Special edition by Global View Monthly on Longmen Nuclear Power Plant (NPP4)
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Contents

To proceed or abolish - you can take your side after reading this article.

Facts that 8 presidents did not know about Nuclear Power Plant 4 (NPP4) gate

Since TaiPower Company presented the plan to construct the 4th nuclear power plant (NPP4) in 1980, over 32 years, NPP4 remains a highly controversial social issue through eight terms of presidency and two changes in ruling party.

Why is that? It's because there is still no consensus about the safety of nuclear power generation. However, the Japanese devastating 311 earthquake followed by nuclear disaster in 2011 has shocked Taiwan. Although TaiPower promises to do the best they can, one after another artificial mistakes still destroy people's confidence in NPP4.

Stop construction immediately? Without NPP4, what would the alternative energy be in the future? Sill no consensus so far. Constructing and operating as planned? No one can ensure if this nuclear power plant would become a bomb that would detonate in any time in the following 40 years and keeps threatening Taiwan's public safety.

In February, 2013, Yi Huah Jiang, Minister of Executive, announced the government will conduct a referendum on NPP4 construction. In this critical moment that would decide the Taiwanese energy development and national safety, Global Views Monthly explores thoroughly the controversies surrounding NPP4 in a well-rounded manner, incorporating design, construction, test operation, and supervision, to seek solutions to this NPP4 issue "even presidents may not understand".

After Minister of Executive suggests resorting to referendum, NPP4, with 90% of the facilities constructed and has been full of problems since the beginning of construction, has come to a key moment- to decide its future.

Looking back on its constructing history, NPP4 has hit numerous world records, and that's exactly why it's so worrisome.

We can say the time it takes to construct NPP4 is unparalleled in human history.

The construction plan was presented in 1980 and was launched in 1999. Through eight terms of presidency (President Ching Kuo Chiang, Teng Hui Lee, Shui Bian Chen, and Ying Jeou Ma), NPP4 literally becomes the most time-consuming public investment plan in the history of Taiwan.

On average, all NPP1, NPP2, and NPP3 completed construction and commercial operation within six years. Today, the three plants' operating cycles are about to expire; however, NPP4's still making very slow progress.

Taking more time on construction means the budget hole will keep expanding.

Budget for NPP4 has been increased by 60%, from 169,700 million dollars to 273,600 million National Taiwanese Dollars (NTD).

TaiPower anticipates that at least 40,000 million NTD need to be added in 2013, which means the overall budget for NPP4 is likely to top 320,000 million NTD.

But is that it? No one, even TaiPower, can guarantee that's all NPP4 is going to take.

"What exactly is the maximum budget? NPP4 is a bottomless money hole!" ShuhSin Tsui, General Secretary at Green Citizen's Action Alliance, criticizes the plan, saying NPP4 has become the most expensive nuclear power plant in the world.

Legislator Qiu Jin Tian says TaiPower has spent so much money but keeps making so many mistakes, "It's like playing the stock market. It's time to consider indemnities."

NPP4 safety issues are complex
Too specialized? Hard to tell the truth?

Why were NPP1, NPP2, and NPP3 constructed so smoothly while NPP4 is still problematic after procrastinating for more than 10 years?

It's in fact pretty hard to explain clearly this major issue that involves national safety. All contracts and procedure instructions are full of construction details. It would be challenging for people without related educational background or working experiences to understand.

"It's fairly hard to see the problems when you check NPP4. Its facade looks fine, but who would get to know problems hiding within concrete blocks?" says Chiu Chin Tian, who had paid an inspection visit to NPP4.

Chuen Horng Tsai, Minister of Atomic Energy Council, who also teaches structural materials in nuclear power in Tsing-Hua University, says even talking about bolt

would take more than a semester. “It’s really hard to introduce nuclear safety for the general public to understand.”

In addition to the fact that nuclear safety is too specialized, it seems that telling the truth isn’t easy.

In July 2011, Tsung Yao Lin, former advisor for both GE and Bechtel and also a former member of the Fourth Nuclear Power Plant Safety Monitoring Committee, expressed that NPP4’s problems are so sizable and serious that TaiPower won’t be able to solve by themselves. He wrote a paper titled “Essay on the Fourth Nuclear Power Plant”, in which he described structural issues NPP4 encounters and hoped that senior government officials could understand. Later he publicized “Strategies for the Fourth Nuclear Power Plant”, suggesting practical solutions.

The then Chairman of the Fourth Nuclear Power Plant Safety Monitoring Committee, Der Jhy Hsieh, placed a very high value on this report and decided to commence a temporary conference in August, in which all participating committee members agreed to submit Lin’s report to the President and Minister of Executive. Hsieh made the following conclusion in the conference, “If no satisfactory approaches are agreed by the end of this year, the construction will be stopped.”

Resignation of chairman of the Fourth Nuclear Power Plant Safety Monitoring Committee
Truth about NPP4 remains untold

However, Chairman of the Atomic Energy Council, Tsai, refused to accept this resolution and thus refused to submit the report to the government. He explained, “This violates administrative ethics. It’s an issue that intrinsically should be resolved by the Atomic Energy Council. Reporting it to the upper level is useless. Even though you submit the report to the President and Minister of Executive, they won’t understand!”

Consequently, Hsieh resigned after a week. He shared his thought in an interview, “One day when I was reading, I saw a ladybug flew by, bumped a piece of glass, and flipped over. The bug tried so hard to fly again but then bumped and flipped again for five times. It’s similar to what I’m encountering now. I can’t fly through this piece of glass.”

Later, Lin also resigned from the Fourth Nuclear Power Plant Safety Monitoring Committee. His reason- my position is too low to have my voice be heard by the government.

Lin, who used to be an advisor of both NPP2 and NPP3, expresses, “Now problems with NPP4 cannot be solved solely by the Atomic Energy Council anymore, but nobody knows that.”

So what exactly is the truth behind “the piece of glass” referred to by these two nuclear safety professionals?

In fact, the fundamental question is- Is NPP4 safe or not? Who can guarantee that?

In November 2011, the critical moment upon presidential election, President Ma made the following statement about NPP4, “I’m in favor of continuing NPP4 construction and operation under the premise that it’s safe and secure.”

Alarming NPP4’s Safety Records
Flooded seven times within five years with equipment burnt out several times

But how about TaiPower’s performance? Based on the records so far, it’s truly worrisome.

According to Ministry of Control’s documents, during NPP4’s construction, there were at least seven artificial mistakes that led to flood.

When typhoon Sinlaku hit Taiwan in July 2008, lack of disaster prevention carried out by TaiPower made accumulated water flood into the second machine room and reached two meters high, immersing facilities such as emergency cooling system, etc. In total, equipment worth 200 million NTD was damaged.

In August 2011, an operator pumped water from the condensate water tank to the suppression pool through high pressure flooder system without following the maintenance rule and toolbox safety meeting. This caused a large volume of water to emit from the valve body and accumulated 30 cm high water. Three sets of earthquake inspection equipment were damaged, control rod accumulator’s level switch, and a couple of other safety-related equipment were all affected by the water, resulting in damages worth 950 thousand dollars.

In March 2012, tap of the fire hydrant in the first unit room of NPP4 fell and water poured out, causing up to 30 cm of water accumulation in the equipment operating room of the first unit.

Astoundingly, the reason was because the hydrant was used as a Japanese model, whereas the connecting extinguisher pipe was from the USA. Merely 26.1% of the parts fit properly. It's evident its purchasing professionalism is doubtful.

In April 2012, malfunctioning automatic bleeder vent of the sea water system caused the overflow of sea water, causing 150 cm of accumulation. However, the same thing already happened in September, October, and December, 2011. This shows that it's because TaiPower is incapable of completely resolving issues concerning equipment design and quality that causes the incidents to happen again and again.

In addition to floods, several equipment burnout accidents also happened to NPP4.

For example, in May 2010, TaiPower workers followed the method used in the three nuclear power plants to clean the electronic enclosure of central control room with feather duster and vacuum cleaner. Unexpectedly, the static electricity generated interfered with output voltage and further caused a short circuit to occur on the metal oxide variable resistor. Eleven surge absorbers were burned out.

Between 2007 and February 2012, the Atomic Energy Council has pointed out at least 15 major violations TaiPower has made, including changing construction design at will, improperly punching and cutting out containment wall's concrete and shear wall structure.

Fictional funds and budgets?
Tsung Yao Lin, "TaiPower is incapable of solving NPP4's problems"

Even participating contractors lose confidence in these careless mistakes.

One contractor privately revealed that "All we contractors want is to finish construction and get our money. It's impossible for NPP4 to be operated."

Someone also joked that "NPP4 doesn't need an earthquake or tsunami to induce disaster. It's not just a nuclear power plant. It's a nuclear weapon!"

