other safety warnings that would hit the bottom line, the utility ignored global best practices. (Behr and Fialka 2011; Ferguson and Jansson 2013)

Sato emphasized that the venting efforts occurred in very difficult and dangerous circumstances and that improvisation was key to the emergency response. He also spoke of the uncertainty the workers were coping with at the time, noting that after the earthquake and tsunami, the electricity went out and monitoring systems were not functioning. Crisis managers were thus flying blind. The plant was also rocked by a series of aftershocks, and nobody knew what might come next in this cascading disaster. The three hydrogen explosions at the site spread radioactive debris and injured colleagues, further hampering emergency operations. The day after the tsunami struck, Unit 1 exploded on March 12, and hydrogen explosions ripped apart the containment structures of Unit 3 on March 14 and Unit 4 on March 15, leaving the spent fuel rod pools exposed to the elements with no containment or cooling. There were fears of a worst-case scenario of an explosion of the spent fuel rods if all the water evaporated from the pools.

Asked if he ever thought they might not succeed in bringing the crisis under control, Sato answered that he was too busy trying to do whatever he could, so there was no time to contemplate failure. He claims that despite the unimaginable dangers and anxieties he was not traumatized by the experience and doesn't suffer from PTSD. Although workers at the time suspected there were reactor meltdowns, he says there was no solid evidence to back up such speculation. That, he maintains, explains the two-month delay in TEPCO acknowledging what the international media had been reporting since mid-March. But there was also a circling of wagons as the domestic media held back. According to Martin Fackler, then the Tokyo bureau chief for the New York Times, "when disaster struck in March 2011, it should be no surprise that the {Japanese}journalists' default mode was to promote the same goals as the national government: maintain order, prevent a public panic, and limit damage to both the nuclear industry and the moral authority of the central ministries that had given birth to it. This meant that the journalists—at least those at the big national newspapers and broadcasters—saw their role as defending the narratives put forth by officialdom, not challenging those with reports about the reality on the ground." (Fackler 2021)

Misery Index

Nuclear proponents point out that nobody died from the radiation emitted during the

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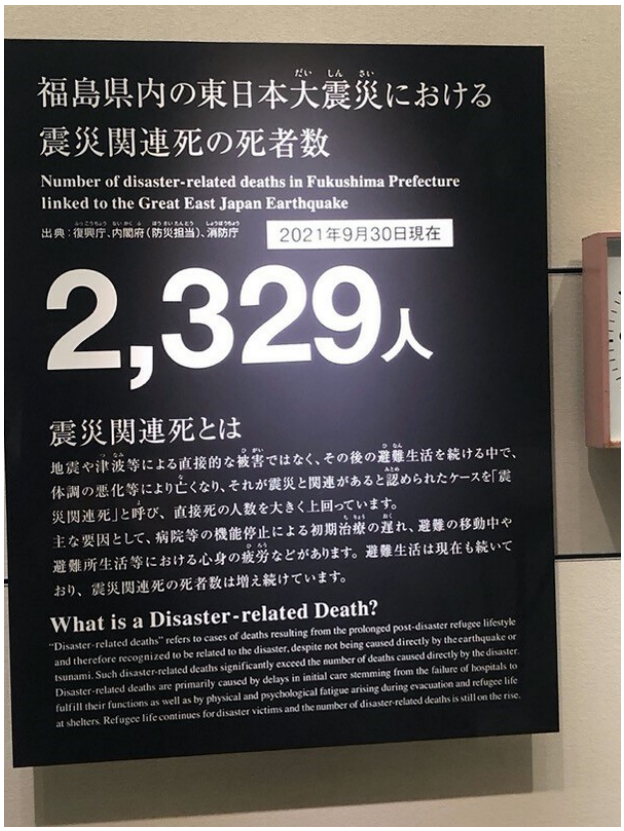
Fukushima nuclear accident, implying that nuclear energy anxieties exceed the actual risks. That argument confronts Japan's tens of thousands of nuclear refugees who have kept their battle alive in the courts and through ongoing media coverage of their lawsuits. (Johnson, Fukurai and Hirayama 2020) For them, the misery index is not just about deaths. The catastrophic loss of communities, careers, family ties and sense of well-being caused by the nuclear accident has left a deep scar. The Great East Japan Earthquake and Nuclear Disaster Memorial Museum in Futaba, co-hosting town with Namie of the Fukushima Daiichi plant, interrogates the "no deaths" claim, with dioramas explaining how the spread of radiation hampered rescue and relief efforts, perhaps condemning some survivors of the tsunami to death. The exhibits also drive home how shambolic the evacuation was, partly because the myth of 100% safety provided a pretext to not conduct any drills; they were unnecessary and if conducted might give ammunition to critics of nuclear power who would see this as an admission that the myth was a fairy tale.



