

TEPCO'S ATOMIC ILLUSION

“TEPCO will not lose trust because they already had lost it.”ⁱ

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Fukushima Daiichi Nuclear Plant, February 2016 ©Christian Aslund/Greenpeace

ⁱ Professor Takeo Kikkawa, “Tepco safety review issues could raise local government concerns”, Graduate School of Innovation Studies, Tokyo University of Science, S&P, Platts, Nucleonics Week, Volume 58 / Number 9 / March 2, 2017.

INTRODUCTION

Hemorrhaging customer base, Fukushima costs of tens of trillions of yen, and no prospects for operating the Kashiwazaki Kariwa (KK) nuclear reactors – Takashi Kawamura, the incoming chair of Tokyo Electric Power Company Holdings, Inc. (TEPCO), has a toxic mountain to climb. The survival strategy of TEPCO is based on the successful implementation of its new business plan revealed in May 2017 – the third since the Fukushima Daiichi nuclear accident of March 2011.

This briefing summarizes some of the elements of the new business plan, and assesses the prospects for TEPCO in the coming years.

FUKUSHIMA COSTS

In November 2016, the Japanese Government announced a revised estimate for the Fukushima nuclear accident (decommissioning, decontamination, waste management and compensation) of ¥21.5 trillion (US\$188 billion) – double the estimate given in 2013.¹ Despite the dramatic increase in projected costs, they are certainly an underestimate given the many unknowns related to the prospects and feasibility for actual ‘decommissioning’ of the Fukushima plant.² The doubling of cost estimates after only five years since the accident began reminds us of the historical and on-going failure of the nuclear industry to provide accurate economic forecasts. This is compounded by the realistic prospect that managing the disaster at the site will extend into next century.

A new assessment published in early March 2017 from the respected Japan Center for Economic Research (JCER) highlights these uncertainties, with an estimate two to three times higher than even TEPCO’s revised 2016 projection. In this analysis, JCER estimates that total costs for ‘decommissioning’, decontamination, and compensation of the Fukushima could range between ¥50-70 trillion (US\$449-628 billion),³ and with enormous uncertainties,

“These calculations are premised on decommissioning the Fukushima Daiichi Nuclear Power Plant. In reality, we don’t even understand the situation with the melted nuclear fuel (debris). In the worst-case scenario, it is conceivable that the plans to retrieve the debris will be abandoned, and that the reactor will be turned into a sarcophagus that has been maintained for all eternity as in the case of the Chernobyl plant. The costs of this scenario have not yet been estimated.”⁴

If over the coming years these latest estimates are confirmed, the Fukushima accident will prove to be the most expensive industrial accident in history.⁵

1 Nikkei Asian Review, “Fukushima cost estimate set to swell to \$188bn” 9 December 2016, see <http://asia.nikkei.com/Politics-Economy/Policy-Politics/Fukushima-cost-estimate-set-to-swell-to-188bn>

2 Asia Times, “The earthquake question”, Daniel Hurst, 8 March 2017, see <http://www.atimes.com/article/unanswered-questions-fukushima-nuclear-disaster/>

3 Japan Center for Economic Research, “Accident Cleanup Costs May Rise to ¥50-70 Trillion - It’s Time to Examine legal liquidation of TEPCO - Higher Transparency is Needed for the Reasons to Maintaining Nuclear Power”, Tatsuo Kobayashi, Principal Economist, Professor Tatsujiro Suzuki, Specially Appointed Fellow (Director of Nagasaki University Research Center for Nuclear Weapons Abolition), Kazumasa Iwata, JCER President, see <http://www.jcer.or.jp/eng/research/policy.html>

4 Ibid.

5 The closest comparison in terms of costs is the 1986 Chernobyl accident, with cost estimates ranging from US\$100-500 billion, see The Financial Costs of the Chernobyl Nuclear Power Plant Disaster: A Review of the Literature, Jonathan M. Samet and Joann Seo, MPH, MSW, 21 April 2016, see https://uscglobalhealth.files.wordpress.com/2016/01/2016_chernobyl_costs_report.pdf

In May 2017, TEPCO announced its 'Revised Comprehensive Special Business Plan (The Third Plan)', premised on the basis that it will improve TEPCO's "profitability and increase its enterprise value in order to fulfill its responsibilities for the Fukushima Nuclear Accident."⁶ TEPCO states that based on the current estimated costs of the Fukushima Daiichi accident it will require the company to pay 16 trillion yen, requiring it to secure 500 billion yen each year (US\$4.5 billion) through to 2026. TEPCO Holdings, the entity established to manage the destroyed nuclear site, and the Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) are desperately seeking ways to sustain the utility in the years ahead, confronted as they are with escalating costs due to the Fukushima accident and electricity market reform. The NDF was originally established by the Government in 2011 to oversee compensation payments and to secure electricity supply, with its scope was broadened in 2014 to include overseeing the decommissioning of the Fukushima Daiichi plant.⁷ The latest TEPCO restructuring plan is intended to find a way forward for TEPCO by securing a future for its nuclear, transmission, and distribution businesses, including the proposed partnership with other utilities to operate the KK nuclear plant. But the plan, already received less than warmly by other utilities rightly concerned at being burdened with TEPCO's liabilities, is premised on the lower Fukushima cost estimates of ¥21.5 trillion not ¥50-70 trillion.

To date, TEPCO's Fukushima costs have been largely covered by interest-free government credit which in December 2016 was increased from ¥9 trillion to ¥14 trillion as of 2017.⁸ Since 2012, TEPCO's electricity ratepayers have paid ¥2.4 trillion to cover nuclear-related costs, including the Fukushima accident site.⁹ That is a pittance compared to the looming costs in future decades and beyond. These growing accident-related costs come at a time when TEPCO and the other electric utilities are under commercial pressure as never before due to electricity market liberalization.

