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Blowout Panels Useless in an Accident – Basic design fault of the Tokai No.2 NPP

(1) Aerial photo of Unit 2 of Fukushima Daiichi NPS. Steam is coming out of the hole in the wall left by the fallen blowout panel. In the background is Unit 1 (taken on 10 April 2011)
(2) Fallen blowout panel and the open hole (taken on 29 August 2011)
(3) One example of a sliding door (taken on 11 March 2013)
Photos courtesy of TEPCO

Tokai No. 2 Nuclear Power Plant (NPP) is a Boiling Water Reactor (BWR), the same as the reactors which melted down at Fukushima Daiichi NPS. Its containment vessel is also Mark II type. Tokai No. 2 also sustained damage due to the 3.11 earthquake and tsunami, but avoided meltdown. It has been about 40 years since it began operations and it is one of the aging NPPs. 960,000 people live within a 30km radius and it is only 110km from Tokyo. Preparations are underway to restart it, but many people are opposed to a restart, claiming the risks are too high. (See CNIC Statement on p.5 for details)

What is a "blowout panel"?

The Japan Atomic Power Company (JAPC) has implemented design changes, additions and tests regarding the screening of the Tokai No.2 reactor building blowout panels.

The blowout panel is a device that prevents destruction of the reactor building by automatically releasing pressure from the building when pressure rises inside it. Problems were pointed out after hydrogen explosions occurred in reactor buildings during the Fukushima accident. In November 2017, the condition that "it must be possible to shut the blowout panel after it has opened" was added to the safety regulations. Tokai No.2 developed a blowout panel closure device and performed vibration tests to verify its function (opening-closing, airtightness) after an earthquake.

Technical problems were pointed out after the tests, and the principle issue is that the blowout panel is related to the structure of the reactor building itself and the design of several systems within it. This article takes an overall look at this issue, and having looked at the design conditions, considers their validity and the setting of severe accident conditions, and examines the blowout panel design standards and operation in detail.

Contents

Containment vessels are weak against external pressure

Containment vessels collapse at an external pressure 1/20 of the internal pressure

The boiling water reactor (BWR) containment vessel is known as the Primary Containment Vessel (PCV), which is intended to confine radioactive materials during an accident. If, for instance, a pipe ruptures inside the PCV in a loss-of-coolant accident, the PCV swells like a balloon to maintain its strength under the internal pressure.

In the case of the Mark II PCV pressure boundary at Tokai No.2, the design pressure is 310 kPa(G) (kilopascals at a gauge [G] reading that sets atmospheric pressure at zero), or roughly 3.1 atm (atmospheres) (G). With a diameter of about 26m and a steel plate thickness of 20-30mm, the PCV is a welded structure having a diameter/plate thickness ratio of nearly 1000. The design pressure of 3.1 atm means that the PCV will withstand twice that pressure (around 6.2 atm) in a severe accident. When external pressure exceeds internal pressure, however, the design pressure of the PCV shell is much lower, collapsing at a pressure differential of around 0.14 atm (2 psi [lb/sq. inch] or roughly 13.7 kPa), rather like an aluminum beer can. This is known as external pressure buckling, and since it can occur at 1/20 or less of the internal design pressure it is necessary to maintain external pressure on the PCV at a low value – the allowable pressure being half or less than the external pressure buckling strength of the PCV, or 1 psi (6.9 kPa).

Secondary containment – the reactor building and the blowout panels

The reactor building, the secondary containment, is constructed to surround the PCV, the fuel exchange floor (top floor) and the spent fuel pool (SFP). It is a steel-reinforced concrete structure (Fig.1). To contain any radioactive materials that might leak from the PCV in an accident, air conditioning maintains a small negative pressure inside the reactor building. However, since the steel-reinforced concrete structure has flat walls and floors, the building's pressure tolerance is far smaller than the PCV. Thus, if the main steam pipe carrying steam from the reactor to the turbine (passing through the PCV) experiences a rupture accident outside the PCV but inside the reactor building, pressure inside the reactor building will rise sharply. Since the reactor building walls may be blown out or the PCV experience external pressure buckling, blowout panels are installed in the upper part of the reactor building and are designed to blow out automatically to release pressure inside the building when it reaches 1 psi (6.9 kPa).

To prevent the entry of radioactive materials into the NPP central control room at the time of an accident, a lid-like isolation damper closes to shut out external air, and the standby gas treatment system (SGTS) removes radioactive materials while circulating air. The central control room is isolated when leaks occur from the reactor, when the blowout panel opens or if there is a failure to maintain the airtightness of the reactor building, but the isolation damper may leak somewhat, or a breakdown or malfunction of the SGTS may expose operators to the danger of contaminated air.

Functions required of the blowout panels

Function 1: Automatic opening when pressure rises inside the reactor building

Twelve blowout panels are installed in the outer wall of the reactor building at Tokai No.2. As secondary containment, the building is required to be airtight, but in the case of an accident such as that mentioned above, the blowout panels are required to open to relieve pressure inside the buildings by releasing steam to the environment. Each panel measures approximately 4.1m × 3.7m and four or more panels are required to open in the case of a pressure rise. The design pressure differential is 6.9 kPa for the blowout and each panel is held in place by 18 clips of a load of about 104 kN (kilonewtons, 10.7 tons). When pressure rises inside the building, the panels are required to blow out automatically without dependence on a power supply or pressurized air supply. However, the panels are large, and as there is a variation in pressure on each of the clips, it is not certain that the panels will open.

Function 2: It must be possible to protect equipment if panels open due to a reference tornado

If the case of a tornado, design conditions presume an instantaneous maximum wind speed of 100m/s, but there is a possibility that blowout panels may still open due to a pressure differential as the external air pressure drops in a tornado. It is required that equipment inside the reactor building be protected from the tornado. As the possibility of the simultaneous occurrence of an accident requiring the building containment function and a tornado that blows out the panels is very low, the panels are fitted with chains to prevent them falling to the ground. They can then be returned to their original positions later. However, the important question is how long it would take to resume airtightness.

Function 3: Protection countermeasures against tornado-blown objects

A protective net is to be installed to prevent disturbances to the functioning of the blowout panels and separately-installed sliding doors from objects blown around in a tornado.