For more than 10 years, all operational schemes set by TaiPower have been left unachieved. Lin says, “All those funds and budgets are fictional as it’s completely out of TaiPower’s capacity to solve NPP4’s problem. They can’t evaluate how much is needed.”

TaiPower is going to submit the new budget and timetable for commercial operation to the Legislative Yuan; however, with anti-nuclear stance growing strong, Minister of Executive announces shocking news- to resort the issue to referendum.

In this critical moment that would decide the Taiwanese energy development and national safety, Global Views Monthly explores thoroughly the controversies surrounding NPP4 in a well-rounded manner, incorporating design, construction, test operation, and supervision, to seek solutions to this NPP4 issue “even presidents may not understand”.

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Time spent on NPP4 construction is unparalleled in human history.
It’s been 32 years! However, whether to stop or proceed remains is undecided.

May 1980: TaiPower presented the plan to construct the NPP4.
July 1986: Budget was frozen.
Feb 1992: Ministry of Executive approved to resume implementation of NPP4 plan.
May 1996: Legislative Yuan passed a bill to abolish all nuclear power plant programs, asking Ministry of Executive to stop constructing NPP4. The Executive Yuen didn’t approve.
Oct 1996: Legislative Yuan passed a re-vote bill to nuclear abolition proposed by Executive Yuen.
Mar 1999: Atomic Energy Committee issued a nuclear reactor construction permit. Construct started.
Oct 2000: Then Minister of Executive Yuen, Chun Shiung Chang, announced to stop construction.
Feb 2001: Work was resumed.
July 2011: Chief of Nuclear Power Regulating office of Atomic Energy Council, also a member of the Fourth Nuclear Power Plant Safety Monitoring Committee, said “If TaiPower failed to make improvements, and then stop construction would be the best decision.”
Dec 2011: TaiPower proposed improvement plans.

Feb 2013: Budget was temporarily frozen. Minister of Executive Yuan announced a public referendum on the future of Nuke 4.

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The most expensive nuclear power plant in the history
An immense pile of money! Investment was added up from 169,700 million to 273,600 million NTD (by 60%). It's expected to add up to 320,000 million NTD in 2013.

June 1992: 169,700 million NTD (original plan)
Sep 2004: Add 19,040 millions to reach 188,870 million NTD. Reason: Total investment was increased due to expansion of the machine units' capacity.
Aug 2006: Add 44,780 million to reach 233,550 million dollars. Reason: Overall construction period was extended due to construction halt, during which prices of raw materials has increased. Exchange rate and interest rate fluctuation as well as changes in contracts all play a role in budget increase.
Dec 2009: Add 401,10 millions to reach 273,660 million NTD. Reason: Construction halt kept affecting the progress. Test-operation period was extended. Number of tests of start-up operation had increased. Prices of raw materials had risen.
Feb 2013: It's expected to add at least 40,000 NTD. Reason: To finish the construction.

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Planned commercial operation dates had never been implemented.
Endless procrastination! It's been 12 years and still no commercial operation had been carried out.

Jul 2000: Expect to commence commercial operation of the 1st reactor (failed)
Sep 2001: Expect to commence commercial operation of the 2nd reactor (failed)
Sep 2004: Expect to commence commercial operation of the 1st reactor (failed)
Jul 2005: Expect to commence commercial operation of the 2nd reactor (failed)
Jun 2006: Expect to commence commercial operation of the 1st reactor (failed)
Jul 2007: Expect to commence commercial operation of the 2nd reactor failed)
Dec 2011: Expect to commence commercial operation of the 1st reactor (failed)
Dec 2012: Expect to commence commercial operation of the 2nd reactor failed)

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Numberless major mistakes

In the past three years, fires, floods, and explosions had devastated NPP4.

Jan 2010: Piles of electric cords was burned up, causing fire at the construction site.
Mar 2010: The first reactor's uninterruptible power system fails, causing fire at the central control room.
May 2010: Improper cleaning operation with feather dusters generates static electricity and burn out MOV. Central control room's electrical circuit exploded again. Central control room was exploded.
Jul 2010: Electrical system was burned out, causing power outage in the plant.
Aug 2010: Rain penetration damageed a voltage transformer, causing abnormal power supply for three days.
Sep 2010: Electric cables weren't laid as required, resulting in 500 thousand NTD fine for violating the regulation.
Jan 2011: Electric cables in the central room were damaged by mice.
Aug 2011: Failed to hang the red card. Building containing the reactor of the first unit accumulated 30 cm of water.
Oct 2011: TaiPower commissions an inexperienced company to manufacture electric machinery pipes, resulting in 400 thousand NTD fine for violating the regulation.
Apr 2012: Float ball wasn't set properly, causing 1 meter of flood near the sea water room. Fire valve was falled, causing 2 meters of flood near the building with the first unit room .

NPP problem 1: Unprecedented nuclear power plant/ How risky is NPP4's "Innovative" design?

In the nuclear energy industry, being the first is not necessarily a good thing. When building NPP1, 2, and 3, Taiwan was merely a follower replicating other countries' nuclear power plant designs; the construction and planning were organized and conducted by foreign consulting firms. However, for NPP4, TaiPower took over many of those tasks. Does TaiPower have the capabilities required?

The general public has been wondering why it only took an average of 6 years to complete NPP1, 2, and 3, but a period of more than 10 years seems not to be enough for NPP4.

During the Fourth Nuclear Power Plant Safety Monitoring Meeting held in July 2011, TaiPower responded with full confidence, asking the participants to have more faith in the company, as it has already handled 7 models of reactors.

However, Tsung Yao Lin, a former member of the NPP4 Safety Monitoring Committee, explained, "Although TaiPower had operational experiences, it did not mean they are capable of building nuclear power plants!" Why was it so difficult to build NPP4?

In fact, NPP1, 2, and 3 were all "standard plants," which means that other countries had operated the same models of reactors and plants several times. Taiwan basically just copied the entire system. The operational success and test results abroad were the best guarantee for safety.

In the primary construction phase, TaiPower was confident in making NPP4 as the best nuclear power plant in the world

However, in the primary construction phase, people were questioning its safety. TaiPower's high-level officials revealed that the government has promised to ensure 200% safety for NPP4, making it the best nuclear power plant.

Therefore, with a goal to build the world's most innovative NPP4, the power plant was designed such an unprecedented model.

Nevertheless, nuclear power plants were not like ordinary goods. If TaiPower copies other countries' models, they could at least learn from those countries' operational experiences. Being "innovative" meant that TaiPower had to take unexampled risks. How exactly was NPP4 different than other nuclear power plant?

Global Views Monthly reporter visited NPP4's Digital Instrumentation and Control System Control Room, the only place on site that was opened for the public. Various sizes of monitors and different colors of light signals stood before us in a space resembling NASA's control room in sci-fi movies.

So this was "the one and only" design.

"It's unprecedented. Even General Electric (GE), the contractor, had no experience in making it. The Koreans also considered its' unimaginable," said Tsung Yao Lin.

An instrumentation and control system (I&C system) is like a nuclear power plant's nervous system; it regulated the magnitude of current, temperature, water level, voltage difference, etc. If something went wrong, the plant would be out of control.

Every item being monitored is called a signal. NPP3 has approximately 10,000 signals, while Japanese power plant, which was used the same model of Advanced Boiling Water Reactor (ABWR) like NPP4, only has about 20,000 monitored signals. However, NPP4 owned nearly 40,000 monitored signals.

"We originally hoped to have a one-touch system that integrates all signals,but it will cause operational difficulties," said Lin. The plant in Japan that uses the same model of ABWR divided its I&C system into 13 independent systems; however, NPP4 asked for the one-touch system, creating a large number of complicated signals.

40,000 digital signals brought up safety concerns

"The first three nuclear power plants' I&C systems are using analog signals. When something is not working, a red light would light up, and it's easy to tell which part is broken. But NPP4 is using a digital system. Many things are written in the same program. If the computer halts, we might not know where the problem comes from," said Andy (assumed name), a TaiPower engineer.

“To solve a problem, we need to know the theory. But the vendors won’t sell you all the know-hows. Therefore, we have to rely on foreign vendors. Things will get complicated if there’s an emergency,” Andy revealed.

If something went wrong, it would take at least two weeks to get a response from the American manufacturer. However, we can’t wait in an emergency. “It took two weeks to handle just one signal. NPP4 had 40,000 signals!” said Lin.

Lin also reminded that changing a signal might also affect other signals. The entire system was very complicated, which makes maintenance extremely difficult.

Moreover, this system had been assigning to three different contractors. We didn’t know whether the interfaces could work together or not, and their accuracy and stability remains an underlying concern.