Since April 2016, domestic electricity consumers in Japan have been able to switch from the monopolistic utilities to independent power providers. Ten months after the initial liberalization, in February 2017, the main electric utilities had lost 2.5 million customers. TEPCO alone lost more than 1.44 million, resulting in a sales drop of 11.7 percent representing ¥5.36 trillion in lost sales.¹⁰ Consequently, profits have fallen off a cliff. In the year to March 2017, pretax profit dropped 30.2 percent to ¥227.62 billion, in part due to decreased electricity prices resulting from declining crude oil prices.¹¹

6 TEPCO, "Outline of the 'Revised Comprehensive Special Business Plan (The Third Plan)' 18 May 2017, see https://www4.tepco.co.jp/en/press/corp-com/release/betu17_e/images/170518e0101.pdf

7 Nuclear Damage Compensation and Decommissioning Facilitation Corporation, (in Japanese) see <http://www.ndf.go.jp/>

8 Nikkei Asian Review, "Japan lifts Tepco's credit line to 14tn yen", 8 December 2016, see <http://asia.nikkei.com/Politics-Economy/Policy-Politics/Japan-lifts-Tepco-s-credit-line-to-14tn-yen>

9 Japan Times, "Tepco customers have paid ¥2.4 trillion to cover nuclear power-related costs since 2012 rate hike", 30 December 2016, see <http://www.japantimes.co.jp/news/2016/12/30/business/tepco-customers-shelled-¥2-4-trillion-uke-related-costs-since-2012-rate-hike/#.WN06ERJ95E4>

10 Reuters, "More than 2.5 mln Japan retail power users switch to new entrants" 8 February 2017, <http://www.cnbc.com/2017/02/08/reuters-america-table-more-than-25-mln-japan-retail-power-users-switch-to-new-entrants.html>

11 Kyodo, "Cost-cutting keeps Tepco in black but nuclear redress taking toll", 29 April 2017, see <http://www.japantimes.co.jp/news/2017/04/29/business/corporate-business/cost-cutting-keeps-tepco-black-nuclear-redress-taking-toll/#.WTnapBN95E4>

TEPCO's consolidated net profit was ¥132.81 billion, down 5.7 percent, not least due to costs related to the Fukushima nuclear accident of ¥392 billion.¹² Prior to the deregulation of the retail electricity market, TEPCO had 22 million customers. As the outgoing TEPCO Chair observed late last year: ***"The number (of customers leaving TEPCO) is changing every day as the liberalization continues.. . We will of course need to think of ways to counter that competition".***¹³

In TEPCO's non-nuclear division, as the JCER report notes,

"The Thermal Power Department and other departments where profits are expected are also exposed to competition when the retail market is liberalized, and there is no guarantee of stable gains from "excess profit" to a degree that can cover the cost of decommissioning the reactor."¹⁴

Further plans to spread the escalating costs of Fukushima centre round METI plans to have other utilities and new power companies pay a proportion of compensation costs. METI's justification for charging customers of new energy companies is that they benefited from nuclear power before the market opened.

The monumental threat to TEPCO is underscored by the proposal for covering the latest official cost estimates for the Fukushima disaster. Of the ¥22 trillion, ¥16 trillion is supposed to be covered by TEPCO through income and shares. The Ministry of Finance is to cover ¥2 trillion for decontamination, and the remaining ¥4 trillion is to be covered by other power companies and new electricity providers.

KASHIWAZAKI KARIWA RESTART PLAN – NOT CREDIBLE

"We had to set a temporary timeline of when to restart reactors to make the business plan. But we cannot predict anything for sure," TEPCO Chair Naomi Hirose, January 2014.¹⁵

A critical factor in TEPCO's new business plan to secure ¥500 billion in funds each year to cover Fukushima accident costs is the restart of Kashiwazaki Kariwa (KK) reactor units 6&7 in Niigata Prefecture. TEPCO is relying on these reactors to provide pretax profits of between ¥160 billion and ¥215 billion on average over the next 10 years.¹⁶ However, reactor units 6&7 have been offline since 2012 and 2011, and TEPCO has so far failed to overcome local and prefectural opposition to restart. Instead of generating income, these reactors cost TEPCO ¥240 billion (US\$2.3 billion) each year they remain offline.¹⁷

12 Ibid.

13 Reuters, "Sales slump for Japan's top utilities after retail power market shakeup", 1 November 2016, see <http://retail.economictimes.indiatimes.com/news/industry/sales-slump-for-japans-top-utilities-after-retail-power-market-shakeup/55177698>

14 Japan Center for Economic Research, "Accident Cleanup Costs May Rise to ¥50-70 Trillion - It's Time to Examine legal liquidation of TEPCO - Higher Transparency is Needed for the Reasons to Maintaining Nuclear Power", Tatsuo Kobayashi, Principal Economist, Professor Tatsujiro Suzuki, Specially Appointed Fellow (Director of Nagasaki University Research Center for Nuclear Weapons Abolition), Kazumasa Iwata, JCER President, see <http://www.jcer.or.jp/eng/research/policy.html>

15 Japan Times, "Tepco business plan, including July reactor restart, gets official OK", 15 January 2017, see <http://www.japantimes.co.jp/news/2014/01/15/national/tepcos-business-plan-including-july-reactor-restarts-gets-official-ok/#.WTT0pROGNE4>

16 Nikkei Asian Review, "Tepco's turnaround prospects hang on retooled nuclear ops", 12 May 2017, see <http://asia.nikkei.com/Business/Companies/Tepco-s-turnaround-prospects-hang-on-retooled-nuclear-ops>.

17 S&P, Platts, "Tepco faces questions about potential nuclear alliance, analysts say", NUCLEONICS WEEK Volume 57 / Number 44 / November 3, 2016.

When TEPCO submitted its second business plan to the Japanese government in 2014 it predicted that units 6&7 would be restarted in mid-2014 and units 1&5 in late 2014.¹⁸ These were never realistic.

Three years later, though TEPCO's third 10-year business plan remains heavily dependent upon the restart of the KK reactors, it has once again pushed back restart, [proposing that it will be in 2019 at the earliest. In three scenarios,¹⁹ TEPCO envisages restart of KK units 6&7 from 2019, 2020 or 2021. Of the other KK reactors, TEPCO is aiming restart for units 1 and 5 from 2021, 2022 or 2023, and units 2, 3 and 4 from 2024, 2025 or 2026. In the worst-case scenario, TEPCO excludes a restart date for unit 2.