Function 4: If reactor core damage occurs while the blowout panels are open, it must be possible to close the apertures rapidly either by remote control or manually

It was thus decided to install sliding doors over the blowout panel openings.

Function 5: To release water to the SFP from water

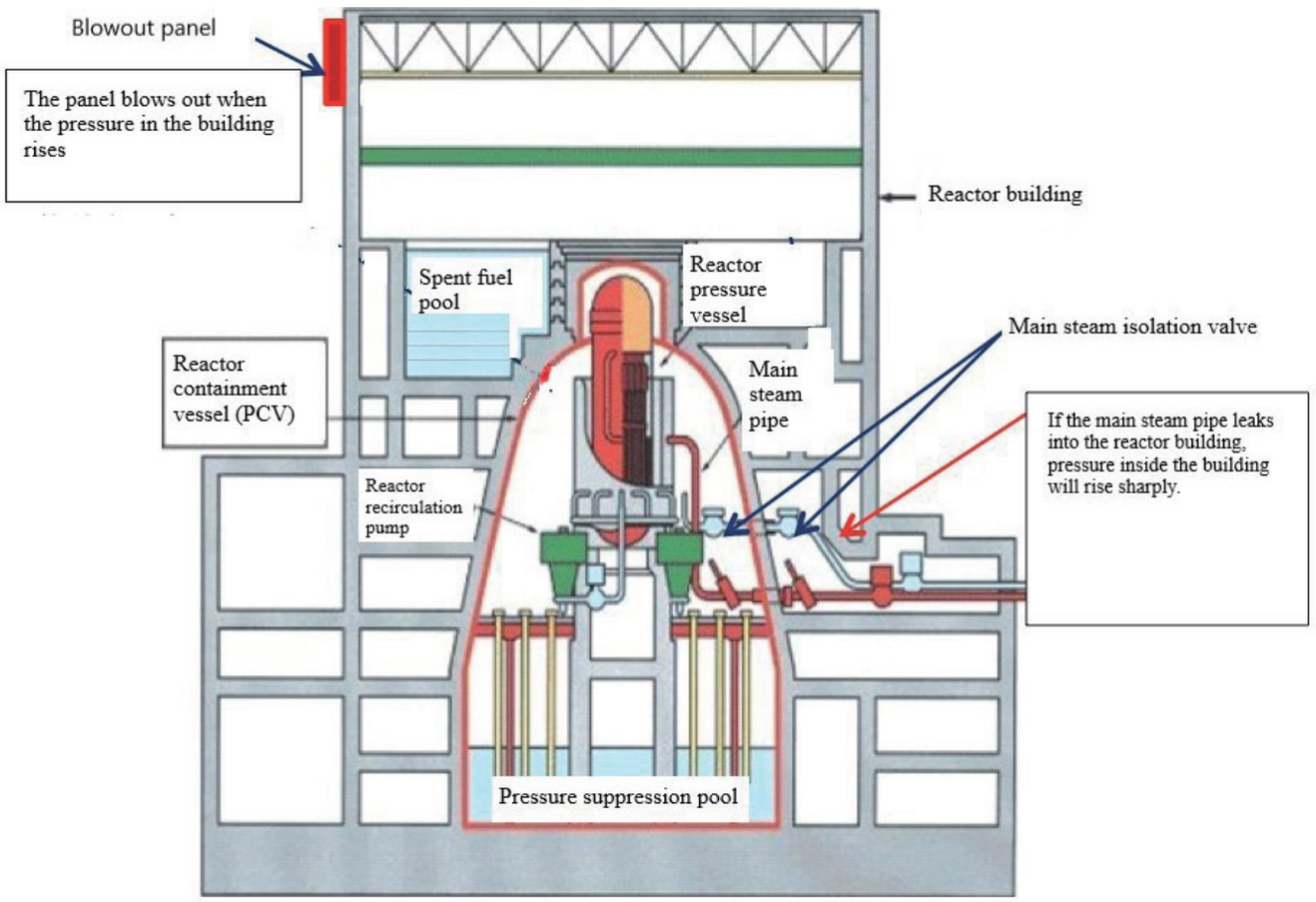

Fig. 1 Reactor building and reactor containment vessel

cannon when there is large-scale damage, it must be possible to open the necessary locations manually.
As a countermeasure, a hydraulic jack mechanism was added to open the blowout panels, and the design of the sliding doors was altered to both open or close the blowout panel opening.

Glitches in the sliding door function confirmation tests

JAPC conducted tests on the blowout panel structure and sliding doors right up to the screening by the Nuclear Regulation Authority (NRA) in June 2018, but many glitches occurred during the tests.

One was that, regardless of whether the sliding doors were open or closed, when a vibration test at or above the design reference seismic motion Ss was performed, damage occurred to the electrical drive chain. Discussions are continuing on whether to add a door bolt or use a higher quality chain. However, if the load and displacement bearing on the structure during an earthquake, and the strength, cannot be evaluated in advance using a vibration test that can perform an adequate strength test, the possibility cannot be denied that the anti-seismic design of other important parts may be inadequate.

Another was that when a vibration at the Ss level was applied to the doors in the closed position, the doors slid open about 300mm and a gap of about 50mm occurred in the packing material that maintained airtightness.

In another vibration test, doors slid open about 85mm from the fully closed position. It is said that JAPC is investigating the amount of chain elongation, but with this repeated trial-and-error situation it is hard to understand how NRA can grant the 'alteration of installation' approval.

This case is apparently not a question of 'alteration of installation' approval but one of 'approved design for a work plan.' However, as mentioned below, the blowout panel and sliding door problem is an important matter in the function of containing radioactive materials and should also be seen as a basic system design problem that includes the reactor building and other components.*

Summarizing the blowout panel problem

1) The reactor building is secondary containment that has the function of containing radioactive materials. The dynamic equipment of SGTS lacks reliability because there is a possibility it may leak, therefore negative pressure could not be maintained.
2) If a main steam pipe rupture occurs outside the PCV, the main steam isolation valve will close in less than 5 seconds. The blowout panels were added to the original design because of possible sudden rise in pressure in the reactor building.
3) If the blowout panels lose their function, once the pressure inside the reactor building rises to a certain