Credit: Great East Japan Earthquake and Nuclear Disaster Memorial Museum

Overall, according to the Fukushima government that runs the museum, there have been 2,329 disaster-related deaths in the prefecture as of September 30, 2021. The display explains that these deaths resulted "from the prolonged post-disaster refugee lifestyle…primarily caused by delays in initial care stemming from the failure of hospitals to fulfill their functions as well as by physical and psychological fatigue during evacuation and refugee life at shelters." The museum also notes how the botched evacuation caused the deaths of 40 patients of the Futaba Hospital due to interruption of medical treatment and the ordeal of evacuation, but other sources suggest a toll of 45 if residents of the nearby Deauville Retirement Home are included. (Nakagawa 2021) The grim picture of

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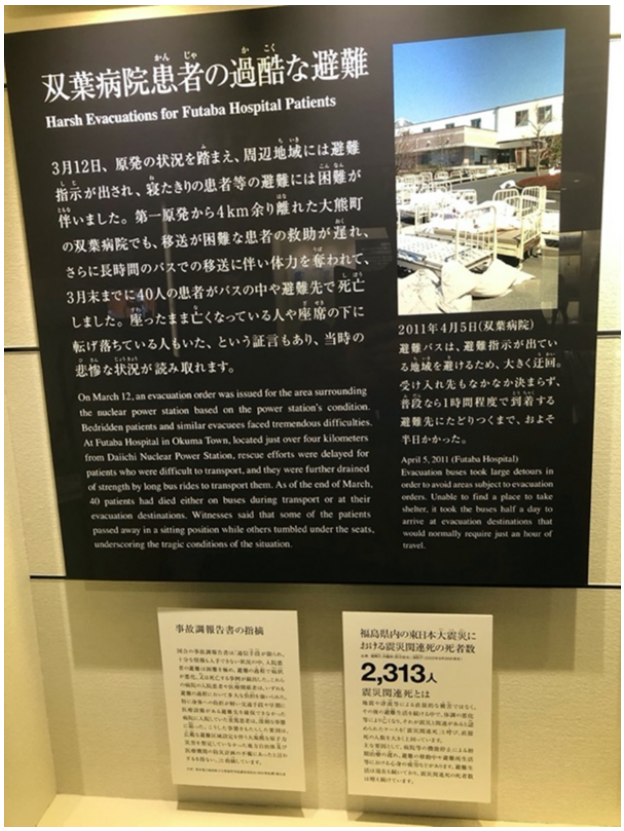
abandoned hospital beds and medical equipment scattered in the parking lot convey a sense of the ghastly experience.



Credit: Great East Japan Earthquake and Nuclear Disaster Memorial Museum

An evacuation order applying to both facilities, just 4.5 km from the Fukushima Daiichi, was issued on March 12 but many patients were not evacuated until March 16. Buses evacuated 209 people on March 12, but 227 others waited for transport until March 16 as officials mistakenly believed everyone had been evacuated. This slow-motion evacuation meant that many did not get adequate medical treatment, and some died on the spot, in transit or soon thereafter from the ordeal. For many relatives and local residents these deaths were caused by the Fukushima nuclear accident as is the surprisingly high number of young people suffering from thyroid cancer. This a relatively rare cancer but the numbers in Fukushima are thirty times the national average.

Court Challenges

In the latest setback for the nuclear village, and PM Kishida's vigorous efforts to promote restarts of idled reactors, on May 31, 2022 the Sapporo District court ordered that the three reactors of the Tomari nuclear power plant in Hokkaido must remain offline. (Asahi 2022b) The judge ruled that Hokkaido Electric plant does not meet reasonable safety standards and that its tsunami defenses are inadequate. The court rejected the utility's assurances and cast doubt on the credibility of its evidence regarding the risk of liquefaction compromising the sea wall. The NRA has also been unusually critical of the utility and its explanations about safety measures and failure "to submit proper materials for the safety screening." (Asahi 2022b) The powerful legacy of Fukushima has been sustained in several similar rulings around the nation.

