

The Lid Comes Off Fukushima Daiichi, “Japan’s Ground Zero”: The Devastating Consequences of Government Inaction

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Global Research, October 15, 2013

[The Asia-Pacific Journal, The Asia-Pacific Journal, Volume 11, Issue 35, No. 1, September 2, 2013.](#)

Region: [Asia](#)

Theme: [Environment](#)

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Japan’s searing summer of 2013 saw the lid slide further off Fukushima Daiichi and its Pandora’s box of radioactive and political crises.

The company in charge, Tokyo Electric Power Company (Tepco), already Japan’s most distrusted firm,² was irredeemably exposed as dangerously incompetent.

A slew of reports concerning leaks of high-level radiation led to increasingly concerned appeals, from within Japan and from overseas, for the Abe Shinzo government to take over at Fukushima Daiichi.



Damaged reactors at Fukushima Daiichi

The most recent opinion poll, released by the Mainichi Shimbun on August 25, shows that no less than 91% of the Japanese public wants the government to intervene.³

Clearly, Abe’s August 7 gambit of publicly declaring “Tepco: shape up!” convinced few that he was doing enough. Indeed, while the Mainichi was in the midst of polling, Abe was being lambasted by an August 23 editorial in Nishinihon Shimbun.

The editors demanded he act, expressing open dismay that he would call for decisive action from Tepco given its shameful record of endless mishaps and denials.⁴

From beyond Japan’s shores, The Economist depicted Fukushima Daiichi as a “nightmare”

with “no end in sight,”⁵ and the editors of Bloomberg addressed Abe directly with stern warnings that the site is “ground zero” for his government, insisting that decisive intervention is crucial in order to “redeem Japan’s nuclear industry, jump-start its economy, and perhaps increase the odds of removing the radioactive pall over Tokyo’s bid to land the 2020 Olympics.”⁶ The August 28 Business Times Singapore spoke up from the East, and excoriatingly editorialized that “Mr Abe appears grudging in his occasional statements of ‘regret’ at the ongoing crisis but resentful that it continues to dent Japan’s international image. Certainly, it embarrasses a country anxious to promote overseas sales of nuclear reactors and to bring other idled reactors back on line.” The editors highlighted the proliferating “international dimensions” of the crisis and cautioned that if Fukushima Daiichi “is not an international threat, then it is difficult to see what is.”⁷

Indeed, as the Business Times Singapore warned, the foreign media are not alone in being alarmed by the Abe administration’s unwillingness to get a grip on Fukushima Daiichi. Japan’s neighbouring states and civil societies also evince increasing concern. South Korea’s Asiana Airlines announced on August 21 that, as of October, because of Fukushima Daiichi, they would discontinue charter flights to Fukushima City.⁸ The situation is in fact so grave in South Korean eyes that the August 8 minutes of the Bank of Korea’s 15th Monetary Policy Board meeting expressed concern that further mishandling of Fukushima Daiichi could make it a “black swan” in the larger context of economic uncertainty confronting the global financial economy in the fall.⁹ And results from the South Korean Gallup agency poll over the three days ending August 29 indicated that 78% of Koreans believe their country is already being impacted by radiation from Fukushima Daiichi. Moreover, whereas 70% of South Koreans regard New Zealand and Australian food as safe, and 75% see South Korean domestic food as safe, an astounding 90% now deem Japanese food products as unsafe.¹⁰

As for China, on August 21 the state officially expressed “shock” over the situation, with its Foreign Ministry calling for Japan to “take effective steps to put an end to the negative impact of the after-effects of the Fukushima nuclear accident.”¹¹ But the government was also careful to declare domestically that the Chinese State Oceanic Administration’s survey results show radiation flows (including Cesium 134) from Fukushima Daiichi into the aquatic environment but not into areas under Chinese jurisdiction. They also stressed they were doing follow-up surveys of the marine environment, and have stated they reserve the right to request entry into waters near Daiichi to conduct to assess the impact the ongoing leaks were having on the ocean.¹² While the official response has been measured, at the popular level – as expressed on Chinese twitter – there is what appears to be a rising magma of outrage.¹³ Given that China-Japan relations are already deeply troubled due to the Senkaku/Diaoyu Islands dispute and the Abe government’s stance on Japan’s role in World War Two, Fukushima Daiichi’s ongoing leaks of contaminated water could further exacerbate tensions.¹⁴

The heightened concerns and calls for a change in the way Daiichi is being managed have been driven by Tepco’s woeful management of the stricken power plant, which continues to be a very grim comedy of errors, with the company lurching from one problem to the next. The accidents, pratfalls and post-obfuscation revelations just keep coming: a rat causing the whole plant to lose power; steam mysteriously appearing above the reactors; reports of

questionable hiring and workplace practices, including contract workers not receiving sufficient safety gear; and, of course, the ongoing issues with large quantities of contaminated water leaking into the ground and ocean.¹⁵