* System of phased nuclear safety regulations
Application for permission to alter the installation of a nuclear reactor (basic design) → Permission for work plan (detailed design) → Permission to alter safety regulations (operational criteria)

level an extremely severe accident such as collapse of the reactor building or buckling of the PCV will occur.
4) Therefore, the accuracy of the 6.9 kPa pressure at which the panels blow out is crucial.
5) As the reactor building will lose its secondary containment function if the blowout panels are open, they must be quickly closed. How long that will take is unknown. If there is a leak in the main steam isolation valve, radioactive materials will continue to escape.
6) That the blowout panels themselves breach the secondary containment boundary when there is a main steam pipe design reference accident is a basic design problem.
7) The PCV is weak against external pressure. It is normally in a positive pressure state, but at the time of an accident the pressure may become negative due to the PCV spray. Delay in operation of the vacuum break valve will cause external pressure buckling of the PCV.
8) Reliability of secondary containment is seriously compromised by the low internal pressure limit of 6.9 kPa of the reactor building. It is unreasonable to require the containment function of the blowout panels, which were designed on the supposition of a design reference accident, in a severe accident following reactor core damage. Depending on the state of the accident, it is unknown whether or not the panels can be reclosed after they have blown out. It will be impossible to maintain the containment function if large amounts of radioactive materials are leaking out.
9) Moreover, since the blowout panels themselves are inadequate, sliding doors, earthquake resistance, and tornado protection have also been required. Using sliding doors in the place of blown out panels will make it impossible to prevent the rise in pressure, leading to destruction of the reactor building or PCV if there is a major release from the main steam line.
10) There is a strong possibility that a hydrogen explosion cannot be prevented. If there is a hydrogen leak from the PCV, as occurred at Fukushima, even if the hydrogen concentration rises, the operation pressure of the blowout panels may not be reached. If a hydrogen explosion occurs, the explosive power acts instantaneously, making the blowout panels totally useless and destroying the reactor building.
11) It is unreasonable that the radioactive materials containment function consists of the reactor containment vessel as the PCV with a design pressure of 3 to 4 atm and a secondary containment facility, the reactor building, with a design pressure of roughly 0.14 atm. Since leakage will possibly occur from the PCV in a severe accident, the secondary containment will be useless in a severe accident such as reactor core meltdown, and many of the contradictions of NPP design will appear.
12) Thus, with current BWR design, even putting aside the facts that the PCV is small and the pressure suppression function is unreliable, it is a serious problem that the reactor building will not withstand an occurrence such as a 'containment bypass' (main steam pipe rupture).

Conclusion

JAPC's blowout panel woes are not simply a problem of inadequate testing or lack of preparations.
It makes one wonder if there isn't a lack of fundamental technical ability regarding load evaluation, strength and function maintenance in basic anti-seismic design.

Further, if we were sincere about learning the lessons of the Fukushima accident, since the blowout panel problem is related to a large number of problems of basic systems design, including the reactor containment vessel, the reactor building, loss-of-coolant accidents, the STGS, hydrogen explosion prevention, anti-seismic design and tornado resistance design, it is not half-baked countermeasures but a draconian reappraisal of the basic design of NPP buildings, etc. that is needed.

Granting approval for Tokai No.2 without a review that returns to the screening for permission to alter the installation will cause people to doubt the quality of the screening for compliance with the new regulation standards.

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Recent CNIC Statements

Don't allow Tokai No. 2 NPP to operate beyond 40 years!

CNIC, 7 November 2018

On 7 November, the Nuclear Regulation Authority (NRA) approved changes to safety regulations that will allow Tokai No. 2 NPP (BWR 1100MW) to operate beyond 40 years. Tokai No. 2 is the oldest boiling water reactor in Japan that has not been decommissioned. It sustained damage in the Great Eastern Japan Earthquake, making it even more hazardous.

In order to make the deadline of 27 November, which marks 40 years since commercial operation commenced at Tokai No. 2 and beyond which operators cannot apply for an extension, formal approval to review compliance with the new safety regulations was granted by NRA on 26 September. Exceptionally, at the same time, Tokai No. 2 construction plans, extension of operation and changes to safety regulations were all under review. The construction plans were approved on 18 October and then today (7 November) approval was granted for the extension and safety regulation changes.

But there are many reasons, such as the flammable cable issue, why Tokai No. 2 should not pass inspection. Recently it was revealed that the stress value for the reactor pressure vessel stabilizer was over allowable limits. In this state, if there was an earthquake, the pressure vessel may not remain horizontal. If it slips, the multiple pipes that are attached to it may rupture which could lead to a major loss-of-coolant accident. Also, if the pressure vessel is not maintained in an upright position, the insertion of the control rods may be hampered, and the vital function of stopping nuclear fission would be lost. Even though this type of serious problem exists, the NRA approved the seismic evaluation.

It is not possible for Tokai No. 2 to restart immediately, despite the extension approval and even if the necessary construction is completed. Japan Atomic Power signed a new agreement with not just Tokai Village, but another five surrounding districts, which makes it necessary to get prior approval from each local government before any restart can take place. In October the Mayor of Naka City declared his opposition to the restart and in June the Mito City Council adopted an opinion brief also opposing the restart. Furthermore, several municipalities in the Tokyo metropolitan area have also raised their voices against restarting Tokai No. 2 and the 20 year extension of operation.

960,000 people live within a 30km radius of Tokai No. 2 NPP and it is only about 110km from Tokyo. Considering the risk of an accident, it must never be allowed to restart. The NRA must withdraw all approvals for equipment alteration, construction plans, extension of operation and changes to safety regulations. Tokai No. 2 should be decommissioned.

Don’t Reprocess Fugen’s Spent Nuclear Fuel! Continue Storing it and Work toward Direct Disposal

–Stop the Irresponsible Deferment Policy and Shift away from Reprocessing–

CNIC, 6 November 2018

Decommissioning work has proceeded on the Fugen Advanced Thermal Reactor (ATR), which was halted on March 29, 2003, the needed approval having been gained for decommissioning on February 19, 2008 from the former Nuclear and Industrial Safety Agency.

On February 26, 2018, the Japan Atomic Energy Agency (JAEA) consulted with Governor Issei Nishikawa of Fukui Prefecture and Mayor Takanobu of Tsuruga to clarify a change in plans for transporting the spent fuel being stored there outside the prefecture, deferring it by nine years from the original plan for completion by the end of fiscal 2017. In addition, they described specific plans for its transport in the first half of fiscal 2018. In response, JAEA filed an application for the proposed changes in March, gaining approval from the Nuclear Regulation Authority on April 25.