Status and Prospects Kashiwazaki Kariwa Nuclear Power Plant 23 June 2017

Reactor	MWe	Start up/Age	Shut down(1)	NRA Application		Long Term Outage (LTO)	Status - Length of shutdown: as of 23 June 2017	Earliest proposed start date – TEPCO plan May 2017	Length of shutdown at earliest proposed start date (1 st April of FY)	Prospects
				Submission	Approval					
Kashiwazaki-Kariwa Unit 1 BWR	1100	1985 – 29 years	06/08/11			Yes	2149 days	2021	3526 days	Uncertain/Decommission
Kashiwazaki Kariwa Unit 2 BWR	1100	1990 – 24 years	19/02/07			Yes	3778 days	2025	6617 days	Uncertain/Decommission
Kashiwazaki Kariwa Unit 3 BWR	1100	1993 – 21 years	16/07/07			Yes	3631 days	2024	6104 days	Uncertain/Decommission
Kashiwazaki Kariwa Unit 4 BWR	1100	1994 – 20 years	16/07/07			Yes	3631 days	2024	6104 days	Uncertain - Decommission
Kashiwazaki Kariwa Unit 5 ABWR	1100	1990 – 24 years	25/01/12			Yes	1907 days	2021	3354 days	Uncertain/Decommission
Kashiwazaki Kariwa Unit 6 ABWR	1365	1996 – 18 years	23/06/12	27/09/13		Yes	1827 days	2019	2473 days	Not before 2021 at earliest
Kashiwazaki Kariwa Unit 7 BWR	1365	1997 – 17 years	23/08/11	27/09/13		Yes	2132 days	2019	2778 days	Not before 2021 at earliest

The proposed plan for restart is not credible. Even on TEPCO's schedule, the KK 6&7 units will have been shutdown for nine and ten years respectively if they restarted in 2021, the earliest restart date for these reactors. The situation is even worse for units 3&4, which have no prospect of restarting on TEPCO's schedule of 2021. Already the reactors have not operated since 2007, and it will be seventeen years before they do based on TEPCO's schedule. Restarting reactors that have been shutdown for many years is complex and not without major risks, with the maintenance and inspection regime required to be robustly applied over a period of years, not something that TEPCO is renowned for.²⁰

18 Japan Times, "Tepco business plan, including July reactor restart, gets official OK", 15 January 2017, see <http://www.japantimes.co.jp/news/2014/01/15/national/tepcos-business-plan-including-july-reactor-restarts-gets-official-ok/#.WTT0pROGNE4>

19 For TEPCO's proposed schedule for restart of Kashiwazaki Kariwa reactors, TEPCO, "Outline of the 'Revised Comprehensive Special Business Plan (The Third Plan)' 18 May 2017, see https://www4.tepcoco.jp/en/press/corp-com/release/betu17_e/images/170518e0101.pdf

20 "Japanese nuclear safety scandal uncovered", 30 August 2002, see <http://www.greenpeace.org/international/en/news/features/japanese-nuclear-safety-scanda/>

As the years pass with no operation of the KK reactors, the debate is increasingly likely to turn to which reactors at the site will be decommissioned rather than restarted. On 1st January 2017, the mayor of Kashiwazaki City announced that as a condition for allowing restart of units 6&7, TEPCO must propose a decommissioning plan by 2019 for at least one reactor from units 1-5 (with no upward limit on the number of these reactors to be permanently shuttered).²¹ The mayor suggested it is inevitable to scale down the KK plant,

“Considering the Fukushima nuclear accident, seven reactors are too many.”²²

The importance of this position should not be underestimated given the central role Kashiwazaki City plays, with local consent a prerequisite to any reactor restart. As already noted, the latest TEPCO business plan includes one scenario with no planned restart date for KK unit 2, suggesting that the utility is already considering decommissioning.

There are major and multiple barriers to the restarting the KK 6&7 reactors, the only two TEPCO reactors under NRA review, with prospects for the other units even more uncertain, these include:

Seismic – Though the Kashiwazaki Kariwa site has a history of major seismic activity, TEPCO also has a history of repeatedly underestimating the risks, and covering up these errors.²³ Almost unbelievably, there are 23 seismic fault lines close to, or under, the nuclear plant site.

Seismologists have long warned about the threat from major earthquakes leading to a severe nuclear accident at KK.²⁴ Opposition to plans to construct the KK plant began as early as 1974, due in large part to seismic risks. Before construction began on unit 1 in 1980, it was known that the ground conditions of the KK site was one of the worst among all of Japan's nuclear power plants. It was necessary to dig down about 40 meters to get to a stratum able to support a nuclear reactor.²⁵ When the Chuetsu-oki earthquake struck Niigata in 2007,²⁶ the reactor buildings were jolted by the 6.8 Japanese Seismic scale quake beyond their design basis. The KK unit 3 turbine building experienced east-west movement 2.5 times above the design basis acceleration.²⁷

21 Niigata-Nippo, “Mayor Kashiwazaki asks TEPCO for decommissioning one of Units 1 to 5”, 6 January 2017 (in Japanese) see <http://www.niigata-nippo.co.jp/news/national/20170601327254.html>

22 Mainichi, “Mayor to link reactor decommissioning to restarting 2 others at same TEPCO plant”, 2 June 2017, see <https://mainichi.jp/english/articles/20170602/p2a/00m/0na/002000c>

23 In August 2002 it was announced that TEPCO had passed periodic inspections of its nuclear power plants by altering inspection data and concealing cracks. This was the first TEPCO scandal. After the scandal was revealed, TEPCO nuclear reactors shut down for periodic inspections could not be restarted and in the spring of 2003 operation of all 17 TEPCO reactors was suspended. At the time of the licensing of the ABWR 6&7 reactors in 19991 TEPCO presented evidence to NISA that the nearby fault lines were not active. This was then proven to be incorrect, with TEPCO's own data showing that they were aware of active faults, including in 1980 though none of this was made public until after the 2007 quake – see http://www.cnrc.jp/english/newsletter/nit123/nit123articles/kkearthquake.html#e*5

24 Professor Ishibashi Katsuhiko, “Why Worry? Japan’s Nuclear Plants at Grave Risk From Quake Damage,” Japan Focus, 1 August, 2007 Volume 5 | Issue 8, see <http://apijf.org/-Ishibashi-Katsuhiko/2495/article.html>

25 Consisting largely of sand deposits of the Arahama Dune Bed.

26 For an overview of the Chuetsu-oki earthquake see,

http://www98.griffith.edu.au/dspace/bitstream/handle/10072/42174/71142_1.pdf;jsessionid=7BDA0FCBF0003D1DDFE6F39FC56BFC17?sequence=1

27 TEPCO, “Impact of the Chuetsu-oki Earthquake on the Tokyo Electric Power Company (TEPCO) Kashiwazaki Kariwa Nuclear Power Station and Countermeasures”, September 2007, see <http://www.tepco.co.jp/en/news/presen/pdf-1/0709-e.pdf>.