The most visible crisis for the last week of August stemmed from an estimated 300 tons of highly toxic water, laced with such deadly radionuclides as Strontium-90, leaking from a tank hastily constructed in the months after the accident. This became a level-3 crisis on August 21, 'serious' on the UN's 7-point International Nuclear Event Scale, and represents the most urgent reported problem at the plant since the initial meltdowns. There has been debate over whether the leak merited a level 3 determination. But Kathryn Higley, specialist in the spread of radiation, head of Oregon State University's Department of Nuclear Engineering and Radiation Health Physics, and one of the few commentators who has actually spent time at the site, warns that it is a serious problem: "It's one thing to have these radiation levels in areas of the plant that by design are going to be hot...This is not by design."¹⁶

The most recent revelation at the time of writing – and it is difficult to keep up – is Tepco's September 1 disclosure that it has found several more radiation hotspots, "one with levels so high it could kill a person within a few hours."¹⁷ This new admission follows an August 28 confession that the leakage of 300 tons of highly radioactive water likely began about 6 weeks before its August 19 discovery.¹⁸ That it took Tepco weeks to notice any of this is no surprise: as Associated Press reporter Mari Yamaguchi notes, Tepco confessed that its monitoring of the 1,000 storage tanks consisted of two workers taking a two-hour walk, twice daily, without dosimeters and without compiling records.¹⁹ Indeed, the tanks themselves were so poorly monitored it remains unclear exactly how much contaminated water escaped. Tanaka Shunichi, chairman of the Nuclear Regulation Authority, has admitted that, "we don't think the leak was exactly 300 tons. ... It could be much more or much less".²⁰

Moreover, the latest leaks come in the wake of Tepco's admission that contaminated water has been flowing into the ocean since the accident first occurred almost two and half years ago. Crises have popped up with such frequency that NRA Chairman Tanaka has described the plant as being like a 'haunted house' in which 'mishaps keep happening one after the other'.²¹ The endless trail of problems, mistakes and obfuscations has left few doubts for most observers that Tepco is not up to the incredibly difficult and important task of decommissioning Daiichi. This awareness underlies the escalating calls for the Abe government to take a more hands-on role.

Sleight of Hand

In response to the level-3 incident at Daiichi, Motegi Toshimitsu, minister of the Ministry of Economy Trade and Industry (METI), announced on August 26 that, "from now on, the government will move to the forefront."²² This position was echoed by Abe, who declared at a press conference in Qatar on August 28 that, "the accident in Fukushima cannot be left entirely to Tokyo Electric Power. There is a need for the government to play a role with a sense of urgency, including taking measures to deal with the waste water."²³ Yet while promising that METI would "step up its scrutiny of TEPCO's measures to respond to a 300-

tonne leak of heavily radioactive water at the site,” Shinkawa Tatsuya, METI director of the nuclear accident response office, was also very clear that TEPCO would remain in control: “This is TEPCO’s plant. It has all the technology, all the maps, all the technical data on Fukushima Daiichi. I think [it] can control the situation, under oversight from the government.”²⁴



These promises for closer supervision of TEPCO’s failing efforts did little to convince the ever-growing ranks of Japanese and overseas observers sceptical of the Abe government’s management of TEPCO and the decommissioning process. Kira Yoshiko, of the resurgent Japan Communist Party, called for immediate action: “The government should declare a state of emergency right now, and intervene to stop the outflow of contaminated water.”²⁵ From the other side of the political spectrum, Toichi Tsutomu, the managing director and chief economist of the Tokyo-based Institute of Energy Economics (an institute closely allied with METI and the nuclear village), insisted that “Tepco is unable to solve the problems on its own...The government has to step in.”²⁶

Influential actors within the ranks of Abe’s LDP also began openly questioning his government’s management of the situation. On August 28, LDP Diet member and party deputy secretary general Kohno Taro bluntly derided the most recent promise for closer supervision: “The METI way of thinking is crazy...TEPCO doesn’t want to spend money, and TEPCO doesn’t want to use their personnel. The government has to step up and take responsibility for all of this, otherwise we won’t get on top of the situation.”²⁷

Pressure from local actors is also intensifying. Sato Yuhei, the Fukushima Prefectural Governor, has called for government intervention as “there is no risk management at TEPCO and they are no longer capable of dealing with this on its own.” The Niigata Prefectural Governor, Izumida Hirohiko (a former MITI/METI energy official),²⁸ has gone even further, openly calling for the liquidation of TEPCO “because right now short-term funding concerns are taking priority over resolving the problems.”²⁹

Incredibly, Abe and his close-knit circle are yet to fully grasp the magnitude of the crisis Japan is facing at Daiichi. Yet the longer Abe allows it to fester, distracted by nuclear sales, tax hikes, and the September 7 Olympic vote, the more he risks making the history books as the PM asleep at the wheel.

