

Sincere Suggestions for Japan after the Fukushima Disaster

By Dominic Yin



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Our Original Understanding of the Fukushima Nuclear Accident

On 3.11, 2011, the Fukushima nuclear facilities were damaged in a magnitude 9.0 earthquake. The plants were designed for a maximum magnitude 8.2 earthquake but a magnitude 9.0 quake is eight times greater, and this caused tsunami exceeding 14 meters in height to hit the Fukushima facilities. The nuclear reactors were shut down automatically after the earthquake by control rods inserted into the core and all nuclear chain reactions were stopped.

However, 6-7% of residual heat continued to be generated by fission of the U-235 isotope nucleus, which will decay and continue to generate residual heat. In nuclear reactor designs, cooling systems should be in place to remove this residual heat.

As nuclear plant electricity supplies on-site power, off-site power and standby diesel generators are designed to be used only in cases of emergency (a gas turbine was not available at Fukushima). The sudden automatic shutdown caused the loss of on-site power, and the emergency diesel generator then started and powered the station emergency cooling system, but the station was struck by the huge tsunami one hour later which took out all multiple sets of back-up emergency diesel generators.

The reactor operators were able to utilize emergency battery power to provide power for cooling the core for eight hours, but after the

batteries ran out the residual heat could not be carried away anymore and so the temperature of the reactor gradually increased and water levels in the reactor fell and caused overheating of the core.

Due to the high temperatures from fuel cladding, hydrogen was produced from the metal-water reactions in the reactor, and so operators vented the reactor to relieve the steam pressure. This released energy together with hydrogen into the primary containment vessel causing temperatures and pressures there to drastically increase.

Operators took actions to vent the primary containment vessel to control the pressure and hydrogen levels necessary to protect it from failure, but hydrogen explosions subsequently occurred in the secondary containment structure.

After that, no action was taken by Tokyo Electric Power Co. (TEPCO) or the Japanese government, or at least they did not inform the public either domestically or internationally what was really happening or what actions would be taken or what should people do. People could only see what was happening by watching television and the residents of Fukushima and nearby areas were not told to make any special preparations by the government after it had consulted TEPCO. The public got its information mainly through headlines in newspapers such as the Sankei Shimbun or on NHK.

Immediately after the earthquake and tsunami, TEPCO announced that the Fukushima nuclear power plants had been automatically shut down.

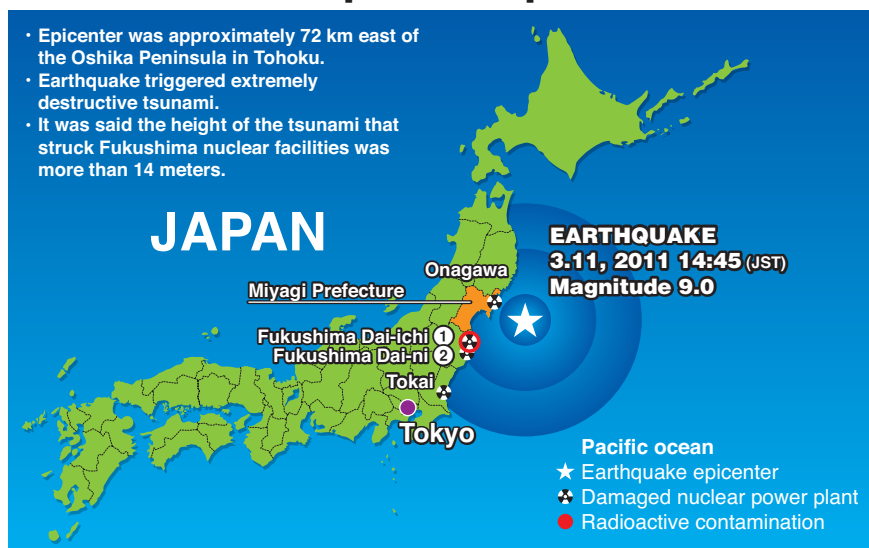
The government then informed residents around the plants that they did not need to make special preparations and turned down an offer of help from the US. The secretary general of the International Atomic Energy Agency emphasized that the situation was very serious but that both the quality and quantity of information available was insufficient to make suggestions.