The epicenter of the 2007 sub-seabed event was 15km northwest from the plant and the ground motion far exceeded KK's basic S1 and S2 earthquake ground motions assumed when the plant was designed.²⁸ Unit 1 was only designed to withstand a M6.9 earthquake arising from the Kihinomiya Fault, and the other units were also built to the pre-2006 seismic guidelines. TEPCO chose during the construction phase, including for the newer 6&7 units, not investigate the possibility of active offshore faults. Even when it did become aware of these, in advance of construction of units 6&7 in 1992/93, it chose not to disclose them.²⁹ TEPCO's original calculations indicated that a M6.9 earthquake arising from the Kihinomiya Fault would only cause a ground motion of 222 Gal (S1), while a M6.5 earthquake directly beneath the plant would only cause a ground motion of 274 Gal (S2). However, to be on the 'safe side', design basis ground motion S1 was set at 300 Gal, while design basis ground motion S2 was set at 450 Gal. In the event, these figures turned out to be gross underestimates.³⁰ During the 2007 Chuetsu-Oki earthquake the ground motion at the 'free surface of the base stratum' for KK Unit 1 was calculated to be 1,699 Gal.³¹ All operating units were shut down, unit 7 was restarted in 2009³²; units 1, 5 and 6 restarted in 2010; however units 2, 3 and 4 have not operated since 2007.³³

Despite TEPCO³⁴ and the IAEA³⁵ concluding that KK shutdown was successful and with no serious damage, it is known that this major seismic event impacted safety functions at the site. Damage of one form or another has been confirmed at more than 3000 locations at the plant. Warnings of the failure of nuclear regulation and TEPCO to conduct effective seismic assessments were made immediately after the 2007 event.³⁶

28 The Kashiwazaki-Kariwa nuclear power plant was designed for basic horizontal earthquake ground motions of 300 Gal (S1) and 450 Gal (S2). Gal is a unit of acceleration. Gravitational acceleration at the earth's surface is 980 Gal. These figures apply to a hypothetical surface called "free surface of the base stratum", where S1 is an earthquake ground motion that could actually occur, while S2 is an almost inconceivable hypothetical earthquake ground motion. Tertiary layers, or earlier bedrock that has not been eroded are generally referred to as "ground". Hypothesizing that above this ground there are no layers or structures, the surface spreading out horizontally is called the "free surface of the base stratum".

29 CNIC, "Kashiwazaki-Kariwa Nuclear Power Plant Seismic Design of the Kashiwazaki-Kariwa Nuclear Power Plant: a Historical Perspective", Nuke Info Tokyo No. 130, 10 May 2009, see <http://www.cnic.jp/english/?p=1988#note5>.

30 Martin Fackler, "Japan's Quake-Prone Atomic Plant Prompts Wider Worry", New York Times, 25 July 2007, see <http://www.nytimes.com/2007/07/25/world/asia/25japan.html>

31 This figure was derived from a peak east-west ground motion of 680 Gal recorded by a monitor in the fifth floor basement of Unit 1, see CNIC, "Kashiwazaki-Kariwa Nuclear Power Plant Seismic Design of the Kashiwazaki-Kariwa Nuclear Power Plant: a Historical Perspective", Nuke Info Tokyo No. 130, 10 May 2009, see <http://www.cnic.jp/english/?p=1988#note5>

32 On the same days as restart TEPCO had problems in unit 7 when problems occurred in the main steam line - (steam leakage from the turbine driven reactor feed water pump – see <http://www.tepco.co.jp/en/press/corp-com/release/09060801-e.html>; reactor operation continued and then on May 11th a further problem occurred with the reactor core isolation cooling system (RCIC), when the water level of the suppression pool went beyond the normal level..."[T]he RCIC could not be shut down by normal procedure and had to be shut down manually at the site." The problems led to a departure from the "Limiting Condition for Operation" stipulated in the Technical Specification. The reactor was subsequently restarted and operated through the remainder of 2009, through to 2011 – see, <http://www.cnic.jp/english/newsletter/pdf/files/nit130.pdf>

33 IAEA Power Reactor Information System, PRIS, Japan, see, <https://www.iaea.org/PRIS/CountryStatistics/CountryDetails.aspx?current=JP>

34 Nucnet, "No Damage To Kashiwazaki Kariwa Fuel, Tepco Confirms", 26 July 2007, see, <http://www.nucnet.org/all-the-news/2007/07/26/no-damage-to-kashiwazaki-kariwa-fuel-tepco-confirms/print>

35 The IAEA produced three reports on Kashiwazaki-kariwa between 2007 and 2009 – see <http://www.iaea.org/newscenter/news/2009/kashiwazaki290109.html>

36 Letter to the IAEA Concerning Earthquake Damage at the Kashiwazaki-Kariwa Nuclear Power Station", Citizens' Nuclear Information Center (Tokyo, Japan), Greenpeace Japan (Tokyo), Green Action (Kyoto), 6th August 2007, see <http://greenaction-japan.org/en/2007/08/letter-to-the-iaea-concerning-earthquake-damage-at-the-kashiwazaki-kariwa-nuclear-power-station/>

Following the March 2011 Fukushima Daiichi accident, the revised Nuclear Regulation Authority (NRA) guidelines, while they did not revise the seismic guidelines of 2006, it did require more extensive assessments of the seismic risks at nuclear plants, including a longer historical record requirement to determine if a fault was active or not. The NRA now defines an active fault as one that has moved any time within the last 400,000 years (in contrast to the previous 120,000-130,000 years). It's worth emphasizing that seismologists have warned that a strong earthquake of up to about 7.3 magnitude could directly hit an area where even perfect seismic research could not discover an active fault line,³⁷ underscoring that while identifying active faults is important, the presence of inactive faults does not preclude a future major event. The seismic formula used by the NRA has been widely criticized as flawed in multiple submissions to court cases during the last three years, including those for the Sendai, Takahama, Ikata, and Hamaoka and reactors, as well as a for the KK plant. Specifically, the so-called Irikura/Miyake method used by the NRA underestimates deformation when using estimated fault area values.³⁸ The result of this is that actual seismic measurements at a site could be several times higher.