Besides, all the procedures in building a nuclear power plant, such as design, procurement, construction, and trial run, involved highly specialized skills. When facing high risks, “experience” will be a key that determined whether the construction of the plant could go well.

NPP1, 2, and 3 were commissioned to a highly experienced nuclear power consulting firm abroad. The company had to test whether the electricity were reached to 100%, and it needed to operate the plant for 100 hours, and had to have TaiPower to confirm its stability and safety before officially handing it over.

“Back then, after operating for 100 hours, we opened bottles of champagnes to celebrate. NPP1, 2, and 3 were all like this. They have run for 10 to 20 years, and there weren’t many problems,” recalled Lin, who worked for Bechtel Corporation in the United States as a plant construction consultant at the time.

NPP4’s bumpy journey

In short, the former three plants were all commissioned to a big construction consulting company; TaiPower was only responsible for monitoring, inspection, and operation. “For NPP1 NPP2 and NPP3, as long as the consultant is very experienced and responsible, TaiPower could simply be a happy proprietor,” expressed Yi-bin Chen, head of the Department of Nuclear Regulation at the Atomic Energy Council.

However, the story is totally different for NPP4. “We don’t know why, but everything is different. The road is not only bumpy, but extremely harsh,” said Ching-chuan Yao, head of TaiPower’s Department of Nuclear Technology.

What are the setbacks that TaiPower faces?

Setback 1

Problems in contracting and specifications

In the beginning, TaiPower wanted to have a consulting firm to organize and handle all the contracts. However, through this method, the bidding price for experienced foreign consulting firms would be relatively higher, because they are taking more risks by shouldering all the responsibilities.

Unfortunately, the sum that the bidder gave exceeded 20% of the base price, and no one won the bid.

Under a limited budget, TaiPower was not able to find a construction consulting company that was willing to handle all the contracts. Therefore, it outsourced the two ABWRs to GE. TaiPower then hired Stone and Webster International Corporation (SWIC) as the consultant taking charge of the design of the balance of plant (BOP), as well as the specifications of construction and procurement. SWIC also assisted TaiPower in coordinating with other manufacturers.

Lin explained using his personal experience that for NPP1, 2, and 3, the procurement of equipment was completely commissioned to the construction consulting firm. Since the firm had already built several plants, it could directly purchase from qualified suppliers. “For example, there are three to four suppliers to choose from for a single pump. All these suppliers were approved by the firm. The consulting company knew the procedure well enough that it would inquire manufacturers about prices ahead of schedule. The manufacturers would then begin producing the equipment. Then the time came, they are ready for use,” said Lin.

“Because NPP4 was unique, there’s no existing equipment available. TaiPower had to compile its own specifications, and SWIC would assist them in the process. However, since such specifications did not exist, no one was brave enough to bid,” commented Lin.

Setback 2

The Procurement Act interfered with the schedule and working procedure

When building the three other plants, the procurements were all commissioned to foreign consulting companies. However, the government enacted the Procurement Act in 1998, which affected NPP4's procurement process.

According to the agreement, SWIC was responsible to come up with the purchase specifications, and TaiPower was in charge of the procurement. Since the lowest bidders were hired, together with the restrictions set by the Procurement Act, whether TaiPower could get the facilities, and the time of their delivery, depended on the bids instead of the progress of construction.

It was difficult to ensure the quality of the equipment purchased through low bidding prices; furthermore, it disrupted the working procedure. "In the end, we got what we didn't need, and what we actually needed weren't there. For example, the chairs arrived when we didn't even have the keel," said Lin.

Setback 3

Terminating contract with consulting firm, TaiPower was forced to take care of the mess

Ironically, although TaiPower wanted to build the best plant, it chose the worst consulting company.

SWIC won the auction by a very low bid, and its quality wasn't good. "SWIC was very weak in design. It's so weak that TaiPower terminated the agreement!" said Lin.

"SWIC's bidding price was US$40 million, while the prices exceeded hundreds of millions for the other three plants. If the consulting firms for those three plants scored 5 in terms of expectation, SWIC only scored 1 or 2," said Ching-chuan Yao, head of TaiPower's Department of Nuclear Technology.

However, according to the scope of work signed between TaiPower and SWIC, the consulting firm should play the most vital role in administering plans, supervising contracts, controlling costs, and managing the schedules.

In fact, Stone & Webster was of no help; instead, it brought many troubles.

In July 2000, SWIC filed for bankruptcy, but NPP4's construction had already started. Stone & Webster was later merged with Shaw, and the original group of staff was gone. TaiPower decided to continue the contract at that stage. "SWIC made many mistakes," admitted Yao.

In July 2007, TaiPower decided to terminate the agreement. Many projects were unfinished at the time of termination, such as NPP4's final safety analysis report (FSAR) and the revision of the lighting system diagram. TaiPower had no choice but to undertake those tasks.

In the end, TaiPower began an arbitration proceeding against SWIC; SWIC not only unfinish its work, but also overspent US$31.38 million, which was paid by TaiPower.

Setback 4

Contract disputes with GE forced TaiPower to change 1,536 designs by itself

Not only was SWIC problematic, TaiPower also had contract disputes with GE, which was in charge of the nuclear island.

In 2000, because the Chen Shui Bian Administration announced to suspend NPP4 construction, GE and TaiPower ended up to have contract disputes. Following a lawsuit, TaiPower even paid GE a compensation of approximately US$30 million. It took another two years for them to discuss the details of the agreement. "It was supposed to take only an afternoon to change a design, but it took three months for GE to change it!" Yi Bin Chen recalled.

TaiPower had no time to wait for GE. In order for the project to continue, it changed the engineering design under the premise of not affecting safety. From 2007 to 2011, TaiPower changed 1,536 designs.

However, relevant laws and regulations required that all changes in designs should be conducted by ASME certified firms. Since TaiPower is not one of them, the Atomic Energy Council considered the act illegal. This also made safety a major concern.

YiBin Chen used a vivid example to illustrate TaiPower's plight. When constructing the three other plants, there were at least one hundred foreign technicians stationing in Taiwan; they stayed for several years. One businessman expected that it would bring

many business opportunities, and started to build a hotel in Gongliao when TaiPower announced to build NPP4.

One time, the NPP4 Safety Monitoring Committee held a meeting in Gongliao, and Chen found out that there was only one foreigner. He later found out that this person was from Germany, and was in charge of NPP4 construction site's fire insurance.

"The hotel later closed down, because there were no foreign teams," said Chen. Did we really need to rely on companies overseas in order to successfully build a nuclear power plant?

One decision leads to a 20-year delay

Perhaps Taiwan can learn from South Korea.

Currently, South Korea has 20 nuclear power plants. In 2009, it even defeated France, the United States, and Japan and acquired a US$20.4 billion worth contract of four nuclear power facilities and construction of four plants from the United Arab Emirates. "Exporting nuclear power" became a major business for South Korea.

Actually, South Korea's first nuclear power plant started commercial operation in 1978, which was far behind Taiwan. They even learned from Taiwan. So, how did they achieve such a success?

Tsung Yao Lin analyzed that South Korea also began by replicating other countries' plants. Under the premise of not changing the design, they gradually localized the internal facilities. After three to five years of operation, they found out the problems, and began to address them. Slowly, as they became more experienced, they no longer need to rely on foreign supports.

"What about us? After we completed NPP1, 2, and 3, we asked for a brand new design. We wanted both the best and the most innovative. It only took a minute to make the decision, but the resulting problems lasted for 20 years," said Lin.

Yi Bin Chen revealed that the former head of TaiPower was very tough. He believed the company could build NPP4 even without GE's help. However, not a single nuclear power plant in the world could terminate its relationship with its suppliers, let alone TaiPower. "After TaiPower took over all the tasks, some of its staff admitted that the

situation was simply messy," said Chen.

Tsung Yao Lin concluded by using airplanes as example. If TaiPower were China Airlines, then NPP1, 2, and 3 would be Boeing 737s; they could start carrying passengers at the moment when they were purchased. NPP4, on the other hand, was like a new model that China Airline wanted to design, hoping to fly longer distance. This was the problem. "NPP4 is the new model of airplane. If we had purchased Boeing 737 instead, the Boeing would have started operating already," said Lin.

NPP4's Major Bids

1. General Electric: Provided two ABWRs
2. Mitsubishi: Responsible for the steam turbine electric generator system and facilities
3. Hitachi: In charge of providing radioactive waste treatment facilities
4. SWIC: 1. Technical support – responsible for designing NPP4's balance of plant and providing specifications for procurement, construction, and relevant facilities, as well as examining technologies used in the nuclear island. 2. Consultant services – including the administering the entire plant's plans, supervising contracts, controlling costs, and managing schedules. (Note: because of its poor quality, TaiPower terminated the agreement in 2007, and took over the remaining tasks).