In January 2022, a group of six young men and women filed a class action lawsuit in Tokyo District Court against TEPCO, seeking 616 million yen (about $4.6 million) in damages from the utility. (Mainichi 2022a) This is the first-class action suit by residents who were minors at the time of the accident. The plaintiffs claim that they developed thyroid cancers due to radiation exposure following the three reactor meltdowns. The Fukushima Prefectural Government and central government have not recognized a causal relationship between local thyroid cases and radiation exposure so establishing a correlation is key to the plaintiffs' case. All have had surgery on their thyroids and in one case the cancer had spread to the lungs.

There is considerable controversy over the

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connection between high thyroid cancer rates among children in Fukushima and the nuclear accident. (Mainichi 2016) Thyroid checkups for children in Fukushima began six months after the nuclear disaster and two health experts concluded that the number of cases was thirty times the expected number based on national levels. Some experts believe the unprecedented mass screening is the reason for a spike in cases, but early detection can't explain the significantly higher incidence recorded since the initial screening. The incidence among residents of Futaba where the crippled reactors were located is 4.6 times higher than in other parts of the prefecture distant from the epicenter, indicating that radiation exposure may have played a role in the unexpectedly high number of thyroid cancers among children there. (Rosen 2021)

Based on screening of the thyroid glands of 380,000 people aged 18 or younger at the time of the nuclear disaster a total of 266 cases of cancer were diagnosed or suspected; based on national rates, there should be about 13 cases. (Rosen 2021) Rosen also reports a significantly higher incidence among children in the thirteen most contaminated towns around the plant where evacuation was mandatory compared to children in other parts of Fukushima. He further argues that the steadily rising number of thyroid cancers detected between 2012-2020 refutes the screening effect theory, that mass testing resulted in higher numbers of diagnosed cases. While the screening effect might explain the large number of cases in the initial screening, it cannot account for the large and growing gap between expected cases based on national data and confirmed cases over time. Rosen argues, "it can be ruled out that the increased cancer rates in subsequent screenings are consequences of a screening effect, because all of these children had already been examined and found to be cancer-free in previous screenings. They must therefore have developed the cancer between the screening examinations." (Rosen 2021)

In March 2022, at the Foreign Correspondent's Club Japan (FCCJ), Iida Kenichi and Kawai Hiroyuki, the two lawyers for the plaintiffs, assert that the actual number of thyroid cases in Fukushima is now 293. (FCCJ 2022) They argue that the burden of proof should be on TEPCO and the state to prove that the unusually high rate of thyroid cancers in the prefecture is not related to the nuclear accident. In other cases of industrial pollution like Minamata there is a precedent to place the burden of proof on the polluter to prove there is no causal relationship between the contamination and the illness suffered by plaintiffs. Lawyers for the thyroid plaintiffs want the court to apply this principle but confront the government's denial of any connection between the nuclear disaster and thyroid cancers. Much is riding on what courts decide.

Many of those displaced by the nuclear crisis have sought accountability and compensation in the courts, filing some 30 class actions suits. In March 2022 the Supreme Court rejected TEPCO's appeal of a lower court ruling and ordered the utility to pay damages of 1.39 billion yen (about US$10 million) to nearly 3,682 people involved in three class action suits filed in Fukushima, Gunma and Chiba whose lives were harmed by the nuclear disaster. (Mainichi 2022b) This is the first of some 30 class-action suits filed by evacuees where the utility's liability for damages has been finalized. Overall, the Supreme Court has rejected TEPCO's appeals in six cases and increased the amount of compensation above government standards.

Finalizing the amount of damages well above existing government standards sends a strong message from the judiciary that the level of compensation is inadequate for what people lost. The Court also expanded the areas eligible for compensation. Under the government standards, former residents of what became designated "difficult-to-return" zones (subject

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to mandatory evacuation) are entitled to 14.5 million yen (about $110,000) while those who evacuated "voluntarily" are entitled to 80,000 yen ($600), an amount calculated based on traffic accident liability criteria. This latter group of nuclear refugees were not required to evacuate but did so due to justified worries about radiation spreading beyond the 20 km mandatory evacuation zone. These plaintiffs argue that they also had to relocate and were deprived of their homes and communities in what became, for want of a better term, "difficult-to-live & work" zones for farmers and fishermen. TEPCO maintained in court that the government standards for compensation are excessive and opposed higher levels of damages. The nuclear refugees, who suffered irreparable harm in good faith waited many years for relief and accountability and will find some vindication if not justice in the ruling. Later in 2022, the Supreme Court is expected to rule on a number of other cases regarding the state's liability.