The Magnitude of Fukushima Daiichi

Japan has been lucky. That expression may seem counterintuitive given the magnitude of the triple disaster, but in spite of the well over YEN 11 trillion worth of damage wrought by the nuclear accident, Japan has been very fortunate that nothing worse has occurred.³⁰ Recall that in the crisis' darkest hours, the Kan government had to consider evacuating Metropolitan Tokyo's over 13 million population (10% of Japan) should the situation at Daiichi spiral further out of control.³¹ This impossible challenge was avoided because several critical factors worked in consort. Many of them were enumerated by Funabashi Yoichi, chair of the Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident:

- the tsunami hit on a weekday, which meant there was 10 times more workers on-site than on a weekend;
- the wind blew out to sea until March 15, which helped the venting process and limited the amount of people exposed to radiation (this was not so fortunate for American sailors, however³²);
- rain did not fall, which limited the amount of radiation spread;
- the explosion at No. 3 Reactor actually sent water into the storage pool in the No. 4 Reactor;
- and, more controversially, Kan Naoto was Prime Minister at the time, because he "understood what the government had to do at the most vital time of the crisis and what decision had to be made at that time."³³

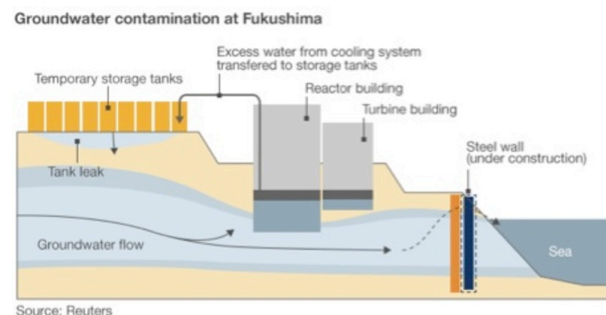
But, as Funabashi cogently warns, luck eventually runs out. And the longer TEPCO remains in charge of the clean-up and decommissioning process, the worse Japan's odds become.

Consider the scale of the contaminated water issue alone. Tepco have 330,000 metric tons stored in about 1000 above-ground tanks (at roughly 90% of their full 390,000 ton capacity³⁴), within the site's drainage system (apparently 20,000 tons of highly contaminated water³⁵), and an undetermined amount in underground storage tanks.³⁶ Every day, according to the Japanese Agency for Natural Resources and Energy, the Nos 1 to 4 area of the Daiichi site receives about 1000 tons additional groundwater flow from the nearby mountains. Of this amount, it appears that roughly 400 tons come in contact with the reactors' structures and underground radioactive wreckage and is thus contaminated, with roughly 300 tonnes of that flowing into the ocean. The remaining 600 tons appears not to be going into the reactor basements, but some volume of it appears to be getting contaminated elsewhere before flowing into the sea.³⁷



Tepco uses about 400 tons of water per day to inject into the ruined reactor facilities (especially the area around the three 100-ton molten fuel cores) in order to keep them cooling. That amount is mixed with the 400 tons flowing in as groundwater. Tepco recycles half and pumps out the latter 400 tons of contaminated water and puts it into these above-ground tanks, each with 1000 ton capacity.³⁸ So every 2.5 days, a new tank is necessary, for an annual total of roughly 150,000 tons. About 350 of the 1000 tanks already in place were for “temporary” storage, hastily thrown together with bolts and bits of cast-off material, and some of them are already leaking.³⁹ That suggests some will need to be replaced. At the same time, Tepco plans to continue installing additional tank capacity, leading to total above-ground storage capacity of 700,000 tons in 2015 and 800,000 tons at the end of the 2016 fiscal year.⁴⁰ But its ability to keep adding tanks is limited by proximity to the facilities, stability of the surface, and the area of Daiichi itself. So Tepco are, so to speak, trying to go up on a down escalator, dealing with “one of the most challenging engineering tasks of our generation.”⁴¹

Several international experts argue the solution is removal of very dangerous strontium and cesium (some leaked water’s radioactivity was 8 million times Japan Ministry of Health and Welfare limits) and then dilution and disposal. The Atomic Energy Society of Japan, for example, includes an accident investigation board that is calling for this. In late August, the board concluded that “It would be realistic to dilute the contaminated water to levels found in the natural world and release it into the ocean after removing radioactive materials other than tritium.” But this kind of release plan is contingent on Tepco getting its Multi-nuclide Removal Equipment (ALPS) back into operation. It is planned to be capable of removing 62 different radionuclides from 500 tons of water per day,⁴² but is offline at present due to weakness in the face of the corrosive water it is designed to filter.⁴³