What Really Happened within 100 Hours of the Earthquake & Tsunami?

At the time of the disaster, we thought that TEPCO and the government had everything under control and that the residents of Fukushima and the people of Japan had faith in the authorities, as the government had said that no leaking had occurred and would not occur in the future.

CHART 1

2011 Great East Japan Earthquake



Source: ADTech, Taiwan

Unfortunately, what subsequently happened created a disaster and proved that the whole risk control system in Japan had failed and has to be totally reviewed and improved.

Even though all the reactors were automatically shut down, as programmed to do so when an earthquake of over magnitude 6.0 occurs, the 13 sets of standby diesel generators were totally submerged by sea water, so the cooling systems could not function.

According to the media in Japan, the two top officials of TEPCO were both absent on the day of the earthquake, but even though TEPCO set up a special task force to handle this case, the Prime Minister's Office did not try to understand the details of the situation. It left it to the Nuclear and Industrial Safety Agency to get some information from TEPCO and later passed on a message to the Prime Minister's Office saying that "The reactors should not have any problem."

As a matter of fact, TEPCO has been the most scandal-tainted operator of nuclear plants in the world during the past decade, and the two nuclear plants in Fukushima have been the chief actors in the scandals. The Japanese media should have known all the details, given that five top executives of TEPCO had been forced to resign in 2002 after 29 cases of fake inspection reports.

But even with so many scandals, nothing had greatly improved since a radioactive leaking case in 1978. TEPCO is a privately owned business with more than 40,000 workers and a total capital stock value of 14 trillion yen, and its priority is probably income and profit. It has not paid much attention to continuously checking the safety of its equipment and facilities or to improving and upgrading its technology, particularly its first-generation facilities built over 40 years ago. It has not researched new technologies to educate and train its managers, operators and inspectors.

Experts in Japan and overseas then became very concerned after hearing from TEPCO that the Fukushima power plants had been stopped and their operations terminated, as this did not mean they were safe.

All the six reactors at Fukushima are boiling water reactors (BWR, [Charts 2 & 3](#)), so they create a huge volume of steam to generate electricity. The hot water then goes to the cooling container, with sea water coming in to cool it down so that it can be pumped back for reuse.

Even though operations were halted, the control rods still created a huge amount of heat which gradually melted the metal covers and

TABLE 1

Fukushima Dai-ichi power station

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
BWR type	BWR-3	BWR-4	BWR-4	BWR-4	BWR-4	BWR-5
PCV model	MARK-1	MARK-1	MARK-1	MARK-1	MARK-1	MARK-2
Electric output (MWe)	460	784	784	784	784	1100
Max. pressure of RPV	8.24MPa	8.24MPa	8.24MPa	8.24MPa	8.62MPa	8.62MPa
Max. temperature of RPV	300°C	300°C	300°C	300°C	302°C	302°C
Max. pressure of CV	0.43MPa	0.38 MPa	0.38 MPa	0.38 MPa	0.38 MPa	0.28 MPa
Max. temperature of CV	140°C	140°C	140°C	140°C	138°C	171°C(D/W) 105°C(S/C)
Commercial operation	1971,3	1974,7	1976,3	1978,10	1978,4	1979,10
Emergency DG	2	2	2	2	2	3
Plant status on 3.11	In operation	In operation	In operation	Refueling outage	Refueling outage	Refueling outage

Source: ADTech, Taiwan

caused a serious nuclear leak, as there was no power from the standby diesel generators and the loss of battery power had stopped the water circulation.