The October 27 edition of the Fukui Shimbun daily noted that JAEA had concluded a contract with Fugen and Orano NC (formerly Areva) of France to prepare for transporting the spent fuel. They are to begin transporting it in fiscal 2023 and complete the transportation of 466 spent fuel rods by the summer of 2026. In its budget request, Japan’s Ministry of Education, Culture, Sports, Science and Technology (MEXT), estimated 6 billion

yen will be needed for preparation expenses in fiscal 2019 for things such as production of transport containers.

Regarding Fugen's spent fuel, JAEA gained MEXT's assent on the grounds that it will have the entire amount reprocessed either in Japan or by reprocessing businesses in countries that have concluded agreements with Japan for cooperation on the peaceful use of nuclear power, so it is expected that Orano will carry out the reprocessing. In this case, the 265 spent fuel rods from Fugen being stored at the Tokai reprocessing plant will probably also be reprocessed. Not only that, if they insist on reprocessing the entire amount, the spent fuel from nearby Monju will inevitably wind up being reprocessed in France too.

In the future, concluding contracts for reprocessing will probably be inescapable. If it comes to that, plutonium, recovered uranium and high- and low-level radioactive wastes will wind up being returned to Japan. No plans have been presented for their use, management or disposal. This will force Japan's citizens to bear an enormous burden.

As Monju's decommissioning shows, Japan's nuclear fuel cycle policy has failed. Yet those involved cling irresponsibly to the policy of reprocessing the entire amount when they ought not be resorting to makeshift measures yet again.

Fugen's spent fuel should not be reprocessed, but storage facilities should be created within Japan and research should proceed on its direct disposal. The same holds for Monju's spent fuel.

Don't push the risk onto citizens with the amendment of the Compensation for Nuclear Damage Act

CNIC, 12 November 2018

On November 2, a bill for the partial amendment of the Compensation for Nuclear Damage Act (hereafter, CND) was submitted to the Diet.

In the first place, this CND amendment is based on supplementary regulations demanding "a drastic review including an amendment of CND at the earliest possible date" and "necessary measures from the viewpoint of minimizing the burden on the people of the nation" when the Nuclear Damage Compensation Facilitation Corporation Act was deliberated in the Diet in 2011. Further, both houses of the Diet limited "at the earliest possible date" to "around a year" and determined, by supplementary decisions attached to that act, that "deliberations to clarify the nature of liability in Article 3 of CND and the nature of the government's liability including the nature of compensatory payments in Article 7 of CND" should also be carried out. In 2015, however, a specialist committee on the nuclear compensation system was set up within the Atomic Energy Commission, and even after serious deliberations had begun progress was extremely slow. It was not until October 30, 2018 that a final draft was approved.

The main points of the draft amendment are: 1) Nuclear power plant (NPP) operators are mandated to prepare and publish a new damage compensation implementation policy, 2) Creation of a system for the government to lend funds to the operator for early compensation (provisional payments) to affected persons before the start of the main compensation payments, 3) In the case that alternative dispute resolution (ADR) by the Nuclear Damage Dispute Reconciliation Committee is terminated, it will be deemed that an appeal has been submitted at the time of the request for settlement mediation if the appeal is brought before the court within one month after the notification of termination of ADR, and 4) The compensatory fund is to be left unchanged at 120 billion yen.

It is surprising that 1) is not already being carried out by NPP operators. At the time of the TEPCO Fukushima Daiichi nuclear accident the government had already devised measures similar to 2) for provisional compensation in the Act on Emergency Measures for Damage due to Nuclear Accidents. 3) can be said to be rational since there has been a series of cases in which the nuclear business side has rejected settlement proposals. On the other hand, the content of 4) is strikingly problematic since it does nothing to adjust the astoundingly miserly current compensatory fund of 120 billion yen in the face of the estimated 22 trillion yen in damages for the TEPCO Fukushima Daiichi nuclear accident.

Originally, CND began as an exemption of makers from liability due to nuclear accidents in order to encourage the construction of nuclear power plants. The discussions in the latest series of reviews have progressed with no mention of this point, but in fact we believe the specialist committee should have taken one step further and questioned the liability of nuclear reactor makers.

Looking back on the deliberations for the Nuclear Damage Compensation Facilitation Corporation Act, where the argument began, it can be seen that there was a shared understanding that the compensatory fund of 120 billion yen was inadequate. Even in the specialist committee, there was general agreement among the committee members on the point that the amount of the compensatory fund should be raised. At the same time, the executive director of the Japan Atomic Energy Insurance Pool (JAEIP), committee member Tetsuro Kihara, stated at the fifth committee meeting, "A five or ten trillion level is simply impossible…. but the idea of lifting the current 120 billion yen to a level of 150 or 200 billion yen is a different question." While making this statement, which appears to suggest that there is a margin for raising the level of the compensatory fund, he made an about-face at the 17th meeting by denying that there was any margin for raising the amount of the fund by stating, "The conclusion is that, as far as the insurance industry is concerned, it would be extremely difficult to raise the fund above 120 billion yen." The nuclear business operators themselves also opposed a raise.

However, it is quite clear, firstly, that it is impossible for JAEIP to hold a mammoth sum of 22 trillion yen in insurance money. If so, while considering raising the amount of the compensatory fund, and to minimize the burden on the people of the nation, rather than maintain the compensation scheme with the premise of allowing the nuclear business operators to continue to exist, based on the Act on the Nuclear Damage Compensation and Decommissioning Facilitation Corporation, it should have been necessary to devise a new compensation scheme based on the 22 trillion yen in damages arising from the TEPCO Fukushima Daiichi nuclear accident that did not necessarily insist on the continued existence of the nuclear business operator. With the specialist committee unable to get a grasp on this problem, we are left with the unavoidable question of what on earth the committee, and the Atomic Energy Commission which led it, had been doing for three years, after which they simply threw the ball back at the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

In the meantime, on October 25, just before the conclusion was reached, MEXT, under whose jurisdiction CND lies, stated at a Liberal Democratic Party (LDP) Education, Culture, Sports, Science and Technology section meeting that it had accepted the CND amendment. This constitutes an extremely grave problem from the viewpoint of procedure. Why should MEXT be going to an LDP section meeting to give explanations without having received the conclusion of the specialist committee? It is impossible for both MEXT and the specialist committee to avoid censure for their disrespect for deliberations.