But even this plan, desperate as it is, is contingent on stopping the flow of groundwater.⁴⁴ And there’s the rub. The present plan for stopping the groundwater flow is an “ice barrier” of about 1500 super-cool liquid-filled pipes encircling the ruined reactors.⁴⁵ In addition to being incredibly expensive – at least tens of billions of yen to build and YEN 1 billion per year to maintain – and requiring a huge amount of energy to operate, there are serious doubts over whether it would work. Indeed, one of Japan’s leading specialist firms on such frozen soil applications (which are used in subway construction and other projects) did not offer a bid in the contract tender for a feasibility study, because it regards the task as altogether different from the standard applications. That project is a technology that has “never been used on such a scale,” and is in any event not in the cards until 2015.⁴⁶

So at present there is no real solution to the water problem. Simply throwing it all into the

sea, as suggested for example by Andy Coghlan in *NewScientist*,⁴⁷ is not likely to happen. Not only is there the growing international concern, but even the Japanese NRA is not sure what is in the water leaking out to sea and what damage it might be causing.⁴⁸

This is Not Just About Water

Without downplaying the seriousness of the contaminated water, and the other setbacks at Daiichi, it is important to recognise that things could very easily, and very quickly, get much worse.

Understandably, most commentary on Daiichi focuses on the multiple leaks of water laced with high- and low-level radiation, but the oncoming challenges are far more serious. As Robert Alvarez, former Senior Policy Advisor at the US Department of Energy and one of the world's top spent fuel pools experts, has warned, sites such as Fukushima Daiichi "have generated some of the largest concentrations of radioactivity on the planet."⁴⁹ They need to be handled by the most competent and best-equipped expertise available.

But sit down and take a deep breath, because from November, TEPCO plans to begin the delicate operation of removing spent fuel from Reactor No. 4 fuel pool. There was no fuel within this reactor per se, so the ambient level of radiation is lower than the neighbouring three reactors. So in that respect, this is the easiest of the cluster. Even so, there are 1,533 used fuel rod assemblies tightly packed together in the spent-fuel pool above the reactor.⁵⁰ They weigh a total of 400 tons, and contain radiation equivalent to 14,000 times the amount released by the Hiroshima atomic bomb.⁵¹ The spent-fuel pool stands 18 metres above ground, was damaged by the earthquake and tsunami, and is in a deteriorating condition. It remains vulnerable to any further shocks, and is also at risk from ground liquefaction. One might add there is a significant terrorist threat, considering the damage that could be done with a light plane or some similar attack. Removing the spent fuel from No 4 and the other pools, bundles that among other fission products contain deadly plutonium,⁵² is clearly an urgent task but must be done properly.

Even under ordinary circumstances spent-fuel removal is a difficult task, normally requiring the aid of computers. But due to the damage, removal of the total 6840 spent fuel bundles from Daiichi No. 4's spent fuel pool, the five other reactors' pools,⁵³ and the entire unit's common pool will have to be done manually. This work will also be undertaken under arduous conditions, increasing the risk of yet another mishap. And if something does go wrong, the consequences could be far more severe than any nuclear accident the world has ever seen. If a fuel rod is dropped, breaks or becomes entangled while being removed, possible worst case scenarios include a big explosion, a meltdown in the pool, or a large fire. Any of these situations could lead to massive releases of deadly radionuclides into the atmosphere, putting much of Japan, including the metropolises of Tokyo and Yokohama, and even neighbouring countries at serious risk.

When the stakes are this high, who do you want to bet on? TEPCO's track record is abysmal. They have done nothing to indicate they can be trusted with handling this difficult task. Even now there are few signs that TEPCO has fully understood the magnitude of the situation they - and we - collectively face, and many signs that their priority has been and remains the company's bottom line not the public interest. This is literally a matter of

national security – another mistake by TEPCO could have incredibly costly, even fatal, consequences for Japan.

Time for Action

While it may be politically inconvenient for Prime Minister Abe to accept, it is time to intervene and take over Daiichi before it is too late. The recent announcements by Abe and Moteji that the government will be intervening more directly in Daiichi are a necessary start, but these appear to be more about managing the political damage than resolving the key issue, which is that TEPCO is simply not up to the task of dealing with the multiple technological challenges. The ongoing debacle over the contaminated water leaks has clearly demonstrated that relying on the NRA to oversee TEPCO is insufficient. Fuketa Toyoshi, a NRA commissioner, recently complained that their “instructions, written or verbal, have never been observed.”⁵⁴ The time for supervising is over – TEPCO must be relieved of control of the whole decommissioning process.

Understandably some may question whether things would actually be much different if the Japanese government took over from TEPCO. While there are certainly grounds for scepticism, the NRA has shown signs that it will be more independent and competent than its predecessor. And placing the Daiichi site directly under the control of the Japanese government creates different kinds of responsibilities and authority. Given that safely decommissioning Daiichi has become a matter that has consequences for all of Japan, leaving it in the hands of a private company (even if propped up with public cash) is insufficient. It is vital that Fukushima Daiichi’s decommissioning be fully taken over by the Japanese government with the assistance of an international task force of experts. Removing the spent fuels from the damaged reactors is something that has never been attempted before, and therefore Japan needs all the help it can get from the international community.