NPP problem 2: Problematic even before starting out electricity generation

Construction and quality assurance process are performed by contractors. Basic principles are compromised to catch up with the schedule.

"No matter how great a nuclear power plant's design is, it's impossible to construct exactly the same way as designed. All of the blueprints for nuclear power plants start from the premise that top-notch technicians are available. Even if a perfect design is presented, no one has ever discussed if my technicians on site are proficient enough."
- Hirai Norio 《The Last Words of Nuclear Plants Workers》

Can you imagine a nuclear power plant's "uninterruptible power supply system" fails?

This ridiculous scenario happened right on NPP4. In March 2010, capacitor of the central control room of the first reactor was burned. "Uninterruptible power supply system" that was supposed to provide emergency power unexpectedly failed, causing half of the instrument surface to light out. It's like piloting a plane without being able to check half of the signals on the instrument panel. People can't help but wonder how disastrous it would be if the power plant is in operation.

Later it's figured that the reason behind this burnout was because one small act isn't implemented thoroughly. Yi Bin Chen, Head of Department of Nuclear Regulation, Atomic Energy Council, said, "The room placing that uninterruptible power supply system had no A/C and was dusty. The capacitor burned out as the temperature in the working environment became too high."

How exactly was the NPP4 being managed at its' construction site?

Years ago the Atomic Energy Council invited representatives of Japan Nuclear Energy Safety Organization (JNES) to assist in checkup. Later on, those Japanese representatives wrote in the report that "This construction site was not safe. We were worried it would pose threats to Japanese representatives' safety. As a result, we were unsure whether we would be able to come to assistance again."

Normally, a nuclear power plant site under construction should still be very well-ordered. "The Japanese construction site was almost perfect!" said Yi Bin Chen.

Quality of monitoring is doubtful as contractors take full charge of construction.

A couple of years ago, the former atomic pile designer at GE, Yoichi Kikuchi, came to Taiwan to inspect NPP4's construction site. In an interview he commented, "In every aspect, I didn't think this power plant would be working. Rusted steel reinforcing bars were scattered everywhere. Engineering and construction management was commissioned to downstream contractors, and no one was overseeing the construction prudently."

"Nuclear safety culture and trainings in the construction site should be conscientious and must be extremely strict. It's not a joke." Tsung Yao Lin, former advisor for both GE and Bechtel, and also a former member of the Fourth Nuclear Power Plant Safety Monitoring Committee, revealed that when he entered NPP4 for the first time, he found out the director of the site was from a fossil-fuel power station , and the guy completely lacks experience in nuclear energy. "TaiPower deployed workers that built fossil-fuel power station to construct nuclear power plants. These personnel was unable to see the problem on site."

Requirements of construction and quality assurance were very different between the first three power plants and NPP4. For the first three plants, it's TaiPower's Department of Nuclear and Fossil Power Projects that took charge of construction and deployed its own personnel. In terms of supervision, foreign consultant companies would assign at least 50 to 60 consultants to be on site.

However, workers from Department of Nuclear and Fossil Power Projects had all disappeared when NPP4 was under construction, as the department at that moment had no workers at all but superiors.

Turned out in the seventies when NPP3 finished construction, there were still more than 2000 workers left, and the original plan was to have them continue to construct NPP4. However, as NPP2 and NPP3 went into operation in 1984 and 1985 respectively, TaiPower's reserve margin had jumped to 55.4%. The Minister of Economy, Yao Tong Chao, therefore decided to suspend NPP4 construction in that time. "Thousands of workers cannot just idle around!" said Head of TaiPower's Department of Nuclear Technology, Ching Chuan Yao. Considering it's overstaffed, TaiPower decided to dismiss all workers responsible for nuclear power construction.

Making mistakes on welding will lead to fatal consequences

As a result, when NPP4 was about to launch construction, TaiPower had no choice but commission the work to contractors and had them take responsibility for quality assurance. Yet how could self-supervision attend to every aspect of work?

In fact, TaiPower carried out stringent quality assurance process when constructing the first three plants. This used to make all employees proud. How stringent did quality assurance used to be? Tsung Yao Lin explained that at the time when all vendors were welding, they were required to use the welding rods distributed from TaiPower also reviewed welding operators' qualification. Only the technicians with license of level B s were qualified to carry out the work. TaiPower also ordered to return rods burnt till the end and to have them photographed, but nowadays these procedures were all under the vendors' control.

"Welding operation had been problematic while I served as a member of the Fourth Nuclear Power Plant Safety Monitoring Committee for seven years. It's not just that welding beads were messy, rusted welding rods were scattered all over the place," Lin said.

Lin notes that no process should be underestimated, "Welding could be fatal! If it's not done properly, pipes would break and water would leak. Consequently if water didn't go into the reactor, then it wouldn't be able to cool down. The worst case scenario would be core meltdown, as happened in Fukushima nuclear disaster that caused significant amount of radiation leaks."

Global Views Monthly reporters interviewed an anonymous senior employee of NPP3, who shared his experience in nuclear power plant construction, "All advanced techniques, such as those related to reactors, steam turbine, and power generator, were implemented with the guidance from foreign consultants, as foreign countries had already built the same kind of plants and already had procedure instructions. We could just follow the steps."

"In the past we'd get a list with works we were in charge of and had to sign upon completion to hold everyone accountable," he said. If we checked database kept in the seventies, we could still find which pipes the interviewee was responsible for.

However, for now, he said, "NPP4's contractors carried out everything by themselves. Signatures were no longer required and thus no one was held accountable anymore."

Young employees have strong educational background, but know nothing about on-site construction.

Having contractors supervising themselves seem unreliable, and supposedly TaiPower should pay the responsibility. Senior workers from the first three nuclear power plant really didn't think the NPP4's status would be developed well.

Another anonymous senior employee, who had worked for the first three plants and had also been deployed to support NPP4 commented, "NPP4 is in chaos now. Most of us had had already retired, and many newcomers were fairly young."

Are those newcomers qualified? "They're proficient in English!" he said. Those young personnel with higher education got accustomed to perform computer simulation and stayed in the office reading original English books; however, they know nothing about on-site work.

He further mentioned the "electric cables reset" incident happened to NPP4. "Contractors charged the length of cables by feet, and they measured the total length required at will. If wires turned out too long, they'd just hide them on brackets. The more they 'measured', the more they earned." No one found it out till the last minute when they figured power lines and control lines were twisted and had to be rearranged from the very beginning.

"Young workers have no actual experience in power plant constructions, and neither do they know how to deal with unexpected situations. All in all, they were lacked of experience and had to completely rely on contractors. There was nothing they could do even if the contractors made mistakes."

He told Global Views reporters that the biggest problem with those youngsters were that they didn't put effort. "I've been to the site to support them once and lost my passion. After that, I never went there again. We, as senior workers were trying to solve their problems, yet they assigned all tasks to other workers. There's nothing I could do to make a difference. What I had suggested to turn out to be in vain."

However, those who did want to contribute sometimes cannot really make the best use of their skills. Legislator, Qiu Jin Tian, got an audio file from a whistleblower who recorded the conversation between a young employee and his supervisor. Turned out this TaiPower employee in charge of supervision was not satisfied with contractors'

quality and progress, and to do his duty of supervision, he refused to issue the project payment. Surprisingly, his supervisor rushed him to pay and told him, “Contractors would file a lawsuit against us if you did so! We’ve already issued money for those who were even worse!”

If this recording is verified as authentic, it indeed indicated that as a proprietor, TaiPower could’t even get tough on its contractors, and its supervision power was unreliable.

The locomotive had arrived in Kaohsiung, yet several compartments had fallen off along the way.

The whole nation was keeping an eye on NPP4’a progress, yet constructive acceleration also affected the quality.

NPP4 workers revealed that Hung Chi Shih, former vice president of TaiPower, insisted on speeding up to meet the deadline. “He would set up a completion date, and if the team failed, all managers and directors would be demoted to technicians. As a result, many issues were left unreported to avoid getting scolded.”

Tsung Yao Lin also illustrated a standard procedure should be followed at the test stage, and procedure instructions for more than 100 systems should be well-prepared. Each process, from margin to core, should be reviewed sequentially in detail. But in order to catch up with the progress, TaiPower adopted the so-called “milestone approach” in engineering management, which meant to carry out tests randomly. For example, TaiPower tested the sprinkler systems that will sprinkle water while dangerous occurrence took place. In that situation, 22 systems will operate simultaneously. This simulation was implemented without procedure instructions. “TaiPower saw the water sprinkled, took a lot of photos that were enough for writing a report, but that didn’t mean those systems really function!” Lin said.

Yi Bin Chen shares one TaiPower worker’s vivid comment on this issue, “It’s like the locomotive had arrived in Kaohsiung, yet several compartments had fallen off along the way.”