CND is directly linked with the problem of the interests of citizens regarding how nuclear energy risks are distributed under the unlimited liability of nuclear business operators. If NPPs are to be operated on just a very small burden, the risk of "cheap NPPs" is essentially borne by the citizens. The bill for the amendment utterly fails to resolve this problem and would allow NPPs to be operated with the citizenry, as ever, bearing the huge risk involved. Implementing deregulation of the power industry while accepting that it is fine to push this enormous risk onto the citizens greatly alleviates the burden on nuclear business operators and will lead to a serious deterioration in the competitive environment.

The U.S. Price–Anderson Nuclear Industries Indemnity Act concentrates liability for damage due to a nuclear accident on the operator regardless of whether the fault lies with the operator or not, and also established a system whereby a ceiling of 1.5 trillion yen is guaranteed through a mutual assistance system between operators. At the same time, the act also states (42 U.S. Code § 2210 (i) (2) (B)) that in the event of an amount exceeding this, funds from industrial circles and others will be considered. In the case of the U.S., the amount of damages in the Three Mile Island nuclear accident did not exceed the amount of the compensatory fund. In Japan, however, damages arising from the TEPCO Fukushima Daiichi nuclear accident, even by government estimates, will total roughly 22 trillion yen (including the cost of decommissioning). As provision against further accidents, the mutual assistance among the operators, based on the current Act on the Nuclear Damage Compensation and Decommissioning Facilitation Corporation, will be totally inadequate.

The current legal amendment began from a demand to consider the law from the viewpoint of minimizing the burden on the people of the nation. If so, while it is natural to maintain the unlimited liability, and based on the premise of the damage arising from the TEPCO Fukushima Daiichi nuclear accident, a mutual assistance system should be set up to include not only the operators but all those in nuclear power industry circles who have profited from the nuclear energy business thus far in sharing the burden. This is the duty that should be borne by the operators and nuclear power industry circles who have expanded a business that has the potential to cause the horrendous damage we have seen from just one accident. If they cannot do this because they believe the risk is too high, the only option is for the operators to withdraw from the nuclear power business.

Reference Material:

Radiation Exposure Data for Nuclear Industry Workers (FY 2017)

Table 1: Radiation exposure of workers at nuclear reactor facilites for power generation

Plant	Attribution	Effective dose level (mSv per person)											Total (Sv/person)	Average effective dose (mSv)	Maximum effective dose (mSv)
		<5	5~10	10~15	15~20	20~25	25~30	30~35	35~40	40~45	45~50	total (persons)			
Tomari	Power Company	535	0	0	0	0	0	0	0	0	0	535	0.00	0.0	0.2
	Subcontractor	1,535	0	0	0	0	0	0	0	0	0	1,535	0.02	0.0	1.0
	Total	2,070	0	0	0	0	0	0	0	0	0	2,070	0.02	0.0	1.0
Onagawa	Power Company	513	0	0	0	0	0	0	0	0	0	513	0.01	0.0	0.6
	Subcontractor	2,436	14	0	0	0	0	0	0	0	0	2,450	0.47	0.2	9.2
	Total	2,949	14	0	0	0	0	0	0	0	0	2,963	0.48	0.2	9.2
Higashi Dori	Power Company	278	0	0	0	0	0	0	0	0	0	278	0.00	0.0	0.2
	Subcontractor	782	0	0	0	0	0	0	0	0	0	782	0.09	0.1	4.8
	Total	1,060	0	0	0	0	0	0	0	0	0	1,060	0.10	0.1	4.8
Fukushima 1	Power Company	1,427	85	17	1	0	0	0	0	0	0	1,530	1.76	1.1	15.9
	Subcontractor	10,168	1,038	638	495	41	26	7	0	0	0	12,413	35.76	2.9	32.7
	Total	11,595	1,123	655	496	41	26	7	0	0	0	13,943	37.51	2.7	32.7
Fukushima 2	Power Company	527	0	0	0	0	0	0	0	0	0	527	0.02	0.0	1.1
	Subcontractor	1,354	0	0	0	0	0	0	0	0	0	1,354	0.05	0.0	1.8
	Total	1,881	0	0	0	0	0	0	0	0	0	1,881	0.07	0.0	1.8
Kashiwazaki Kariwa	Power Company	1,153	0	0	0	0	0	0	0	0	0	1,153	0.02	0.0	0.6
	Subcontractor	4,472	19	5	0	0	0	0	0	0	0	4,496	0.96	0.2	12.7
	Total	5,625	19	5	0	0	0	0	0	0	0	5,649	0.98	0.2	12.7
Hamaoka	Power Company	788	0	0	0	0	0	0	0	0	0	788	0.02	0.0	0.5
	Subcontractor	3,132	0	0	0	0	0	0	0	0	0	3,132	0.44	0.1	4.2
	Total	3,920	0	0	0	0	0	0	0	0	0	3,920	0.45	0.1	4.2
Shiga	Power Company	403	0	0	0	0	0	0	0	0	0	403	0.00	0.0	0.1
	Subcontractor	1,664	0	0	0	0	0	0	0	0	0	1,664	0.02	0.0	0.7
	Total	2,067	0	0	0	0	0	0	0	0	0	2,067	0.02	0.0	0.7
Mihama	Power Company	422	0	0	0	0	0	0	0	0	0	422	0.02	0.1	1.9
	Subcontractor	2,672	15	0	0	0	0	0	0	0	0	2,687	0.63	0.2	8.9
	Total	3,094	15	0	0	0	0	0	0	0	0	3,109	0.65	0.2	8.9
Takahama	Power Company	525	0	0	0	0	0	0	0	0	0	525	0.01	0.0	0.6
	Subcontractor	3,489	3	0	0	0	0	0	0	0	0	3,492	0.43	0.1	6.1
	Total	4,014	3	0	0	0	0	0	0	0	0	4,017	0.44	0.1	6.1
Ohi	Power Company	478	0	0	0	0	0	0	0	0	0	478	0.03	0.1	0.9
	Subcontractor	2,093	0	0	0	0	0	0	0	0	0	2,093	0.33	0.2	4.8
	Total	2,571	0	0	0	0	0	0	0	0	0	2,571	0.36	0.1	4.8
Shimane	Power Company	493	0	0	0	0	0	0	0	0	0	493	0.01	0.0	0.7
	Subcontractor	2,529	28	0	0	0	0	0	0	0	0	2,557	0.84	0.3	9.7
	Total	3,022	28	0	0	0	0	0	0	0	0	3,050	0.85	0.3	9.7
Ikata	Power Company	402	0	0	0	0	0	0	0	0	0	402	0.03	0.1	2.9
	Subcontractor	2,024	70	33	3	0	0	0	0	0	0	2,130	1.74	0.8	16.5
	Total	2,426	70	33	3	0	0	0	0	0	0	2,532	1.77	0.7	16.5
Genkai	Power Company	637	0	0	0	0	0	0	0	0	0	637	0.01	0.0	1.2
	Subcontractor	2,389	1	0	0	0	0	0	0	0	0	2,390	0.25	0.1	6.6
	Total	3,026	1	0	0	0	0	0	0	0	0	3,027	0.25	0.1	6.6
Sendai	Power Company	413	0	0	0	0	0	0	0	0	0	413	0.01	0.0	1.3
	Subcontractor	2,398	0	0	0	0	0	0	0	0	0	2,398	0.44	0.2	3.9
	Total	2,811	0	0	0	0	0	0	0	0	0	2,811	0.45	0.2	3.9
Tokai	Power Company	213	0	0	0	0	0	0	0	0	0	213	0.00	0.0	0.0
	Subcontractor	609	0	0	0	0	0	0	0	0	0	609	0.00	0.0	0.2
	Total	822	0	0	0	0	0	0	0	0	0	822	0.00	0.0	0.2
Tokai 2	Power Company	272	0	0	0	0	0	0	0	0	0	272	0.01	0.0	0.6
	Subcontractor	1,249	0	0	0	0	0	0	0	0	0	1,249	0.17	0.1	4.9
	Total	1,521	0	0	0	0	0	0	0	0	0	1,521	0.18	0.1	4.9
Tsuruga	Power Company	304	0	0	0	0	0	0	0	0	0	304	0.01	0.0	0.7
	Subcontractor	1,160	0	0	0	0	0	0	0	0	0	1,160	0.05	0.0	1.2
	Total	1,464	0	0	0	0	0	0	0	0	0	1,464	0.05	0.0	1.2
Commercial Plant Total	Power Company	9,783	85	17	1	0	0	0	0	0	0	9,886	1.97	0.2	15.9
	Subcontractor	46,155	1,188	676	498	41	26	7	0	0	0	48,591	42.69	0.9	32.7
	Total	55,938	1,273	693	499	41	26	7	0	0	0	58,477	44.63	0.8	32.7