Mykle Schneider, an independent international consultant on energy and nuclear policy with deep understanding of Fukushima Daiichi, has proposed one way of intervening. Schneider’s proposal is to create an international task force of experts on the most pressing issues that have to be dealt with at Daiichi. The Japanese government and NRA would remain in control. But an international task force – led by one Japanese and one international expert – could offer recommendations for dealing with the most challenging aspects of the decommissioning process. Schneider’s outlines his proposal as follows:

A core group of about a dozen experts would work full-time on the project and could draw at will on the expertise of several dozen corresponding experts that are carefully selected by the core group. A significant share of the core group should be independent experts (i.e. with no link to corporate or state interests). In addition, the ITFF would work in an open expert network, free to draw on any expertise in any field that it judges pertinent.⁵⁵

This is only one possible plan, but indicates the scale of initiative the Abe government needs to begin seriously considering. Reflecting on the disaster, former PM Kan Naoto recently observed that, “Somewhere inside me I just believed that, with Japan’s technological proficiency, an accident would not occur. I greatly regret that optimism now.”⁵⁶ Kan’s hindsight is now our collective foresight, and Abe needs to view matters this way as well. Undue optimism or even wilful blindness must not be permitted to hold sway in handling the decommissioning of Daiichi.

It is certainly understandable that Prime Minister Abe and his backers do not want to directly take on this toxic job. They risk being tarred with responsibility for further mishaps. They will also have to release contaminated water, and thus risk undermining their campaign to restart Japan's 48 idled nuclear reactors.⁵⁷ But this crisis is clearly too big for TEPCO, and the public overwhelmingly wants decisive intervention. So the buck stops at the PM's desk. Even if he cannot recognise the necessity of changing course with the way Daiichi is being managed, Abe should be able to realise that it is also in his political interests to make some drastic changes. While the Prime Minister may be in a relatively powerful position at present, with his party controlling both houses and facing a weak opposition, the political landscape could shift quickly if the situation at Daiichi continues to deteriorate.⁵⁸ Indeed, many of Abe's other key aims as leader – including restoring Japan's economy and national pride – are dependent on successfully managing the precarious situation at Daiichi. Another major accident would greatly undermine his “Abenomics” program, which has been central to his political success this time around. Even his pro-nuclear agenda is reliant upon what happens in Fukushima: with each new problem or revelation, public scepticism towards nuclear power only deepens.

This crisis at Fukushima Daiichi transcends the politics of being pro- or anti-nuclear. The evidence overwhelmingly indicates that Fukushima Daiichi's current management is an unsustainable threat to the future of the country. To be polemical: Abe can save Japan or TEPCO, but he can't save both. When put in those terms, the choice is an easy one. Or at least it should be.

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Their joint editorial appeared in [The Japan Times](#) and is available in [Japanese translation](#).

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Notes

¹ This is a much expanded and updated version of an op-ed article that ran in the August 29, 2013 Japan Times. See Christopher Hobson and Andrew DeWit "Government must take over Fukushima nuclear cleanup," August 29, 2013: [here](#)

² For example, Tepco ranks by far the worst in the Nikkei BP July 4 "Environmental Brand Survey" of 560 domestic firms' brand image for global warming efforts, energy efficiency, resource-efficiency, and waste treatment. See (in Japanese) "Nikkei BP 'Environmental Brand Survey 2013,'" July 4, 2013: [here](#)

³ See "91 percent of Japanese want gov't to step in a Fukushima plant: Mainichi poll," Mainichi Shimbun, August 26, 2013: <http://mainichi.jp/english/english/newsselect/news/20130826p2a00m0na004000c.html> The original Japanese release a day before, on August 25, is at: [here](#)

⁴ See (in Japanese) Nishinihon Shimbun, "As Much as Level 3: Why is the National Government Slow to Respond?" August 23, 2013: [here](#)

⁵ See "Japan's leaky nuclear plant: no end in sight," The Economist, August 24, 2013: [here](#)

⁶ See The Editors; Bloomberg, August 26, 2013: ["Abe's Nuclear Imperative Starts at Fukushima,&rdquo](#)

⁷ See Editors; Business Times Singapore, August 28, 2013: ["Fukushima risks must be addressed urgently,&rdquo](#)

⁸ Note that the carrier "only started the charter flights in July at Japan's request." August 22, 2013: ["Asiana Cancels Flights to Fukushima," The Chosunilbo](#)

⁹ The minutes were released August 27, and were remarked upon in "Japanese Radiation Leak: Leading Japan to Possible Become a 'Black Swan,'" Business Korea, August 29, 2013: [here](#)"