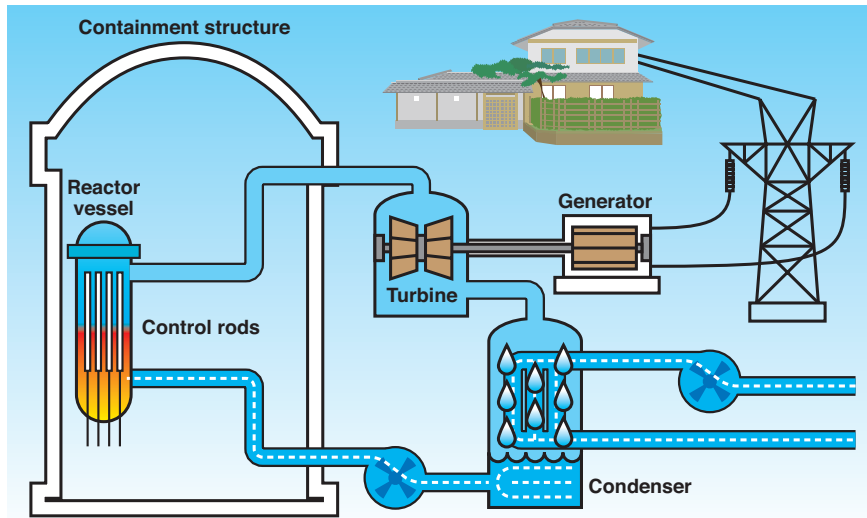
After the Prime Minister's Office heard about this very serious occurrence, one that could have disastrous results, the government demanded that TEPCO immediately open the valves to relieve the steam pressure and pump in sea water for cooling - but for reasons that are not clear TEPCO twice rejected this demand, probably because it did not want its investment to be totally destroyed by sea water. Even though it was eventually forced to open the valves and later pump in sea water, it was by now too late as the first reactor explosion had occurred and nuclear materials had started leaking after the tsunami hit the plants 24 hours later.

There were many rumors about what went on between TEPCO and the Prime Minister's Office but most of the media believed that both of them were lying to the public.

Who Should Be Held Responsible & What Should Be Done?

TEPCO must conduct a transparent *post mortem* analysis and clearly explain its findings to the public. It should make a deep apology to all the people in Japan and neighboring countries, and if TEPCO is reluctant to do so, the government should force it to report transparently what really happened and deeply apologize in order to regain some public trust.

CHART 2

Boiling Water Reactor (BWR)

Source: ADTech, Taiwan

CHART 3

Fukushima Dai-ichi power station (UNITS 1-5)

Reactor building

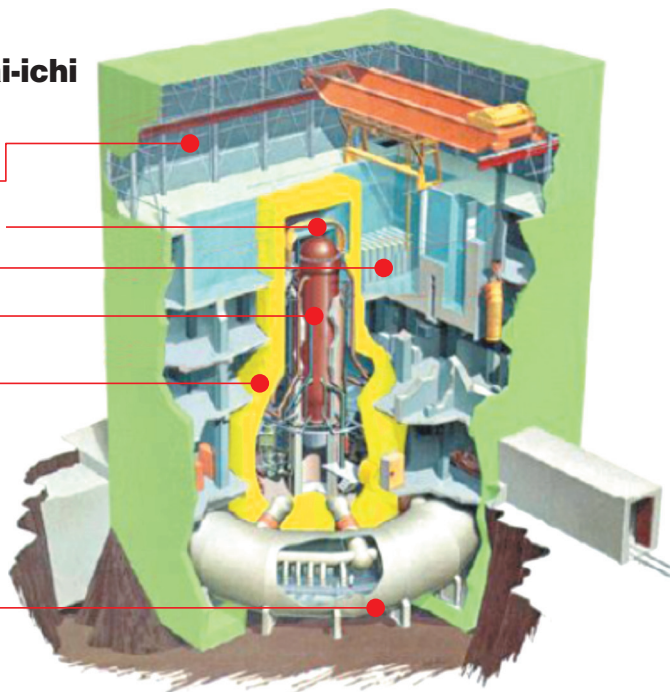
Containment vessel

Spent fuel pool

Reactor pressure vessel

Dry well

Suppression chamber



Source: ADTech, Taiwan

TEPCO must also sell some of its assets to raise funds to compensate all innocent victims as much as possible.