The Nuclear Regulation Authority released the FY 2017 'Report on radiation management in nuclear facilities' on 17 October 2018 (https://www.nsr.go.jp/data/000249314.pdf) This data was compiled from the section on 'Management of radioactive waste and exposure of workers at nuclear reactor facilities for power generation, research and development facilities, fabrication facilities, reprocessing facilities, waste disposal facilities and waste management facilities."

In the 16 nuclear plants other than Fukushima Daiichi, a total of approximately 44,500 workers received a collective dose of 7.12 Person Sv, an average of 0.2 mSv per person. Compared to this, 13,900 workers at Fukushima Daiichi received a collective dose of 37.51 person Sv, an average of 2.7 mSv per person, a much higher exposure to radiation.

On 6 June 2017, a plutonium release and exposure accident occurred at Japan Atomic Energy Agency (JAEA) Oarai Research and Development Center Fuel Research Building (see NIT No. 179). The 50 year committed effective dose of five exposed workers was: one received a dose of between 100 to 200 mSv, far exceeding the legal limit of 100 mSv in 5 years or 50 mSv in 1 year. Two of the workers received a dose of between 10 mSv to 50 mSv, which exceeds the recommended dose in the safety regulations of 20 mSv in 1 year or 13 m/Sv in 3 months. According to safety regulations, restrictions on radiation related work have been imposed on these three workers. The other two workers were exposed to less than 10 mSv. The exposure data for all five workers is considered to be personal information and has not been included in the table.

<Ryohei Kataoka, CNIC>

Table 2: Radiation exposure of workers at Monju and Fugen

Plant	Attribution	Effective dose level (mSv per person)				Total (Sv/ person)	Average effective dose (mSv)	Maximum effective dose (mSv)
		<5	5~10	nothing over 10mSv	Total (persons)			
Monju	Power Company	355	0	0	355	0.00	0.0	0.0
	Subcontractor	948	0	0	948	0.00	0.0	0.0
	Total	1,303	0	0	1,303	0.00	0.0	0.0
Fugen	Power Company	108	1	0	109	0.02	0.2	5.7
	Subcontractor	356	8	0	364	0.11	0.3	8.5
	Total	464	9	0	473	0.13	0.3	8.5

Table 3: Radiation exposure of workers at nuclear fuel fabrication facilities

Plant	Attribution	Effective dose level (mSv per person)				Total (Sv/ person)	Average effective dose (mSv)	Maximum effective dose (mSv)
		<5	5~10	nothing over 10mSv	Total (persons)			
Global Nuclear Fuel Japan GNF-J	Power Company	244	0	0	244	0.01	0.0	0.8
	Subcontractor	105	0	0	105	0.00	0.0	0.1
	Total	349	0	0	349	0.01	0.0	0.8
Mitsubishi Nuclear Fuel (MNF)	Power Company	323	0	0	323	0.04	0.1	2.4
	Subcontractor	70	0	0	70	0.00	0.0	0.0
	Total	393	0	0	393	0.04	0.1	2.4
Nuclear Fuel Industries (Tokai)	Power Company	179	0	0	179	0.02	0.1	1.1
	Subcontractor	65	0	0	65	0.00	0.0	0.0
	Total	244	0	0	244	0.02	0.1	1.1
Nuclear Fuel Industries (Kumatori)	Power Company	176	0	0	176	0.02	0.1	0.6
	Subcontractor	74	0	0	74	0.00	0.0	0.0
	Total	250	0	0	250	0.02	0.1	0.6

Table 4: Radiation exposure at Japan Nuclear Fuel Rokkasho Nuclear Fuel Cycle Facilities