¹⁰ In consequence, Japan's products rank with scandal-plagued Chinese food products, hardly a positive outcome for a Japan keen to promote food exports. On the poll, see (in Japanese) "Korean Poll Shows Nearly 80% Believe "Radiation Damage From Japan," TBS (JNN) News, August 31, 2013: [here](#)

¹¹ See Sebastian Sarmiento-Saher, "Japan's Never-Ending Nuclear Nightmare", The Diplomat, August 24, 2013: [here](#)

¹² On this, see (in Japanese) Imazeki Chuuba, "China State Oceanic Administration: "Marine Effects From Fukushima Nuclear Accident Expanding," SBI Searchina, August 26, 2013: http://news.searchina.ne.jp/disp.cgi?y=2013&d=0826&f=national_0826_033.shtml and Antoni Slodkowski, "Fukushima operator to seek foreign advice on toxic water", Reuters, August 26, 2013: [here](#)

¹³ This aspect is covered (in Japanese) by Hatakeyama Sakae, “Japan Covered in Sin: Chinese Twitter on the Leak of Contaminated Water From the Fukushima Reactors,” SBI Searchina, August 23, 2013: [here](#) The volume of messages include such sentiments as “no matter how big the crime, little Japan’s unfazed,” “the little one’s sole contribution to the world is doing harm,” “the US atom bomb didn’t wipe out the Japanese, but they’re exterminating themselves with leaked radiation.”

¹⁴ These tensions are already so fraught that in an annual survey taken since 2005 by China Daily and the Japanese non-profit think tank Genron NPO, mutual aversion was at its worst level in a decade. Fully 92.8% of Chinese surveyed “hold a negative attitude toward Japan, 28 percentage points higher than last year. Similarly, 90.1 percent of “ordinary” Japanese have negative feelings toward China, in contrast to 84.3 percent last year.” The survey was conducted in June and July of 2013, prior to the intensified concern over Fukushima Daiichi. See “Diaoyu Islands issue drives China-Japan enmity: survey,” Xinhua, August 7, 2013: http://news.xinhuanet.com/english/china/2013-08/07/c_132611210.htm

¹⁵ A good summary can be found in Jake Adelstein, “Japan’s nuclear comedy just goes on and on,” Japan Times, August 31, 2013: [here](#)

¹⁶ Quoted in Patrick J Kiger, “Fukushima Leak’s ‘Level 3’ Rating: What It Means,” National Geographic, August 29, 2013: <http://news.nationalgeographic.com/news/energy/2013/08/130829-fukushima-level-3-serious-incident-rating/> Professor Higley spent a week earlier this year at Fukushima Daiichi, as noted in Phred Dvorak, “Japan Races To Contain Worst Fukushima Spill Since Meltdown,” Wall Street Journal, August 22, 2013: [here](#)

¹⁷ On this, see Mark Willacy “New radiation hotspots found at Fukushima nuclear plant,” Australian Network News, September 1, 2013: [here](#)

¹⁸ See Mari Yamaguchi “Japan: Nuke Plant Operator Found Leak Too Slowly,” ABC News, August 28, 2013: [here](#)

¹⁹ Mari Yamaguchi “Japan: Nuke plant operator found leak too slowly,” Associated Press (via Kansas City Star), August 28, 2013: [here](#) Tepco has since increased the tank patrol personnel by 50 to around 60 people in total, using thermography to check tank levels.

²⁰ See Mari Iwata, “Authority Chairman Not Convinced Level 3 Needed”, Japan Real Time, August 28, 2013: [here](#)

²¹ See Kiyoshi Takenaka and James Topham, “Japan’s nuclear crisis deepens, China expresses “shock””, Reuters, August 21, 2013: [here](#)

²² See Yuji Okada, Takashi Hirokawa and Jacob Adelman, “TEPCO ‘Whack-a-Mole’ Means Government Takeover in Fukushima”, Bloomberg, August 27, 2013: [here](#)

²³ See “Japan PM pledges greater government role at Fukushima”, Channel NewsAsia, August 29, 2013: [here](#)

²⁴ See Ben McLannahan, “Japan says Tepco to retain control of Fukushima Site”, Financial Times,

August 28, 2013: [here](#)

²⁵ See Hiroko Tabuchi, “Nuclear Operator Raises Alarm on Crisis”, New York Times, August 23, 2013: [here](#)

²⁶ Quoted in Quirin Schiermeier and Jay Alabaster, “Government ‘must step in’ to halt Fukushima leaks,” Nature, August 29, 2013: [here](#)

²⁷ See Ben McLannahan, “Japan says Tepco to retain control of Fukushima Site”, Financial Times, August 28, 2013: [here](#)