In 《The Last Words of Nuclear Plants Workers》, Hirai Norio, who had worked at Fukushima Daiichi and Daini Nuclear Power Plants as piping 1 technician, pointed out that “It’s never the issues of design theory that leads to nuclear power plant

accidents. What matter significantly were engineering and construction."

What a sound warning message to NPP4 in Taiwan!

NPP problem 3: The inexperienced take charge of the last line of defense/ Experts worry about TaiPower's ignorance as test-operation is implemented with self-trained skills.

A test-operation was the last line of defense before commercial operation began. It is also a guard ensuring safety for the 40 years that follow. In developed countries, all relevant procedures, starting from composing the test-operation procedures, were conducted by veterans. However, TaiPower had chosen a different route for NPP4. Not only did they write the procedures themselves, they also acted as both the player and the referee for the test-operation. Would this really guarantee the safety of the 23 million people in Taiwan?

Whether a nuclear power plant was safe or not had always been a controversial question, and most of the time consensus could't be reached. How exactly did the international community determine whether a nuclear power plant could operate commercially?

"We cannot say that it's not safe just because anti-nuclear activists walk around Taiwan for 300 times. Nor can we conclude that it's safe just because TaiPower's chairman said so. Only the results of the test-operations count," said Tsung Yao Lin, who used to work for Bechtel Corporation; he was a consultant for NPP2 and 3, and a former member of the NPP4 Safety Monitoring Committee.

A "test-operation" refered to the process where every single system was being tested before a nuclear power plant put the radioactive fuel rod in place, trying to discover all the underlying problems carefully. It was considered as the last shield to ensure safety before commercial operation starts.

NPP4 has been running the test-operations since 2007; however, Tsung Yao Lin, who was a member of the NPP4 Safety Monitoring Committee, found the problems were serious and urgent when he was checking the procedures and the execution of the test-operations.

"No matter how serious the problems used to be, the test-operation serves as the last line of defense. But unexpectedly, NPP4's test-operation was like a play game!" said Lin worriedly. Later, the Atomic Energy Council came up with a review based on Lin's report titled "Significant Deficiencies Found in NPP4's Test-Operation."

What exactly went wrong in the test-operation that determined the safety of 23 million people for the next 40 years? What made the experts so worried?

Guideline for Test-operation Procedures

Incapable consulting firm forces the inexperienced TaiPower to go to the battlefield

Test-operation begins from composing the procedures. How the procedures are written determines how the tests are to be conducted. “For nuclear energy, the most important thing is to follow the steps. Things that are not mentioned in the procedures will not be checked,” said Yi Bin Chen, head of the Department of Nuclear Regulation at the Atomic Energy Council.

Therefore, in advanced countries, the procedures are always written by the most experienced veterans. For example, Bechtel Corporation has hired experts from around the world to compile the procedures for NPP3.

As for NPP4, Stone & Webster International Corporation (SWIC), the company responsible for the test-operation, was not professional enough, and it was not capable to run the operation. “SWIC did a very poor job. They even returned us the money for compiling the procedures before we terminated the agreement, and asked us to write it ourselves,” said Ching Chuan Yao, head of TaiPower’s Department of Nuclear Technology. Hence, TaiPower had to fumble its way through.

It is understood that TaiPower later hired 300 young staff “without any experience in nuclear power plants. It’s like hiring someone who has never seen or take an airplane to run a test flight,” criticized Tsung Yao Lin.

Tsung Yao Lin had raised his concern about the candidates running the test-operation to the members of NPP4 Safety Monitoring Committee in 2008, suggesting TaiPower to hire experienced candidates from abroad. At that time, NPP4’s director and TaiPower’s vice president both promised that there’s nothing to worry about, “These people were trained, and we had layers of examination and verification systems; there’s an internal examination committee, if the procedures were not good enough, then we would ask them to revise.”

In 2000, NPP4’s test-operation procedures were completed, and there were approximately 300 of them. Lin randomly picked three that were related to safety.

“Like I expected, some of the procedures were absolutely ridiculous,” said Lin.

Lin explained that there were two kinds of tests to be conducted after the systems and facilities were installed. One was the post construction test, which separately tested whether each of the motors and meters work. The other was the so-called test-operation, which tested the entire system.

However, in the first edition of test-operation procedures, Lin found out that the two tests were mixed in the same procedure. “They thought those two tests were the same, which means they didn’t even know the basic! If all those procedures were compiled by newbies, what should we expect? It’s fatal!” Lin continued.

Test-operation

If TaiPower acted as both the referee and the player, who was to supervise?

Yi Bin Chen also mentioned that the procedures should always include the acceptance criteria, and every operational staff should sign for the step that he/she is in charge of. However, for the first test-run procedure, the staff only signed at the very end of it; some of the acceptance criteria were not even mentioned. “The young staff might not know where to find the data. Sometimes the data they got were wrong,” expressed Chen. TaiPower was asked to work on those issues.

Moreover, Tsung Yao Lin mentioned that NPP3’s test-operation procedures were examined by the original design-consulting firm. However, NPP4 was not checked by its design-consulting firms (General Electric, etc.). Whether it can complete the test-operations remains a concern.

Another major issue for TaiPower to run the test-operation is that they act as both the referee and the player at the same time.

For NPP1, 2, and 3, the test-operations were conducted by foreign consulting firms. The plants were handed over to TaiPower after completing the tests.

“People who work at power plants should be picky!” said Lin. “Back then, the supervisors, the director of the plants and I just kept looking for problems. We did so because we didn’t want problems to arise later,” said Lin as he recalled how things were like when he was the consultant for NPP2 and 3.

“That was actually the right attitude,” Lin continued. TaiPower ought to be hypercritical. Once commercial operation begins, a plant would run for 40 years; of course we should only accept a flawless one.

Nonetheless, in the primary stage during NPP4’s test operation, those running the tests and those taking over the plant were the same group of people.

“In the past, the plant served as the gatekeeper filtering out the problems. Now, with TaiPower running the test-operation, who is to supervise them?” asked Lin. When supervisors and executers are mixed up, the subsequence is that they might not be brave enough to talk about the problem when there is one.

TaiPower responded with full confidence

TaiPower’s veterans are more experienced than the consulting firm

In response to the criticism that both the test-operation and the take-over were done by the same group of people, Ching Chuan Yao, head of TaiPower’s Department of Nuclear Technology, answered, “Regardless of whether Tsung Yao Lin wass right or not, since everyone believed his point of view, we have already started to make improvement in August 2011.”

However, NPP4’s director Po Hui Wang did not consider Tsung Yao Lin’s criticism that the writers compiling the procedures were too young a fair one.

In fact, NPP4’s commercial operation was scheduled to start in July 2001 after TaiPower obtained its construction license in 1999. Wang said that elites from the three other plants were selected and sent to the U.K. for operations staff training.

Although TaiPower had no experience in writing test-operation procedures, Wang believed, “We had experts in electricity and specialists in steam turbines from thermal power plants. They had worked at the construction site for almost ten years after their returned from the training overseas. In our view, they were experienced and knowledgeable. They knew the plant better than GE and SWIC.

“NPP2 and 3’s pre-test procedures were provided by Bechtel Corporation. We hadcompared the English versions with ours, and I were convinced that we were a group of very responsible engineers. Our versions were by no means weaker,” Wang said confidently.

However, whether receiving “operations training” or running “test-operation” were the same remains a question mark. The fact that TaiPower had outstanding operational staff doesn’t mean that they know how to run the trial.

Moreover, Wang emphasized that NPP4’s test operation procedures had gone through a series of TaiPower’s extensive examinations and reviews, and an internal system review meeting was held. “It’s not as terrible as what people think it was,” said Wang.

On the other hand, Lin questioned that although it seems like the procedures had gone through a series of examinations, and a total of eight people signed, each of them only made two suggestions on average. He randomly inspected a few, and had come up with more than 100 suggestions. The question was not whether the procedures were complete enough, but whether those people were capable of conducting the examinations.

Seeing the director’s confidence, Lin responded, “I was completely shocked. My blood froze. Fools rush in where angels fear to tread. It’s scary. Very scary.”

Lin believed that the director and the staff at the plant should be more hypercritical, but not kept telling others that everything’s okay. “For example, when an airplane was full of problems, and the captain kept saying there’s nothing wrong with it, who would like to take the plane?” said Lin.

Apparently, TaiPower can only earn people’s faith in the test-operation through more concrete evidences.

For NPP4, those responsible for compiling the test-operation procedures wererelatively younger

Items	NPP1	NPP2	NPP3	NPP4
The average age of the editors of the procedures (Age)	45.17	49.33	48.42	33.33
The average age of those who ran the test-operation and signed for the procedures (Age)	37.25	32.3	31.39	36.65
The average age of the operating staff	50.24	50.73	51.8	34.65

(Age)				
Operating staff's average length of service at TaiPower (Year)	26.05	25.32	27.2	7.85

People's doubt 1: Is NPP4 safe?/ Atomic Energy Council: We'll strive our best to supervise, yet TaiPower still has the ultimate responsibility.