This was the view of former NRA deputy chair Kunihiro Shimazaki when he testified in April 2016 in a court case against the Ohi nuclear plant in Fukui prefecture. Shimazaki, an emeritus professor of seismology at Tokyo University and the only seismologist to have been an NRA commissioner during his period in office from 2012-2014, has challenged the formulas used by the regulator in computing the scale of earthquakes, which he believes underestimates potential seismic impact by factor of 3.5.³⁹ In 2016, he warned that,

"I see lack of clarity and responsibility in committees of experts organized by the state...In the world of science, we can together look for facts and can reach agreement to a certain extent. That is not the case when the state is involved, and mistakes will be repeated if we are not aware of the difference."⁴⁰

In July 2016, the NRA dismissed Professor Shimazaki's evidence.

Further critical analysis of the NRA's seismic approach includes the failure to adequately apply uniform hazard spectrum in probabilistic analysis, and at a level less than that applied for example by the U.S. Nuclear Regulatory Commission (NRC),⁴¹ with the NRA failing to provide sufficient explanation as to the process used to construct the uniform hazard spectra. The result of this is that the NRA is adopting an approach that undermines its own efforts to determine the specific seismic hazard at any given site, including at Kashiwazaki Kariwa.

37 Ishibashi Katsuhiko is a professor at the Research Center for Urban Safety and Security of Kobe University, International Herald Tribune/Asahi Shinbun on August 11, 2007

38 Mainichi, "NRA to scrap recalculated quake ground motion data for Oi nuclear plant", 21 July 2016, see <http://mainichi.jp/english/articles/20160721/p2a/00m/0na/013000c>

39 Shimazaki, "'Maximum-class' Japan Sea tsunami scenarios are less than maximum-class — An error, left uncorrected, is a recipe for another 'unforeseeable' disaster, Kagaku (Science Journal), Vol. 86, No. 7, July 2016, see https://www.iwanami.co.jp/kagaku/eKagaku_201611_Shimazaki.pdf

40 Japan Times, "State ignored predictions 10 years before 3/11 tsunami, says seismologist", 23 March 2016, see <http://www.japantimes.co.jp/news/2016/03/23/national/state-ignored-predictions-10-years-311-tsunami-says-seismologist/#.WTK44xN95E4>

41 Sato-Satoshi, "Technical Issues of Japanese Seismic Evaluations from the Point of Global Standards", 28 April 2015, commissioned by Greenpeace Japan, see <http://www.greenpeace.org/japan/global/japan/pdf/20150428-seismic-evaluation-en.pdf>

“When comparing the process of determining the design-basis-earthquake in Japan to other examples in the U.S. and other countries, there are many unclear elements in the Japanese process, as it is not worked out comprehensively. It is unacceptable to promote this process as the highest standard in the world.” Satoshi Sato, former General Electric engineer, 2015.⁴²

Two of the 23 faults at the KK site, designated alpha and beta, run under unit 1. TEPCO had previously stated that they had not moved in the last 120,000-240,000 years, though seismic experts doubted their conclusions. There remain enormous uncertainties as to whether the KK reactors could withstand the 7.5 magnitude earthquake that could occur when the fault at the eastern end of the sea basin off Sadogashima Island in Niigata Prefecture slips.⁴³ In June 2015, an NRA subcommittee concluded that they could not rule out the presence of an active fault beneath the KK units 6&7. This was subsequently amended and declared inactive. However, investigations have continued. In 2016, the relationship between the presence of volcanic ash at the site and possible active fault lines became public. This was the main issue raised as recently as 22 May 2017, by geologists and other scientists who challenged TEPCO and the NRA over their seismic assessments at the Kashiwazaki Kariwa site.⁴⁴ They countered that the conclusion that there are no active faults at the site was incorrect and called for a full-scale review of the science.⁴⁵

In February 2017, TEPCO's efforts to move forward with restart of Kashiwazaki Kariwa suffered another setback. In evidence to the NRA, it confirmed that the planned Emergency Response Center (ERC), does not meet the regulator's seismic requirements. The on-site ERC would be essential in the event of a severe accident. TEPCO had originally said the building could withstand an earthquake with a maximum intensity of seven on the Japanese seismic scale. During the NRA screening process, however, it acknowledged that it may not be able to withstand even half of the assumed strongest seismic shaking, TEPCO said it learned about the inadequate level of earthquake resistance in 2014, but the information had not been shared within the company or communicated to the NRA. In response to the disclosures, NRA Chairman, Shunichi Tanaka, stated that it had, ***“left us with lingering suspicions.”***⁴⁶

The NRA subsequently ordered TEPCO to resubmit the review application for the KK reactors, while also continuing the current review. TEPCO has now decided to create an ERC inside the KK unit 5 reactor building to meet NRA requirements.

Until recently, TEPCO had also failed to disclose the risks of liquefaction at the site. However, in October 2016, TEPCO informed the NRA that it will be reviewing its plan for restart of the 6&7 units due to the 'discovery' that ground liquefaction as a result of an earthquake could collapse the nuclear plants tsunami seawalls.⁴⁷

42 Ibid.

43 CNIC, “No future for Kashiwazaki-Kariwa except gradual decommissioning” Nuke Info Tokyo No. 157, 27 November, 2013, see <http://www.cnic.jp/english/?p=2849>

44 Kashiwazaki Kariwa Nuclear Power Fault Study Group, “Kashiwazaki Kariwa Nuclear Power Station site and its surroundings - Proposal for strict scientific judgment on stratigraphy of middle and upper Pleistocene”, 22 May 2017, (in Japanese) see <http://masatate.blog.fc2.com/blog-entry-55.html>

45 NHK, “Kashiwazaki Kariwa Nuclear Power Plant” Fault “Inactive” experts reviewed review”, 17 April, 2017.

46 S&P, Platts, “Tepco safety review issues could raise local government concerns”, NUCLEONICS WEEK Volume 58 / Number 9 / March 2, 2017.

47 Mainichi, “TEPCO to review plan to reactivate nuclear reactors due to liquefaction fears” 14 October 2016, see <http://mainichi.jp/english/articles/20161014/p2a/00m/0na/012000c>.