²⁸ Governor Izumida entered METI’s predecessor organization MITI in 1987, after graduating from Kyoto University’s Department of Law. Before his 2004 election as the Governor of Niigata Prefecture, he spent considerable time in MITI’s Agency for Natural Resources and Energy. On this, see the Governor’s home-page profile (in Japanese) at: [here](#)

²⁹ On these statements and their context, see Aaron Shadrack and Mari Saito, “Japan official wants Fukushima operator Tepco to be liquidated,” Reuters, August 28, 2013: <http://uk.reuters.com/article/2013/08/28/us-japan-nuclear-tepco-idUKBRE97R0L820130828>

³⁰ This accounting of course omits much human suffering from being displaced as well as the potential health damage. One of the most authoritative speakers on the latter is Kodama Tatsuhiko, Professor in the Laboratory for System Biology and Medicine, RCAST, University of Tokyo, who warns convincingly that “Two Years After the Nuclear Accident, We Must Now Contemplate the Internal Irradiation,” Actio, May, 28: <http://actio.gr.jp/2013/05/28103038.html>

³¹ See Martin Fackler, “Japan Weighed Evacuating Tokyo in Nuclear Crisis, New York Times, February 27, 2012: [here](#)

³² On this, see Roger Witherspoon, “A Lasting Legacy of the Fukushima Rescue Mission: Cat and Mouse with a Nuclear Ghost,” The Asia-Pacific Journal, Vol 11, Issue 12. No. 1, March 15, 2013: [here](#)

³³ See Roy K. Akagawa, “Interview – Yoichi Funabashi: Fukushima nuclear crisis revealed Japan’s governing defects”, Asahi Shimbun, February 29, 2012: [here](#)

³⁴ The figures are from Tepco spokesperson Suzuki Kaoru, and are cited in Jason Rogers “Faulty Tank at Fukushima Had Been Dismantled, Moved, Tepco Says,” Bloomberg, August 26, 2013: [here](#)

³⁵ On this aspect, see the citation of Tepco’s admission that this water’s cesium content was 2.35 billion becquerels per litre versus normal background levels of 150 becquerels per litre, in Sreeja VN “Japanese Government To Support Tepco’s Efforts to Contain Fukushima Contaminated Water Leak,” International Business Times, August 7, 2013: [here](#)

³⁶ Tepco initially built seven of these underground tanks with a total capacity of 58,000 tons, as a cheap means of storing contaminated water. But in April of 2013, leakage from these tanks forced Tepco to move their contents above-ground. On this, see “TEPCO faces ‘biggest management crisis’ after toxic water leak from Fukushima tank,” Mainichi Shimbun, August 22, 2013: <http://mainichi.jp/english/english/newsselect/news/20130822p2a00m0na014000c.html> As of August

17, Tepco reports some remaining water in the tanks. See “Water Leak from the Underground Reservoirs in Fukushima Daiichi Nuclear Power Station (Follow-up Information No. 216),” Tepco Press Release, August 17, 2013: [here](#)

³⁷ On this information, see (in Japanese) “Agency for Natural Resources and Energy Reports Calculation of Daily Flow of 300 Tons of Contaminated Water From Fukushima Daiichi into the Sea,” Reuters, August 7, 2013: [here](#)

³⁸ On these numbers, see Fred Dvorak, “Japan Races to Contain Worst Fukushima Spill Since Meltdown,” Wall Street Journal, August 22, 2013: [here](#)

³⁹ On the tanks, see Mari Saito and Antoni Slodkowski, “They Have No Idea What to Do With 330,000 Tons of Radioactive Water Leaking At Fukushima,” Reuters (via Business Insider), August 23, 2013: [here](#)

⁴⁰ For the storage numbers, see “NRA: Water leak at Fukushima nuclear plant a ‘serious incident.’” Asahi Shimbun, August 21, 2013: <http://ajw.asahi.com/article/0311disaster/fukushima/AJ201308210065> And note that this article, as with some others reports Tepco spokespersons suggesting that the total capacity of above-ground tanks at the site as of August 6 was 412,000 tons, with 80% (346,000 tons) of contaminated water already stored. These data conflict with other statements from Tepco

⁴¹ See Yuriy Humber, “Fukushima’s toxic water pool grows as Tepco dithers,” The Age, August 31, 2013: [here](#)

⁴² On the AESJ statement, see “Radioactive water should be diluted, released into ocean: experts,” Mainichi Shimbun, August 29, 2013: [here](#)

⁴³ The ALPS unit was built by Toshiba and “was taken offline after the radioactive water it was designed to filter was found corroding its pipes and basins.” See “ALPS filter off until at least September,” Japan Times, August 26, 2013: [here](#)

⁴⁴ On this critical but largely ignored point, see paragraphs 13 and 14 of Yuriy Humber and Jacob Aldeman, “Tepco faces 132 Olympic Pools Worth of Radioactive Water,” Bloomberg, August 28, 2013: [here](#)

⁴⁵ A concise (and perhaps unduly optimistic) description of the technology is available at Peter Fairley, “How the Fukushima Ice Barrier Will Block Radioactive Groundwater,” MIT Technology Review, August 30, 2013: [here](#)

⁴⁶ On these numbers, see Fred Dvorak’s careful work, “Japan Races to Contain Worst Fukushima Spill Since Meltdown,” Wall Street Journal, August 22, 2013: [here](#) and “Japan Studies Plan to Contain Radioactive Water,” Wall Street Journal, August 29, 2013: [and here](#).