Plant	Attribution	Effective dose level (mSv per person)				Total (Sv/ person)	Average effective dose (mSv)	Maximum effective dose (mSv)
		<5	5~10	nothing over 10mSv	Total (persons)			
Reprocessing Plant	Power Company	1,326	0	0	1,326	0.00	0.0	0.3
	Subcontractor	5,220	0	0	5,220	0.05	0.0	1.6
	Total	6,546	0	0	6,546	0.05	0.0	1.6
Uranium Enrichment Plant	Power Company	279	0	0	279	0.00	0.0	0.4
	Subcontractor	530	0	0	530	0.00	0.0	0.6
	Total	809	0	0	809	0.00	0.0	0.6
Low-level radioactive waste disposal center	Power Company	87	0	0	87	0.00	0.0	0.1
	Subcontractor	235	0	0	235	0.00	0.0	0.0
	Total	322	0	0	322	0.00	0.0	0.1
High-level radioactive waste disposal management	Power Company	182	0	0	182	0.00	0.0	0.0
	Subcontractor	943	0	0	943	0.00	0.0	0.1
	Total	1,125	0	0	1,125	0.00	0.0	0.1

Table 5: Radiation exposure of workers at Research and Development Facilities

Plant	Attribution	Effective dose level (mSv per person)				Total (Sv/ person)	Average effective dose (mSv)	Maximum effective dose (mSv)
		<5	5~10	nothing over 10mSv	Total (persons)			
Ningyo Toge Uranium Enrichment Prototype Plant	Power Company	57	0	0	57	0.00	0.0	0.0
	Subcontractor	168	0	0	168	0.00	0.0	0.1
	Total	225	0	0	225	0.00	0.0	0.1
Reprocessing Facilities (Tokai)	Power Company	325	0	0	325	0.00	0.0	0.2
	Subcontractor	918	0	0	918	0.03	0.0	3.2
	Total	1,243	0	0	1,243	0.03	0.0	3.2
Oarai waste management facility	Power Company	25	0	0	25	0.00	0.0	0.0
	Subcontractor	184	0	0	184	0.00	0.0	0.2
	Total	209	0	0	209	0.00	0.0	0.2
Oarai R&D Center Fuel Research Building	Center staff	69			71	below 200	2.5	
	Other than Center staff	140			141	below 200	0.2	
	Total	209		1※ above 50mSv	212	199	0.9	

Some areas are left blank to protect personal information regarding exposure of workers at Oarai R&D Center

NEWS WATCH

Suspension of Ikata NPP Operations Discontinued

On December 13, 2017, the Hiroshima High Court handed down a provisional decision to suspend operation of Shikoku Electric Power Co.'s Ikata Unit 3 reactor (PWR, 890 MW) until the end of September this year. The reactor had remained idled even after that time, having been shut down for a periodical inspection. Prior to the end of that period, however, a different judge at the Hiroshima High Court accepted Shikoku Electric Power's objection and decided on September 25 to rescind the injunction. The Unit 3 reactor was restarted on October 27.

Units 1 and 2 are being decommissioned, and an encircling network has formed locally in Ehime Prefecture, where the plant is located, along with Hiroshima, Yamaguchi and Oita Prefectures facing it across the Seto Inland Sea to attempt to halt operation of Unit 3, the sole remaining reactor, through provisional injunctions. The district courts of Ehime, Hiroshima and Oita have all dismissed their requests, and the Hiroshima High Court's injunction was overturned, but another hearing is underway at the Yamaguchi District Court Iwakuni Branch, and complaint hearings are continuing at the Takamatsu High Court after dismissal by the Ehime District Court, and the Fukuoka High Court after dismissal by the Oita District Court. Also, the principal suit is still in progress in various district courts.

Way Partially Cleared to Operation of Tokai No. 2 Plant Past 40 Years

Commercial operation of the Tokai No. 2 Power Station (BWR, 1100 MW) will reach the 40-year mark in November. It is the oldest among Japan's operating boiling water reactors. The Nuclear Regulation Authority (NRA) approved nuclear reactor installation alterations on September 26, 2018 for the new standards conformity inspection, leaving many issues unresolved, such as inflammable cables. The inspection for approval of extending the operating period to 60 years and inspection for approving construction plans were conducted in parallel to meet the swiftly approaching operating term limit in November, proceeding as an exceptional case. Approval was granted for the construction plans on October 18 and that for extending the operating period, on November 7.

Even if the needed construction is completed in the future, restarting the reactor and extending its operating term will not necessarily go smoothly. In addition to the safety agreement concluded with the village of Tokai, where the Tokai No. 2 plant is located, the Japan Atomic Power Company concluded a new safety agreement covering a greatly expanded scope, including five cities in the vicinity of Tokai Village, in March 2018 regarding the restart and extended term of operation. Under that agreement, the company must obtain a consensus of all six municipalities through prior understandings before undertaking actions such as restarts. In October, the mayor of Naka City declared his opposition to restarting the reactor, and the Mito City Council adopted a memorandum in June opposing it.

In November, JAPC Vice President Nobutaka Wachi remarked that nowhere in the agreement was there any mention of a right to refuse. In twisting the meaning of the agreement, he provoked an outraged response from the six municipalities. He finally apologized and retracted his words, but JAPC's idea is to bide their time and obtain a consensus in the long term.

Decision to Decommission Onagawa Unit 1 Reactor

On October 25, the Tohoku Electric Power Co. decided to decommission the Unit 1 reactor at its Onagawa Nuclear Power Station, reporting the decision during a visit by President Hiroya Harada to the Miyagi Prefectural Government Office, where he met with Miyagi Governor Yoshihiro Murai. This comes less than a month after a regular press conference on September 27, where Harada declared that they were "considering decommissioning" the reactor, and thus can be considered exceptionally prompt.

Addition of the four reactors at Tokyo Electric Power Co.'s Fukushima Daini plant (BWR, 1100 MW each), which the company has declared it

is considering decommissioning and for which decommissioning is for all practical purposes a certainty, and the Onagawa Unit 1 reactor, for which the decision has been made, make it 20 nuclear reactors of the 54 counted prior to the Fukushima nuclear accident that are slated for decommissioning. Applications have yet to be filed for a further nine reactors to undergo testing for compliance with Japan's new regulatory standards. No application has been filed for the Onagawa Unit 3 reactor (BWR, 825 MW). Tohoku Electric Power Co. says it is making preparations for filing, but there is a possibility that this reactor will also be decommissioned.