The site is divided into a lower area at an elevation of 5 meters above sea level where units 1-4 are located; units 5-7 are in an area of the site 12 meters above sea level. Liquefaction occurred at the site during the 2007 Chuetsu-Oki earthquake.

TEPCO analysis presented to the NRA concluded that the tsunami walls protecting units 1 through 4 could be destroyed if the soil liquefied,⁴⁸ with the serious potential to affect operations elsewhere on the site, including at units 6&7, in the event of an emergency. Large-scale construction is expected to take at least a year in an attempt to counter the risks from ground liquefaction, with doubts over the effectiveness of such measures. Consequently, TEPCO will be further delayed in applying to the NRA for review of any additional reactors at the site.

SAFETY RETROFITS AND MAJOR QUESTIONS ON REACTOR PRESSURE VESSELS

TEPCO has invested ¥470 billion (as of September 2016) on retrofits and post-Fukushima safety measures at the Kashiwazaki Kariwa plant since March 2011. In January 2017, TEPCO revised its projected costs for such measures to ¥680 billion.⁴⁹ Investments so far have included construction of a 15 meter tsunami seawall, as well as the installation of filtered vents and catalytic hydrogen recombiners (to prevent hydrogen explosions). One measure includes the installation of a so-called corium shield beneath unit 6&7 Reactor Pressure Vessels (RPV), completed for unit 7 in May 2016, in an effort to prevent molten fuel in the event of a severe accident breaching the primary containment.⁵⁰ Though the effectiveness of these measures remains in doubt, it is at least acknowledgement by TEPCO that their reactors are at risk of a severe accident.

One of the major issues that remains ignored by both TEPCO, the regulator, and the other nuclear utilities in Japan, is the safety of their RPVs. These are Class 1 pressurized components, which are not permitted to fail due to the severe radiological consequences that would follow.

Reactor Pressure Vessels installed in all Japanese nuclear power reactors are at risk of catastrophic failure, due to potentially flawed manufacturing and quality controls exercises at the forging stages, technical assessments commissioned by Greenpeace Japan in 2016 concluded.⁵¹

Documents supplied to the NRA by the Japan Casting and Forging Company (JCFC), Japan Steel Works (JSW) and JFE Holdings all show the potential for excess carbon in their large steel forged components, so called positive macrosegregation, according to the report by nuclear engineering consultancy Large&Associates of London.⁵²

48 TEPCO, submission to NRA, 13 September 2016, see

http://www.tepco.co.jp/about/power_station/disaster_prevention/pdf/nuclear_power_160913_02.pdf

49 Yoichi Yoneya, "Kashiwazaki Kariwa Nuclear Power Plant Safety Cost, 1.4 times TEPCO's Forecast", Asahi Shimbun, 27 January 2017, see <http://www.asahi.com/articles/ASK1W6SG4K1WULFA03P.html>

50 TEPCO, First Quarter, FY2016 Nuclear Safety Reform Plan Progress Report (Including Progress on Safety Measures at Power Stations)", see http://www.tepco.co.jp/en/press/corp-com/release/betu16_e/images/160802e0102.pdf

51 Large&Associates, "Irregularities and Anomalies Relating to Nuclear Reactor Primary Cooling Circuit Components Installed in Japanese Nuclear Power Plants", Large&Associates, 10th December 2016, see

<http://www.greenpeace.org/japan/Global/japan/pdf/R3235-A2-12-12-16-FINAL.pdf>

52 Ibid.

While attention on the issue focussed on steam generator components, the issue is even more important in relation to RPV's. Japan Steel Works supplied all of the RPV components for KK (Boiling Water Reactors (BWRs) do not have steam generators). Whereas the NRA dismissed the possibility of carbon excess in these components, mainly on the basis of the methods of manufacture, the submissions of JSW, and JCDC and JFE, clearly show that macrosegregation heterogeneity forms in the pre-forged steel ingots for components installed in Japanese reactors. The submissions also showed that both JSW and JCFC used a flawed carbon content prediction model. In addition, the JCFC, JSW, and JFE submissions to the NRA included contradictions, anomalies, and misleading statements, which further increase concern regarding the quality control of their steel component manufacturing.

Contrary to the NRA's claim, JSW acknowledges that positive macrosegregation exists in the steel ingot with a residual amount remaining in its finished reactor pressure vessel components.⁵³ Despite this no checks have been conducted on the KK RPV's for carbon macrosegregation.

The risk of a KK RPV catastrophic failure, through Pressurized Thermal Shock (PTS), which occurs during a rapid drop in temperature in the cooling system, increases as a consequence of a higher carbon content and resultant reduced toughness of the steel.

By not ordering physical checks for carbon macrosegregation at Japanese reactors, including those at Kashiwazaki Kariwa, the NRA has demonstrated a complacency verging on incompetence that is reminiscent of its discredited and disbanded predecessor, NISA.⁵⁴ Given the reality that there is no prospect for restart of even the Kashiwazaki Kariwa units 6&7 in the near future, TEPCO should be required to conduct testing of those reactors RPVs.

Legal challenges There is an ongoing administrative lawsuit against the restart of the KK reactors, in particular centered on seismic risks at the site. There is also the near certainty of additional future legal challenges being filed, including injunction requests.⁵⁵ As has been shown in other cases, these lawsuits have the potential to delay and stop restart.

53 Japan Steel Works, ". . .Carbon segregation tends to occur in the top side riser of the ingot core. The riser is cut away and discarded in order to remove this region...The final component is located in a region where there is no increased component concentration zone, therefore, carbon segregation in excess of 0,26 wt.% does not remain", see "BWR Reactor Pressure Vessel Material: Manufacturing processes and measures to prevent remnant carbon segregation 17 October, 2016, as cited in Large&Associates, "Irregularities and Anomalies Relating to Nuclear Reactor Primary Cooling Circuit Components Installed in Japanese Nuclear Power Plants", Large&Associates, 10th December 2016, see <http://www.greenpeace.org/japan/Global/japan/pdf/R3235-A2-12-12-16-FINAL.pdf>

54 Large&Associates note that at minimum the NRA should have received certificates verifying that the zones of segregates had been removed at the appropriate intermediate stages of the forging process – this could have been in the form of the certified 'forging ratio'; a record of the discard weight; and chemical analysis of swarf and other small discards yielded during the interim rough and final finish machining stages, none of which has been provided in the submissions of power utilities or JCFC, JSW or JFE.