⁴⁷ Coughlan argues that Japan should “filter out as much radioactive material as possible, dilute the rest, and dump it in the Pacific.” But he neglects to discuss the on-site capacity for this filtration, the various types and levels of radionuclides, and the international dimensions of the crisis. See Andy Coughlan “Should Fukushima’s radioactive water be dumped at sea,” August 28, 2013: [here](#)

- ⁴⁸ See “Japan regulator urges more comprehensive monitoring of Fukushima sea to assess impact of leaks,” Washington Post, August 29, 2013: [here](#)
- ⁴⁹ Robert Alvarez is quoted in Matsumura Akio, “Fukushima Daiichi Site: Cesium-137 is 85 times greater than at Chernobyl Accident,” April 3, 2012: [here](#)
- ⁵⁰ On this, see (in Japanese) “Fuel Removal Preparation in Final Stages: Fukushima Daiichi No 4 Pool,” Chugoku Shimbun, September 1, 2013: [here](#) This article declares there are 1533 used fuel rods in the pool, whereas the “Report by The American Nuclear Society Special Committee on Fukushima” indicates an inventory of 1535, of which 204 are new. See Table 1 “SPF Inventories and Estimated Total Decay Heat”: [here](#) The discrepancy is due to Tepco’s having removed two unused bundles from the pool in a test in 2012: Aaron Sheldrick and Antoni Slodkowski, “Insight: After disaster, the deadliest part of Japan’s nuclear clean-up”, Reuters, August 13, 2013, [and here](#).
- ⁵¹ See Aaron Sheldrick and Antoni Slodkowski, “Insight: After disaster, the deadliest part of Japan’s nuclear clean-up”, Reuters, August 13, 2013, [here](#)
- ⁵² On the contents and other aspects of so-called “high-level waste,” see the US Nuclear Regulatory Commission “Backgrounder on Radioactive Waste,” US NRC, February 4, 2011: [here](#)
- ⁵³ For the precise number per pool as well as their decay heat, see the “Report by The American Nuclear Society Special Committee on Fukushima,” Table 1 “SPF Inventories and Estimated Total Decay Heat”: http://fukushima.ans.org/inc/Fukushima_Appendix_G.pdf The report’s co-chairs were Dale Klein, Ph.D., former chairman of the Nuclear Regulatory Commission, Michael Corradini, Ph.D., Wisconsin Distinguished Professor of nuclear engineering and engineering physics at the University of Wisconsin, and Eric Loewen, Ph.D., President of the American Nuclear Society. For these and other details, see [here](#)
- ⁵⁴ See “Japan upgrades Fukushima nuclear leak to ‘serious incident,’ slams plant operate for late response’, CBS News, August 28, 2013: [here](#)
- ⁵⁵ See Mycle Schneider, “Why Fukushima is worse than you think”, CNN, August 30, 2013: [here](#)
- ⁵⁶ See Edan Corkill, “Naoto Kan speaks out”, The Japan Times, August 31, 2013: [here](#)
- ⁵⁷ All of Japan’s nuclear reactors will be offline from September 15, when reactors 3 and 4 at Kepco’s Oi plant go into their regular maintenance schedule. See Eric Johnston “Fukushima spill snags reactor restart quest,” Japan Times, August 29, 2013: [here](#)
- ⁵⁸ Indeed, former PM Koizumi Jun’ichiro has of late been challenging Abe directly on the entire nuclear issue. Koizumi insists it is essential to declare a zero nuclear target now. He is apparently causing deep consternation in the Abe inner circle because he has the ears of the growing anti-nuclear LDP contingent. Koizumi persuasively argues with such examples as (re the claim that the Japanese economy will collapse without nuclear power) in the past it was said “Manshu is a lifeline,” but Japan developed in spite of its loss [after the Pacific War]. He also points to the fact that this was an extraordinarily, once-in-a-century, hot summer and nuclear power was not necessary. See (in Japanese) “PM Abe Deathly Pale? Koizumi Jun’ichiro declares himself for getting out of nuclear and calls on the PM to decide,” Nikkan Gendai, August 27: [here](#) Koizumi’s challenge was widely carried

by the Japanese media. A summary of his thinking and how he arrived at his conclusions is available at "Former PM Koizumi's anti-nuclear case makes sense," Mainichi Shimbun, August 26, 2013: [and here](#).

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