Industrial Accident Recognition for Worker's Death from Lung Cancer at Fukushima Daiichi Plant

On September 4, Japan's Ministry of Health, Labour and Welfare recognized lung cancer as an occupational injury caused by exposure to radiation in the case of a man who developed lung cancer while he had been employed as a subcontract worker performing restorative and other work after the Fukushima Daiichi nuclear accident. He has died, but his surviving family members have filed for recognition as an occupational injury. The man's radiation dose was approximately 195 millisieverts, of which about 74 millisieverts came from his work after the accident.

This is the first time lung cancer has been recognized as a disease caused by exposure to radiation.

Technical Report from NUMO

NUMO (the Nuclear Waste Management Organization of Japan) released its "Comprehensive Technical Report" on November 21, posing it as a summary of technical grounds for declaring geological disposal of high level radioactive waste (HLW) safe. Among reasons for asserting its safety, the report says that the overpack (steel 19 cm in thickness) containing the vitrified HLW canisters can resist corrosion for 17,000 years without being penetrated, that disposal sites can be chosen away from volcanos so as not to be affected by them for at least 100,000 years, and that even if magma penetrates a disposal site in 100,000 years, spewing the radioactive material therein via volcanic ash, the radiation from it would have no notable impact.

TEPCO to Organize Nuclear Operations under In-house Company

TEPCO filed an application with the NRA on November 20 to revise its operational safety program, putting its nuclear power operations under an in-house "Nuclear Power Company." It will integrate all of the company's nuclear operations aside from the Fukushima Daiichi plant, bringing together the Kashiwazaki-Kariwa, Higashidori and Fukushima Daini NPPs and all of TEPCO's other organizations involved in that field.

Toshiba Liquidating UK Subsidiary and Abandoning Moorside Nuclear Plant Design Plans

Nobuaki Kurumatani, Chairman and CEO of Toshiba, announced on November 8 that the company would liquidate its subsidiary NuGen, which had been planning to build three new AP1000 reactors (with a total capacity of 3.6 million kilowatts) in West Cumbria, UK. This withdrawal is expected to entail a loss of 15 billion yen, but even so, Toshiba is calling it "an economically rational decision."

NuGen was organized in 2009 by the Moorside NPP project as a consortium of three companies, SSE of the UK, Iberdrola of Spain and GDF Suez (which later changed its name to ENGIE) of France. SSE withdrew in 2011 and Iberdrola in 2013, selling their respective stakes to Toshiba. With the bankruptcy of Westinghouse in 2017, ENGIE sold its shares to Toshiba, leaving the latter as NuGen's sole owner. After that, Toshiba considered selling NuGen to the Korea Electric Power Corporation, but did not go forward with that deal. Brookfield Asset Management Inc., which bought Westinghouse from Toshiba, also showed interest in NuGen, but ultimately talk of that faded too.

There were plans for construction of new nuclear reactors at three sites in England to provide a total of 16 million kilowatts of electric power by 2030, and the Moorside NPP was one of them. Regarding the remaining two sites, EDF of France has started building two EPRs (European pressurized reactors) at Hinkley Point, but the project planned by Hitachi's subsidiary Horizon Nuclear Power at Wylfa Newydd is facing various difficulties including high costs and mode of financing.

Who's Who:

Masakazu Saeki: Kyoto community leader and organic vegetable grower

I don't recall when I first met Saeki-san. Perhaps it was when I saw him working hard as one of the organizing staff at the national anti-nuke rally in Kyoto… This was a two-day rally and symposium that took place in the depressing atmosphere after the Three Mile Island nuclear accident, but the name of the citizens' organization, Hangenpatsu Medaka no Gakko (the Anti-nuke Killifish School), left me with a fresh impression. In this school, it was hard to tell who were the students and who were the teachers--rather than who was teaching whom, everyone was learning and everyone communicating. I think it was a pioneering instance of the way of thinking which leads citizens' movements to bring about political change.

I later met him at anti-nuke rallies at nuclear power plants from time to time, but especially important was when we (Nanatsumori Publishing House) published a book "A Nuclear Phaseout: Now the growth rings are clear – Nuclear power plant sites after Fukushima" (edited by the Anti-nuke Movement National Liaison Association) at the end of September 2012, 18 months after the TEPCO Fukushima Daiichi Nuclear Power Station accident. As Saeki-san was the facilitator of the Anti-nuke Movement National Liaison Association, he was deeply involved in the planning and editing of the book. He wrote for us, "Firstly, let's make full use of the overall situation, not just focus on the smaller scale of each nuclear power plant." When I went to Kyoto, I decided to take one of the books for him.

"We're having a festival right now, so why don't you come to the shrine?"

The festival was the "Zuiki Festival," a representative autumn festival of Kyoto that had first started around the year 1,000 CE. The shrine is far more splendid than the Tokyo Yushima Tenjin Shrine and seems larger than even the Kanda Myojin. In the festival, the shrine parishioners offer a fine portable shrine made from taro stems and autumn vegetables and carry the shrine around the neighborhood. Saeki-san was the vice chairman of the festival committee (he

is currently the chairman). Stalls were set up for the evening festival in the grounds of the shrine, which was bustling with people, but almost none of them were tourists. It was a relaxed festival with nearly all participants being local people. The nights are dark in Kyoto, but at a street corner on my way back, I could still hear the joyful sounds of the festival.

Saeki-san does organic farming in Kyoto City, growing Kyoto vegetables, which he sells in front of his shop at his home; I'm having him send me a box of them twice a month. They are simply super-delicious! A person I know who is researching organic farming and who has a Ph.D. in agriculture says, "Vegetables have the taste of the person who grew them." "Saeki-san's vegetables have a stubborn taste, don't you think?" I can detect strong willpower hidden away in his soft-spoken Kyoto dialect.

A while ago, I had Saeki-san send some of his vegetables to the daughter of a certain film director. When I sent her an email saying, "I think they taste of anti-nuke, but how did you like them?" I received a reply with a nice photo. "Now I understand why I thought they were just the right thing for me to eat."

<Hideaki Nakazato
President of Nanatsumori Publishing House>

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