The Atomic Energy Council is only responsible for supervising the "Safety Systems." With a team of 20 members, the Council is using random inspections to vouch for 23 million people's lives. Is NPP4 safe? The Council's stance is that it will not ta 1ke charge of the tasks that TaiPower should handle itself.

The Fukushima Daiichi Nuclear Disaster caused by the East Japan Earthquake shocked the entire world, and evoked many people's fears. The Japanese authority reported in a review report that the accident was a "manmade" one after six months of investigation.

The report pointed out that as early as in 2006, Tokyo Electric Power Company (TEPCO) and the Nuclear and Industrial Safety Agency (NISA), Japan's control authority, had recognized the potential damages that tsunamis may bring. However, NISA did not request the plant to reinforce its safety structure, saying that it was the plant's duty.

This report has given countries that have nuclear power plants a warning: the fact that the control authority connived the plant and did not act proactively was the main cause of the manmade nuclear disaster in Fukushima. Does the problems which were found in the Japanese bureaucratic system also being apparent in Taiwan? Can the Taiwanese Atomic Energy Council control authority and really safeguard the country?

Whether NPP4 can operate commercially depends on whether the Atomic Energy Council, the highest Taiwanese nuclear energy control unit, approves and issues it a license. However, how complete was the Council's supervising on NPP4?

Atomic Energy Council: The issue of safety cannot be summarized in a sentence

"How would you guarantee safety for everyone in this country?" According to Chuen Horng Tsai, Minister and Chairman of the Atomic Energy Council, this was the question that he encountered most frequently during an interpellation at the Legislative Yuan. His response was, "The issue of safety couldnot be summarized in a sentence, and it was not something that my job title can guarantee. Instead, there was a set of standards and tools behind it."

Tsai expressed that the Atomic Energy Council's current safety standard can be divided into two categories: 1. The general safety standard – covering all relevant rules, regulations, and standards. 2. Safety analysis report – before building a plant, a primary safety analysis report (PSAR) is compiled. After constructions start, and detailed designs and individual tests are run, a final safety analysis report (FSAR) is written. Both reports need to be examined by the Council.

Moreover, for NPP4, the Atomic Energy Council has prepared a "Pre-Fuel Loading Notes for Lungmen," listing 74 criteria covering operation, maintenance, quality, training, fire protection, and pre-operation inspection, etc. Before loading the fuel, the Council will invite experts from the Nuclear Regulatory Commission (NRC) to run a joint inspection, checking whether all preparations are complete. Once all the procedures pass the tests, the results can be used as a basis for NPP4 to apply for fuel loading and operation license.

Can safety be guaranteed by just conducting desktop inspection?

The question is, can safety be guaranteed by passing Atomic Energy Council's inspections? Tsung Yao Lin, former member of the Fourth Nuclear Power Plant Safety Monitoring Committee, criticized that the Atomic Energy Council was merely checking the laws, regulations, and procedures. "FSAR is like the Constitution Law. Being neglectful and lazy would not violate against it, but would lead to risks!" said Lin.

Lin expressed that the Atomic Energy Council has adopted the regulatory style used for the other three plants. However, since these plants adopted a standard design, and were built by foreign consulting firms under turnkey contracts, in a way, they were already checked by the nuclear energy control authority in the States. The Atomic Energy Council only had to make sure all things abide by relevant laws and regulations, and check the procedures. However, the Council did not have the manpower to run on-site inspections for the designs, facilities, constructions and test-operations.

Yi Bin Chen, former director of the Department of Nuclear Regulation admitted that for NPP1, 2, and 3, they only had to do desktop inspections. An alumnus of the Institute of Nuclear Engineering and Science at National Tsing Hua University, Chen recalled, "The pay wasn't good at the Atomic Energy Council in the past. Didn't even

try to compare it with what TaiPower had offered. My classmates considered the Council a springboard before they move abroad. Under such circumstances, there really weren't enough manpower to run the inspections or to execute the audits."

However, for the responsibilities of the Atomic Energy Council's shoulder is much heavier than before. Since NPP4 had a unique design, and its contract with the original foreign consulting firm had been terminated, the consulting firm's duties, such as design, procurement, and supervision are handed over to TaiPower and other contractors. In the end, the Atomic Energy Council became the only gatekeeper.

The Atomic Energy Council was only responsible for the safety system, and it sent three staff to station at NPP4

Chuen Horng Tsai revealed that the Atomic Energy Council had increased the number of staff at NPP4 to twenty. Among them, three have stationed on-site for inspections. "Some people think that we were just setting in our offices. But that's wrong," said Tsai.

The problem is, a nuclear power plant construction site is very complicated, which requires the work of thousands. Sending only three staff is like a David versus Goliath spectacle. Can they really discover all the problems?

Tsung Yao Lin expressed that the NRC in the United States have more than 2,000 engineers to provide consulting services; thus, their inspections and audits can be thorough. Although the Atomic Energy Council in Taiwan has tried its best, it's still inadequate.

In fact, the Atomic Energy Council's control over the issue is actually limited.

NPP4 currently has 126 systems, and the Atomic Energy Council categorized these systems into "safety systems" and "non-safety systems." The Council is only in charge of the supervision of the 50~60 safety systems.

So what's a safety system? Yi Bin Chen explained that it has three main functions: Making sure 1. The reactor core can have a safe shutdown, 2. The heat energy released by the core can be taken away, and 3. The radioactive substances can be coated, not being released. In short, the safety system is almost like the last layer of protection in case of a nuclear accident. Only the systems that are related to the

aforementioned functions will be checked and supervised by the Atomic Energy Council.

Yi Bin Chen said those systems are relevant to people's safety; the Atomic Energy Council will strive its best to supervise them. On the other hand, the non-safety systems are only relevant to power generation; they are TaiPower's responsibility.

However, Tsung Yao Lin expressed that for nuclear power plants, it's very difficult to clearly separate "safety" from "non-safety."

Take the burn down of the master control room's current condenser in March 2010 as an example. At that time, because the condenser was burnt, the uninterrupted power system had an outage. More than half of the panels in the control room lost their light signals. This means that more than half of the conditions cannot be shown on the instruments. However, unexpectedly, this incident was categorized as non-safety-related, which mean it was not under the [Atomic Energy Council's] supervision.

"Even if half of NPP4 was burnt down, just because they would be all non-safety systems, they would not under the Atomic Energy Council's supervision. Does this make any sense?" questioned Lin.

Only random inspections, instead of general inspections, were allowed; it's hard to promise there were no loopholes

Besides, the Atomic Energy Council could only conduct random inspections, not general ones, even for those safety-related systems. Take simply the test-operation procedures as an example, "There are 300 books of procedures, and each has more than 200 pages. How is it possible for the Council to check through them?" asked Lin.

Yi Bin Chen admitted that it's true that it's impossible to check through all the procedures. The control authority only checked whether what needed to be there were there, whether what needed to be signed were signed, and whether the acceptance criteria that needed to be filled out were filled. "We are not the designer; we cannot check whether all the digital standards are right. It is TaiPower and the vendors' responsibility to check them," said Chen.

If random inspections were used for both the procedures and the testing of facilities,

would it be possible that there were fish escaping from the net? Chen answered bluntly, “Theoretically speaking, yes, it’s possible.”

Chen revealed that the Atomic Energy Council only assigned a total of 40 staff to supervise the nuclear power plant. If we wanted to run the tests step by step, and on a 24-hour schedule, it weould be impossible to have general inspections with the Council’s small number of staff and professional skills.

TaiPower actually has its own safety-supervising unit, the Department of Nuclear Safety, and its function is very similar with that of the Atomic Energy Council. However, this department has 100 staff. “The Atomic Energy Council cannot work on behalf of TaiPower; the Department of Nuclear Safety has to shoulder its own responsibilities,” said Chen.

The other limitation that the Atomic Energy Council faces is that it can only supervise the test results; it might not be able to control the process.

On March 2012, the fire-plug in NPP4 Unit 1’s fire-hydrant cabinet fell off. The fire fighting water gushed out and accumulated to 30-centimeter-deep. If something like this happened in case of a fire, the result would be unthinkable. According to the Control Yuan’s investigation, the root of the problem was that the fireplugs TaiPower purchased were Japanese ones, and the connecting extinguishing pipes were American ones; they were only 26.1% matched. This reveals that something is wrong in TaiPower’s expertise in procurement.