The Japanese government should take over TEPCO by buying the majority of its shares, and it too should carry out a transparent *post mortem* analysis and report to the public, as well as apologizing to all the people in Japan and neighboring countries.

The government must establish a special task force to be chaired by the New Energy and Industrial Technology Development Organization and invite academic experts both in Japan and overseas to cooperate with all countries with nuclear power plants in working on nuclear safety and training programs.

All existing nuclear power plants in Japan must be retrofitted with new technologies to improve nuclear safety, as renewable energy sources such as solar and wind power cannot replace nuclear power

in the short term to supply nearly 30% of the total energy needs in Japan.

In order to regain the trust of people in Japan, the government must use the media, and especially television, to inform the people about actions being taken at nuclear plants and why.

Humble & Sincere Suggestions

The Japanese people have been trained to be disciplined and obedient and they had complete trust in their government. But one problem is that they must have group-based decisions and the process of achieving this is always very slow. The plant managers in Fukushima could not make the decision to open the valves because, on the one hand, this was not written in the regulations and, on the other hand, they did not want to be responsible for destroying the plants, and so left it to the Tokyo headquarters to make the decision even though they knew it would have the disastrous result of making the control rods overheated.

The top two decision makers in TEPCO were absent at the time (where were they?) and the other executives did not want to make such a decision and tried to work out some other remedies, twice refusing to follow the prime minister's instructions and delaying urgent action.

Therefore, I can see that one problem was that there was no hero to make the brave decision to take urgent action (I cannot understand why TEPCO has the right to reject orders from the prime minister). The lack of courage and determination to be held responsible and accountable, resulting in a very slow process of decision-making in

Japan, has caused a frequent loss of business opportunities, and in this particular case the huge resulting disaster has struck a heavy blow to Japan's economic and sustainable development.

Under these circumstances, I strongly suggest that the Japanese government take over all the nuclear power plants privately owned, including those run by TEPCO after it has compensated all the Fukushima victims. All the plants must have all their safety devices fully checked and monitoring teams for each plant must be organized consisting of experts from not only Japan but also overseas and with the right to make urgent decisions on the spot if such cases are not covered by the written regulations.

I also suggest that the Japanese government dispatch experts to join the monitoring teams in other countries to do the same job, as this is indeed a global issue.

Pressurized water reactor (PWR)

We all know that it is very difficult for the Japanese to make an apology but this is a must, and TEPCO has to compensate the victims based on its own mistakes. The government should make new investments in the industry to restart its functions with safety devices and new regulations in place.

If TEPCO refuses to cooperate in these measures, the government should learn from Western countries and support all the victims in suing TEPCO to make it bankrupt, and then take it over.

The government must also apologize to the people to regain their trust after continuous demonstrations in Japan in the last 16 months which might escalate into more serious anti-government actions.

Since Japan has to develop sustainably, renewable energies which are not “base load” cannot replace nuclear power in the short term as nuclear power already accounts for nearly 30% of Japan’s total energy needs. Under these circumstances, the government has to clearly inform the public about what actions need to be taken to restart nuclear power plants.