55 AFP, "Group files injunction to stop restart of Kashiwazaki-Kariwa reactors", 24 April 2012, see <https://japantoday.com/category/national/group-files-injunction-to-stop-restart-of-kashiwazaki-kariwa-reactors>

Political – Perhaps more than any other utility, TEPCO faces political opposition to its restart plan at the local and prefectural level. The mayor of Kashiwazaki city, Masahiro Sakurai, who had previously shown some understanding to the idea of restarts, expressed that his anxiety about TEPCO's nature has **"heightened"** due to the disclosures in February 2017 over the failure of the proposed Emergency Planning Center, which, combined with the disclosure last year that the company tried to cover up the core meltdowns at the Fukushima plant, **"There is now the possibility that I may not give my consent"** to the restarts.⁵⁶

It is however the election last year of the new Niigata Governor that presents the most challenging political obstacles to restart, one for which TEPCO has no solution for dealing with this in the near term. Exit polls at the time of the election found that 73 percent of voters opposed restarting the Niigata plant, while only 27 percent were in favor.⁵⁷ Elected with a clear mandate to stop restart of the KK reactors, the Governor's first term in office runs until mid-2020, beyond the earliest start up time proposed by TEPCO of 2019. It remains unclear whether Governor Yoneyama will run for a second term, but with polling numbers as they are (and they are unlikely to significantly diminish over the coming years) the opposition to restart from the people of Niigata is clear. Given that local and prefectural consent is a prerequisite for restart, TEPCO is confronted with a reality that they cannot overcome, at least in the coming years.

One of the Governor's central positions is that TEPCO has failed to fully investigate the causes of the Fukushima Daiichi disaster, and its impact on those affected, stating that:

"Five years after the accident, the situation still hasn't been resolved...(and that) a technological solution would also be rather difficult."⁵⁸

Given the ongoing nuclear crisis at the Fukushima Daiichi plant, including no feasible solution for retrieving the hundreds of tons of molten fuel beneath the reactor pressure vessels, there is no timetable for when TEPCO will be able to satisfy the Governor's demand that the Fukushima accident can be fully investigated.⁵⁹

In mid June 2017, the Governor stated that a soon to be created advisory committee will review the 2011 Fukushima nuclear disaster and its health impacts, as well as examine evacuation drills in Niigata.⁶⁰ The review would take an estimated 3 years, during which time consent for restart by local communities, the prefectural assembly, and Governor will not be possible.

56 Asahi Shimbun, "EDITORIAL: TEPCO blunders raise doubts on ability as nuke plant operator", 4 March 2017, see <http://www.asahi.com/ajw/articles/AJ201703040025.html>

57 Jeff Kingston, "Could nuclear advocacy be Abe's undoing?", Japan Times, 29 October 2016, see <http://www.japantimes.co.jp/opinion/2016/10/29/commentary/nuclear-advocacy-abes-undoing/#.WT0KBBN95E4>

58 Nikkei Asian Review, "Anti-nuclear mood prevails in Japan governor race", 18 October 2016, see <http://asia.nikkei.com/Politics-Economy/Policy-Politics/Anti-nuclear-mood-prevails-in-Japan-governor-race>

59 Daniel Hurst, "The Earthquake Question", Asia Times, 8 March 2017, see <http://www.atimes.com/article/unanswered-questions-fukushima-nuclear-disaster/>

60 Kentaro Hamada and Osamu Tsukimori, "Niigata governor's plans may upend TEPCO's nuclear restarts, restructuring", Reuters, 9 June 2017, see <http://www.euronews.com/2017/06/09/niigata-governors-plans-may-upend-tepcos-nuclear-restarts-restructuring>

On the issue of evacuation, and mirroring the position of his predecessor, Governor Yoneyama warned that,

“It is unclear how we will get the 10,000 buses needed to transport the 440,000 people living in the vicinity of Kashiwazaki Kariwa...⁶¹ I can't allow a restart as things stand now, when the lives and livelihoods of residents can't be protected.”⁶²

To compound these challenges to TEPCO, the possibility of a prefecture wide referendum was also raised by the incoming governor.⁶³ While not legally binding, a referendum has the potential to effectively stop the restart of all KK reactors. A poll on the 2016 Gubernatorial election showed about 64 percent of Niigata voters opposed the restart of any of the KK reactors.⁶⁴ The nuclear plant was already witness to a referendum in 2001 which terminated plans by TEPCO to use plutonium MOX fuel in unit 3. More than 50% of the Kariwa villager voted on 27 May 2001 in Japan's first referendum on the use of the MOX, with turnout at 88.14% of the village's 4 090 eligible voters. TEPCO abandoned its plans to use MOX fuel at Kashiwazaki-kariwa, which remains in storage in the spent fuel pools at the site.⁶⁵

TEPCO MERGER PLAN - NO TAKERS – PUSHED BACK TO 2026

In October 2016, a METI⁶⁶ official floated the idea of a creating a subsidiary for TEPCO's nuclear power operations, which could then be merged with another nuclear operator. ***“This would make it easier to make an alliance,”*** said a Nuclear Decommissioning Fund official.⁶⁷ TEPCO at the time declined to comment. Apart from the possible economic benefits of such a merger, it was thought that operating Kashiwazaki Kariwa with another utility could contribute to overcoming local opposition in Niigata to restart, and that METI:

“may ask Tohoku Electric Power Co. to join TEPCO to take over operation of Kashiwazaki-Kariwa-6 and -7...Niigata residents are familiar with Tohoku Electric, not TEPCO, as Niigata is an area where Tohoku Electric sells its electricity.”⁶⁸

The Japanese government has been a strong advocate of this approach, describing it as ***“essential”***, and thinking it would be a positive step toward 'detoxifying' TEPCO.⁶⁹

61 The Economist, “Stop-start - One plant illustrates the bleak outlook for the country's idle reactors”, 13 October 2016, see <http://www.economist.com/news/asia/21708727-one-plant-illustrates-bleak-outlook-countrys-idle-reactors-stop-start>

62 Nikkei Asian Review, “Anti-nuclear mood prevails in Japan governor race”, 18 October 2016, see <http://asia.nikkei.com/Politics-Economy/Policy-Politics/Anti-nuclear-mood-prevails-in-Japan-governor-race>