However, the appropriateness of TaiPower’s procurements and the installation process are not under the Atomic Energy Council’s control. There are thousands of equipment components in a nuclear power plant. We don’t know whether similar flaws will arise in the process.

To face the questioning voices that there’s not enough manpower to supervise TaiPower, Chuen Horng Tsai emphasized, “The Atomic Energy Council is the referee. If players’ performances weren’t good, we wouldn’t ask the referee to teach them play. The most important thing is for TaiPower to honestly face its problems in the past, and look for solutions.”

Yi Bin Chen also said reluctantly, “According to the Convention on Nuclear Safety, it is the proprietor that has the ultimate responsibility for safety, not the control authority.

However, most people think it's the control authority's responsibility."

In this case, it seems like the Atomic Energy Council can only do a certain things. TaiPower need to handle the remaining tasks itself. However, if TaiPower failed to manage itself, and if the Atomic Energy Council had happened to miss the dead space, what could we to do? It looks like we don't have an answer yet.

People's doubt 2: Can NPP4 really operate?/ TaiPower: Be more confident. Our engineers are responsible.

The NPP4 was a major construction, had suffered from many mishaps. Why so? Global Views Monthly reporters interviewed Pu Tsan Chen, Top Commander of NPP4 since March 2012 as well as Vice President of TaiPower, Ching Chuan Yao, Head of TaiPower's Department of Nuclear Technology, and Po Hui Wang, General Manager of NPP4, to answer all of the concerns in once.

Q: NPP4 didn't adopt a turnkey contract and had resulted in problems in design, procurement, and construction, etc. Why did TaiPower make this strategic decision?

Yao: Turnkey contracts were risky tasked for contractors because they had to bear price fluctuation during six or seven years when a nuclear power plant was under construction. As a result, contractors would ask for sky-high prices. In the end, base price for NPP4 requested by participating contractors was 20% higher than the starting bid price. This violated procurement regulations.

As the budget for NPP4 was limited, in the end Stone and Webster International Corporation (SWIC) won the bid with merely $40 million USD. This differed significantly from the first three power plants which took hundreds of millions of dollars.

In addition, the contract TaiPower had signed with SWIC wasn't full scope but with limited responsibility. This meant TaiPower had to take charge of certain procurements and works.

Q: Knowing that budget was limited, why couldn't TaiPwer ask for more from Legislative Yuan? Wasn't that true that compromise only led to bigger problems?

Yao: TaiPower sought to unfreeze the original budget for NPP4 of $169,700 million NTD in 1989, and in 1992, Legislative Yuan approved to restore the budget. This approval led to a fight outside of Legislative Yuan. There were serious social tensions, and at the same time TaiPower felt having the budget restored was good enough, thus didn't ask for further revision.

However, this budget was compiled several year ago, and when the construction

finally took place, it's not enough anymore. TaiPower had no choice but to find a way to achieve the goal within the budget.

Digitalization of NPP4 is more advanced than the Japanese nuclear power plants

Q: Unlike the first three plants, the design of NPP4 didn't just follow the same mode adopted by foreign countries' nuclear power plants. This is criticized as the "one-and-only" creation. Besides, the complexity of its digital computer-based instrumentations and control system are unprecedented and it is a big risk. What's your opinion?

Chen: Four plants in Japan were using the same reactors as ours, so it's not unprecedented, and although the contractor of NPP4's nuclear island wasn't a Japanese company, but General Electric (GE), from the USA, had participated in the design of the Japanese plants. Therefore, NPP4 was a result of cooperation with Japan and the U.S.

There were 28 thousand control points in Japan's plants in the digital computer-based instrumentations and control system. In NPP4, there were 35 thousands. Establishing more points means more money, more complex, and we want to know more about our plant. It means our digitalization is better-rounded than that of Japan.

The former three plants useed analog signals with numbers shown on the indicator, but it still had to rely on the operating staff to analyze the numbers. That's why staff members at the control room had to be proficient in analysis.

After using the digital computer-based instrumentations and control system, part of the tasks can be executed by the computer. So far we'd tried two tests and the results turned out very well.

Q: If the instrumentations and control system experienced was malfunction, it would take at least two weeks to send the system abroad for inspection and repair. Would it be too long? If problems had took place, would TaiPower still able to solve the problem in time?

Chen: The goal of the tests is to find out flaws in design. We would have no problem take care of technical issues after NPP4 operates officially.

Q: NPP4 has been under construction for more than 10 year, and many facilities are

quite old. Some had even been submerged. How could TaiPower make sure those facilities are operable?

Chen: These facilities are not located outdoors and don't have to bear the weather. They are placed in the storage space of warehouses with A/C. Both humidity and temperature are in perfect control. Large facilities are cleaned and oiled regularly to maintain operability. We purchase backup facilities for damaged ones. As to old facilities with no backup available, we'd ask experts from GE to see what substitutes to use.

All facilities face the issue of getting old when they're in operation for 10 years. This doesn't just be happened at NPP4. All three plants will face it upon running for 40 years. Every facility is tested before putting into use to determine if it's out of mode.

TaiPower could have done better to avoid cable rearrangement

Q: Did NPP4 have any problem with supervision and quality assurance? For example, it took almost a year to rearrange the cables. Why couldn't TaiPower find out this mistake until all cables were laid?

Chen: Public Construction Commission (PCC) rules that there are three layers of quality assurance. The first layer is the internal quality assurance from contractors; the second one is supervision from Lungmen Construction Office; and the third one is quality assurance from the safety unit of the head office.

However, PCC's structure has changed. In the past, it's TaiPower that deployed their own staff members, but now many operating staff is employed by contractors. At Lungmen (NPP4) Construction Office, there are around 1500 QA testers (second layer), within which around 680 personnel are from TaiPower. The rest are engineers recruited elsewhere.

Under this circumstance, if we took cable rearrangement as an example, it was true that we failed to identify the problem at the first and second layers by only found the problems out at the third stage. It's TaiPower's fault.

NPP4 operates more than 100 systems and it's impossible to reach perfection. There is always room for improvement. No construction is problem-free. Construction works of NPP1, NPP2, and NPP3 didn't go smoothly without any issue, but during those times, the society and the media didn't pay great attention. However, the standard set

and attention paid to NPP4 were way higher than the other three plants. This turned out really stressful.

Q: Why did up to 1530 items undergo changes in design? How could this make the public feel assured with the safety of NPP4?

Yao: A lot of incidents took place while constructing NPP4. First, the consulting firm, SWIC, went bankrupt. Finished products turned out differently with the change in personnel. In addition, SWIC made lots of mistakes in design drawings, and those all had to be corrected.

Second, from the very beginning, GE, who won the bid for the nuclear island, planned to completely copy the model of Japan's Kashiwazaki-Kariwa Nuclear power plant. However, facilities Japan bought were made in Japan, whereas facilities GE bought were made in Europe and U.S.. They were all differ in size. It was figured out in the beginning that many facilities couldn't fit in the nuclear island. Motors and pipelines were all somewhat different from original designs.

Third, sequence of facilities installation also affects changes in design. For example, if you install water pipes first, then it's likely that air pipes and electric pipes won't fit. To avoid changes, the sequence has to be exactly the same as design drawings show, but in fact it's impossible as NPP4 must adhere to the government's Procurement Act, which means sometimes it took three years just to wait for the facilities to be delivered. What came first would be installed first, and this was likely to affect the facilities delivered later. Therefore, changes had to be made and there was no way to stick to the original design.

NPP4's construction was suspended for 100 days under Shui Bian Chen's government. This has led to contract disputes with GE, and at the beginning it took two years to sign the contract with GE. According to the contract, GE was responsible for creating all of the design drawings; however, GE stated said that they had done what they were paid, and they'd only proceed with the work if TaiPower paid more.

When I were transferred to here in 2006, there were only two GE staffs, and their job was to ask me for money every day.

When we were negotiating with GE, hundreds of contractors and gangs of workmen were waiting outside for design drawings. They couldn't construct without the

drawings.

At that time, I thought since some works had nothing to do with safety, it would be fine to construct in advance. After all, problems that I encountered weren't serious. It's just because some steps were halted. What could I do? I thought it wouldn't be too late to have GE review the work after contract disputes were solved as these jobs were reversible. They could be torn down if mistakes were made.

However, based on regulations, works related to safety have to be conducted by ASME certified firms. TaiPower was fined by the Atomic Energy Council, because it's not a certified firm.

In addition, when TaiPower terminated the agreement with SWIC, we assumed we could take care of their jobs. The Atomic Energy Council also thought it's illegal to revise those designs.

In fact, I've already reported these issues to the Council. I proposed an alternative solution in 2007, but it wasn't approved until 2011. However, I just couldn't postpone those works until they're approved.

Q: Why couldn't you postpone the construction till the Atomic Energy Council had approved? Was it turned out to be that the more you hurry, the less progress you were likely to make?