In 2019 the Tokyo District court ruled that three top former TEPCO executives were not guilty of professional negligence resulting in death and injury. (Johnson, Fukurai and Hirayama 2020) Despite the verdict, however, the prosecution was invaluable because, "this criminal case revealed many facts that were previously unknown, concealed, or denied, and it clarified the truth about the Fukushima meltdown by exposing some of TEPCO's claims as nonsense." (Johnson, Fukurai and Hirayama 2020) Media coverage also kept the issue of TEPCO's culpability and negligent decisions in the limelight.

Lessons Learned?

Why wouldn't Japan's nuclear village use the Russian invasion of Ukraine and spiking energy prices to regain lost ground? This is happening elsewhere around the world but everywhere the technological, logistical, political and financial challenges of a nuclear revival are daunting for an industry haunted by massive cost overruns and epic delays, just ask Finland where their new reactor finally began operating this year, 13 years behind schedule, at nearly quadruple the original Euro 3 billion price tag. (Alderman and Reed 2022) Nuclear energy is not a quick fix for the current energy crunch, especially considering that Japan's idled reactors have been mothballed for a decade. Moreover, there are legitimate concerns whether the key problem of poor crisis training for staff at nuclear plants has been overcome.

Sato believes Japan needs nuclear power as part of a balanced energy policy because its energy security remains vulnerable. This is the view that the government and utilities are promoting, but some key lessons of the Fukushima crisis are being overlooked, especially the dangers of wishing risk away. The disruption and costs of the Fukushima accident have been immense, forcing mass, long term evacuations that transformed once prosperous communities into desolate ghost towns. Japan's nuclear refugees are a living reproach to the lax safety culture at TEPCO and the failure of the state to provide effective oversight. So too are the over 2,300 disaster-related deaths and the high incidence of thyroid cancer.

Given current regulatory guidelines, it won`t be easy to get approval and restart additional reactors if indeed the government is prioritizing safety. Rushing restarts would require easing sensible safety protocols. There is no short-term solution to Japan's energy vulnerability but reducing emissions will require a shift away from coal, a policy Japan has resisted. It also means renewed commitment to boosting renewable energy and subsidizing smart grid initiatives to better integrate renewable energy sources. (Jensterle 2019)

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There has been rapid progress, but as Andrew DeWitt reminds us, shifting Japan's energy strategy away from coal and nuclear also entails various risks, and huge challenges remain. (DeWit 2020) Nonetheless, by 2020 Japan ramped up renewable energy-solar, wind, geothermal, hydroelectric and biomass, to 20% of total electricity production from just 10 % in 2010. Japan has also aggressively promoted various smart city initiatives and they offer a path to lower electricity consumption and enhanced disaster resilience. (Barrett et al 2020) Accelerating these transitions appears more promising than turning on aging reactors based on dated technologies that are vulnerable to risk.

Touring the Daiichi site is a reminder of what can go wrong and the consequences if it does in a seismically active archipelago where earthquakes, tsunami and volcanic eruptions often wreak havoc. The Great East Japan Earthquake and Nuclear Disaster Memorial Museum highlights how essential emergency preparedness is, including evacuation drills. It is thus disturbing that the NRA's mandatory 30 km evacuation protocol, calling on all towns within this radius of nuclear reactors to collaborate on conducting evacuation drills, has occurred just once. The single exception is the Onogawa plant in 2022, but there instead of ordinary citizens, town officials from Onogawa and Ishinomaki who knew what to do participated in the drill under ideal conditions. This will help them better understand the challenges. But even in that case, it seems more of a symbolic gesture rather than a robust emergency exercise that will help local residents prepare for a worst-case scenario, which is what the drill is all about. The dangers of improvising an evacuation as radiation spews into the heavens as happened in Fukushima back in 2011 are well-known, but this lesson seems, like many others, to have been forgotten or sidelined. As the people of Fukushima understand too well, there are no do-overs and taking these lessons seriously is essential.

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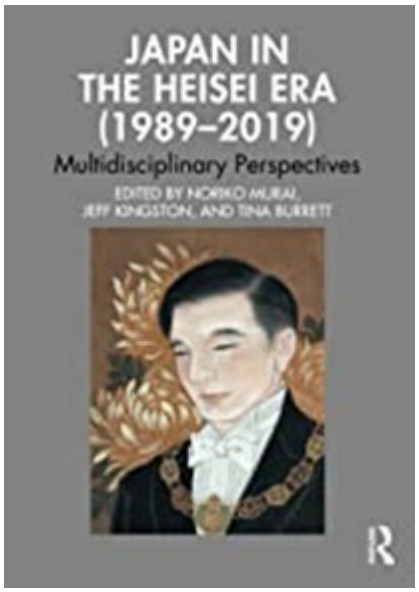

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