63 Sankei, “Prefectural referendum is also an option”, 18 October 2016, (in Japanese) see <http://www.sankei.com/life/news/161018/lif1610180036-n1.html>

64 Bloomberg, “Niigata governor Ryuichi Yoneyama stands firm against restart of Kashiwazaki-Kariwa plant”, Japan Times, 1 February 2017, see <http://www.japantimes.co.jp/news/2017/02/01/national/niigata-governor-ryuichi-yoneyama-stands-firm-against-restart-of-kashiwazaki-kariwa-plant/#.WTII8BN95E4>

65 “In the referendum, if the number against the Plutothermal Program [the MOX program] is in majority, we cannot implement it”, stated Tokyo Electric Power Company (TEPCO) President Naoya Minami, at a press conference in Kariwa, Japan, on 23 January 2001, WISE, “TEPCO admits referendum could kill MOX program”, 29 January 2001, see http://www.wise-paris.org/index.html?/english/ournews/year_2001/ournews010129.html&/english/frame/menu.html&/english/frame/band.html

66 METI's position on this is central to the future of TEPCO, the utility is now owned 50.1% by Nuclear Damage Compensation and Decommissioning Facilitation Corp., or NDF, which is a government body in combination with Japan's other nuclear utilities.

67 S&P, Platts, “Tepco may seek partner for nuclear operations”, quoting Shigehiro Yoshino, managing director at Nuclear Damage Compensation and Decommissioning Facilitation Corp., or NDF, cited in Nucleonics Week, Volume 57 / Number 43 / October 27, 2016. The NDF is Japanese government body that holds a 50.1% ownership stake in Tepco to oversees decommissioning work at Fukushima Daiichi.

68 S&P, Platts, “Tepco may seek partner for nuclear operations”, Nucleonics Week, Volume 57 / Number 43 / October 27, 2016.

69 Reuters, “Japan's Tepco to seek partners for nuclear business”, 11 May 2017, see <http://www.businessinsider.com/r-japans-tepco-to-seek-partners-for-nuclear-business-2017-5>

There was no enthusiasm from Japan's nuclear utilities for this proposal. In addition to the multiple practical, legal, liability and other financial risk issues, they have other priorities in overcoming the obstacles to restart their own reactors. In May 2017, Hokuriku Electric president made clear that, ***"We're not interested in a nuclear merger with them...Changing a plant operator would make it harder to get local trust on plant operations", views mirrored by both Chubu Electric.***⁷⁰

While the gas tie up between TEPCO and Chubu Electric is a potential model for a future partnership,⁷¹ the politics and complexity of such a merger are on a far grander scale. Eventual merger of struggling nuclear utilities may be inevitable, but not in the coming years. Reflecting this reality in early 2017, TEPCO pushed back merger plans, with a TEPCO official stating that:

"We're expecting a merger or integration to take place in 10 years or so. . . That would be longer than [the timeframe in which] we want to restart Kashiwazaki"⁷²

TEPCO, like all utilities in Japan, do not know what the future holds, including the number of reactors even available for restart in 2026. There is every possibility that only one, two, or none of its reactors will be operating by 2026, and there is a high probability that one or more reactors at Kashiwazaki Kariwa will already have been designated for decommissioning.

CONCLUSION

Much like the erroneous claim that the Fukushima Daiichi nuclear plant will be decommissioned in 3-4 decades, TEPCO and the central government are attempting to create an illusion for the people of Japan (including shareholders and investors⁷³), while at the same time deluding themselves on the prospects of success.

There will be no early restart for the Kashiwazaki Kariwa 6&7 reactors, the only two under NRA review. Multiple obstacles would need to be overcome, putting in significant doubt a restart even by 2021. TEPCO's own restart scenarios concede that units 2, 3, 4&5 may not operate before 2024-2026. If accurate, this would mean they would have been shutdown for between 11 and 19 years. The reality is that TEPCO's restart schedule for Kashiwazaki Kariwa, the world's largest nuclear power plant with a combined capacity of 7,965 MW, lacks all credibility. In addition, the decommissioning of the older reactors is now on the agenda, though for obvious financial reasons TEPCO cannot talk publicly about this. TEPCO's prospects in terms of nuclear reactor operations are wholly negative and their new business plan is not viable. Projections on TEPCO's earnings, and therefore their ability to cover dramatically rising Fukushima costs, are based on the false premise of an early restart of the KK reactors. Securing ¥500 billion each year to cover their share of Fukushima costs of ¥16 trillion is not going to be realized. Instead the Government is likely to seek to increase the share of costs to be borne by the taxpayer and other power companies.

70 Yutaka Kanai at a press conference May 19 2017, S&P Platts, "Tepco's revised offer for nuclear venture unlikely to lure partner: analysts", Nucleonics Week - Volume 58 / Number 21 / May 25, 2017.

71 The TEPCO/CHUBU 50/50 JERA joint venture was set up in April 2015 to reduce costs of procuring and selling fuel such as coal and liquefied natural gas.

72 S&P, Platts, "Tepco may seek partner for nuclear operations", Nucleonics Week, Volume 57 / Number 43 / October 27, 2016.

73 JP Morgan, "Tokyo Electric Power Company Holdings (9501): Feasibility of Revised New Comprehensive Special Business Plan Unclear, Retain Neutral Rating", Asia Pacific Equity Research, 29 May 2017.

This financial burden will only grow further as the actual costs of the Fukushima disaster rise – potentially to between ¥50-70 trillion.⁷⁴

The 2017 new business plan offers no real solutions to the enormous challenges faced by TEPCO; and, by extension, it exposes the deep flaws in current Japanese energy policy and its unrealistic nuclear share target of 20-22 percent by 2030. The new TEPCO President, Takashi Kawamura, confronted by this reality, will almost certainly be preparing yet another new business plan within the early years of his tenure.

74 Japan Center for Economic Research, “Accident Cleanup Costs May Rise to ¥50-70 Trillion - It’s Time to Examine legal liquidation of TEPCO - Higher Transparency is Needed for the Reasons to Maintaining Nuclear Power”, Tatsuo Kobayashi, Principal Economist, Professor Tatsujiro Suzuki, Specially Appointed Fellow (Director of Nagasaki University Research Center for Nuclear Weapons Abolition), Kazumasa Iwata, JCER President, see <http://www.jcer.or.jp/eng/research/policy.html>