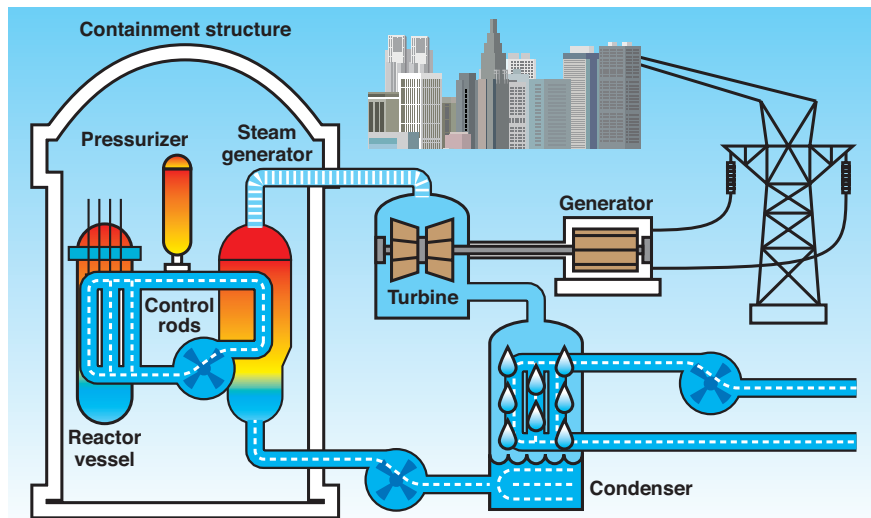
I strongly suggest that the Japanese government learn from Finland and establish “Nuclear Power Plant Lifecycle Management” which is a safety culture for nuclear plants that was applied to the OLK3 nuclear power plant in Oikiluoto for not meeting safety requirements over the last five years, and which was already established by the French industrial conglomerate Areva SA.

After 3.11, I immediately invited experts from ADTech in Taiwan to go to the Chengdu Nuclear Energy Research and Design Institute to introduce their “Simulation Technology” already applied to the four nuclear power plants in Taiwan. This technology is now being installed in one of the nuclear plants on the coast of China to enable quick and immediate remedial actions to be taken in the event of an accident.

Furthermore, I arranged for the energy storage technology of BYD in Shenzhen to be introduced at the Daya Bay Nuclear Power Plant, where it will be buried underground to avoid tsunami and typhoons, an extra form of insurance in addition to the standby diesel generators.

I have also invited and arranged for a technical team from Finland to go to Beijing in September to discuss cooperation on the issues of nuclear safety, nuclear culture, the world’s first permanent storage of nuclear waste, and especially continuous maintenance to ensure their nuclear plants continue to have 40 years of operating life.

I was invited to deliver a speech in Osaka on March 24, 2011 at the “International Standardization Meeting of Environmental Technologies” on the theme of “Think of the Future of the Asian Community through International Standardization” and my topic was “Green and Low Carbon Cooperation between Japan and Greater China for East Asia”. After 3.11 I was asked whether I would still come to Japan to give my speech and my answer was affirmative, but the meeting was unfortunately cancelled on March 20 as all other foreign speakers refused to attend.



Source: ADTech, Taiwan

I believe nonetheless that Asian countries at least should be united in working together to build up a nuclear safety culture and improve our technologies for our mutual benefit. I know that the Japanese are very careful in protecting their technologies, as I have been disappointed several times when leading delegations to Japan that were study missions and we were not allowed to see the technologies but only to visit some unimportant areas. This attitude has to be changed as other countries will also eventually arrive at achieving the same technologies.

Finally, I would like to highly recommend that Japan, China and South Korea create an organization to work on nuclear power safety, technology and engineering education in order to reach the equation: safety = safe technology + safe people.

A safety culture is the assembly of characteristics and attitudes in organizations and individuals which is an overriding priority and through which nuclear plant safety issues receive the attention warranted by their significance. A safety culture is important as it is broadly relevant to all areas related to defense, and it is particularly important for operational safety and for learning the most important lessons from severe accidents. We have to learn together, and must encourage a questioning and learning attitude to protection and safety in order to discourage complacency.

Therefore, I sincerely and humbly suggest to Japan that it solve its internal problems first by taking fair and just actions to regain the confidence of its people, and then work initially with South Korea and Greater China (China, Hong Kong, Macao and Taiwan) and later establish a global organization to achieve a “Nuclear Renaissance” and other renewable energies and contribute to the sustainable development of the world.

JS

Dominic Yin is CEO of the Greater China Sustainable Development Council and chairman of the Hong Kong Association of Energy Services Companies. He sits on the boards and committees of numerous other industry-related companies and associations.