Yao: TaiPower has to pay the interest every day until construction is done. If the overall budget is more than $0.3 trillion NTD, then the interest every day would be $30 million NTD!

As to whether haste makes waste in this case, we can't rule out the possibility. However, it's worth noting that only 30 to 40 items required revision after GE's review.

Strategy Command Center was established in 2012 to reduce overall problems

Q: What's the progress of NPP4?

Chen: Systems of the first reactor are undergoing individual operation tests to find out issues and adjust their designs accordingly. Starting from 2013, large-scale and overall test operations will be executed on the first reactor. The second reactor is still under construction with instrumental control labels being laid.

Since the public is paying more attention to Lungmen power plant, in 2011 the President has ordered that commercial operation won't be executed if safety isn't guaranteed. We're working with extreme caution, especially when it comes to digital computer-based instrumentations and control system (DCIS). This system requires lengthy verification to ensure proper procedures. The process of its test operation will take more time.

For the first reactor, so far 3000 issues have been identified during field tests. Now there are 270 reports of issues identified during field tests to be resolved. Hopefully this task will be done at the end of 2012.

As to how much more budget is needed and how to arrange schedule, we're now discussing with GE's consultants and are still evaluating. An initial result will be reached before the end of 2012.

Q: In what ways can improvements be made in design, supervision, quality assurance, and test operation?

Wang: All of us engineers are very responsible and are striving our best at work. Please be more confident. I've been abroad to participate in Asian Nuclear Conference's Meeting of Heads of the plant. We were looked down on at the meeting. This prompted me to tell colleagues that we must become respectable. We must pick ourselves up where we've been fallen!

In August 2011, we figured rearrangement was needed since cables were laid incorrectly. In total those cables were 2120 thousand meters in length. This could circle around Taiwan twice. At that time 250 staff members took part in cable arrangement. On Chinese New Year's Eve, almost 20 of them even volunteered to stay in order to accomplish the task.

Since central control room's cable had been damaged by mice, we now make it a strict rule that no food is allowed at the construction site. Even chewing a betel nut would be fined $3000 NTD.

Chen: In March 2012, after I was transferred and assigned as Top Commander of NPP4, I established the Strategy Command Center.

I hope to integrate comments from Department of Nuclear Technology (in charge of design), Construction Office (in charge of construction), and Lungmen power plant (in charge of operation). That way Directors or Heads of the three units can discuss and get a clearer idea about the procedures to facilitate coordination. Working procedure management can also be improved to execute construction more smoothly.

In addition, quality assurance management and control becomes stricter. In the past, Lungmen Construction Office executed 50% of sampling inspection. It's aiming at 100% now. The inspecting rate of the Head office (the third layer) was enhanced from 30% to 50%.

Test operation procedures were all translated into English for GE, Mitsubishi, and Hitachi to review so as to facilitate test operations of major facilities.

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When it comes to nuclear safety, does TaiPower dare to defy the authorities?

In the interview, Pu Tsan Chen, Vice President of TaiPower, and Ching Chuan Yao, Head of TaiPower's Department of Nuclear Technology, expresses frankly, "It would sound like we are blaming our predecessors if we point out certain already existing issues." This implies the awkward situation senior leaders of TaiPower are facing.

However, Chuen Horng Tsai, Head of the Atomic Energy Council, suggests that TaiPower does shoulder some burden of management, but if TaiPower worries that reviewing certain works will embarrass the former management echelon, it will go against the "nuclear safety culture" a nuclear power plant should develop.

According to Tsai, the so-called nuclear safety culture means "when it comes to nuclear safety, those in charges should dare to defy the authorities."

Yi Bin Chen, Head of the Department of Nuclear Regulation at the Atomic Energy Council, said taking nuclear safety culture into consideration, Japan wasn't suitable for developing nuclear power generation. "Japan had no problem with technologies, yet its culture was problematic", he commented.

That's because Japan puts strong emphasis on venerating the predecessors and worshipping the culture of obedience. Nuclear safety culture went wrong when engineers didn't dare to speak out when they identified problems. This had led to the

occurrence of major accidents every few years, such as JCO nuclear criticality accident at Tokai Fuel Plant in 1999, Mihama Nuclear Power Plant's steam pipe blew out case in 2004, and Fukushima nuclear disaster in 2011.

Chen recalled that his Japanese classmate once told him every time when representatives of the Japanese nuclear units wait for taxis after a meeting, it's always the government officials who stand in the first row, followed by power company's staff, and vendors are always waiting at the last row. It's obvious to tell vendors don't dare to challenge the power company, which doesn't dare to challenge the government authorities. The truth is easily hidden without the courage to challenge.

Tsai added that false concepts from procurement to management and even the negligence of quality assurance have already happened. These all have something to do with the decisions and implementations in the past. TaiPower has to admit those mistakes in order to make improvements. However, Chinese tradition culture is indeed a burden and remains a huge challenge for TaiPower.

Expert's view on NPP4: Former member of the Fourth Nuclear Power Plant Safety Monitoring Committee

Is NPP4 still hopeful? Tsung Yao Lin, "Yes, but a thorough check is required."

Is NPP4 safe? If yes, then to what extent would you call it safe? To answer the question, Global Views reporters headed southwards to Pingtung to visit Tsung Yao Lin, former member of the Fourth Nuclear Power Plant Safety Monitoring Committee.

We were not the only ones that had gone all the way to Pingtung. Kwai Ming Chen, former Chairman of TaiPower, and Hwai Chiung Hsu, former Vice President of TaiPower, had also paid a visit to Lin. Even Head of the Atomic Energy Council asked reporters in an interview "what did Tsung Yao Lin say?"

During Chinese New Year 2013, after reading the December 2012 edition of 《Global Views Monthly》, Minister of Economy, Chia Juch Chang, even brought the magazine down to discuss with Lin for several hours and invited him to report to Yi Huah Jiang, Minister of Executive, about existing safety concerns and corresponding solutions.

Tsung Yao Lin is one of the few experts with practical experiences in nuclear power plant construction and safety analysis. When it comes to NPP4, Lin is the one to seek consultation from. He graduated from Department of Nuclear Engineering of Ching Hua University in 1969 and has worked for both GE and Bechtel Corporation as a consultant. During the time when NPP2 and NPP3 were under construction, Lin served as the representative of a US consultant company for seven years. Eight years ago, he was invited to serve as a member of the Fourth Nuclear Power Plant Safety Monitoring Committee. The more he gets to know NPP4, the more worried he becomes. Witnessing that calls for commercial operations are getting strong while the construction remains problematic, he decides to speak his mind.

Love well, whip well- He criticizes in the hope that NPP4 can operate safely

Lin wrote 《Essay on the Fourth Nuclear Power Plant》 in July 2011. It was the first time he publicly criticized serious issues of NPP4, including equipment, construction, quality assurance, and supervision. They all differ tremendously from the previous three plants. Der Jhy Hsieh, former Vice Chairman of the Atomic Energy Council and former Head of the Fourth Nuclear Power Plant Safety Monitoring Committee agreed

that the report Lin wrote is “of great importance”.

Some people compared NPP4 to Taiwan’s High Speed Railroad (HSR), saying even though the HSR was problematic at the beginning, in the end everything turns out fine. Lin disagrees, “Those who criticized HSR were layman politicians; however, all NPP4 issues that I had pointed out were matters of fact. TaiPower knew that and had no objection to my opinions.” In fact, hardly anyone at the Atomic Energy Council as well as directors and staff members of TaiPower had more experience than Lin in terms of nuclear power plan construction.

Sometimes Lin even identified problems with NPP4 faster than the Atomic Energy Council did. Therefore many environmental protection organizations and even political figures want to pay a visit to Lin but were all declined.

Lin made himself clear, “I were not an anti-nuclear activist. I did support national policy!” In his opinion, since President Ma has stated he supports to continue NPP4’s construction on the premise of safety, Lin explained that all of the criticisms and proposals he made aim at achieving this goal.

However, although he dares to speak out the truth, just like the kid in《The Emperor’s New Cloth》, he got extremely frustrated with several responses from the authority.

In 2010, Lin wrote 《Significant Deficiencies Found in NPP4’s Test-Operation》after inspecting test operation of NPP4, in which he listed issues exposed during test period in detail.

Surprisingly, the then Head of Atomic Energy Council, Chuen Horng Tsai, told him “significant deficiencies” sounded too aggressive and suggested that he should revise it. In the end, the meeting minutes the Atomic Energy Council released did revise the title as “On-site Observation Report”. Lin made an oral report on that meeting for a full hour, yet not a single word he said was recorded in the meeting minutes.

A letter of opinion to the president fell on stony ground

In July 2011, Lin wrote NPP4’s overall structural issues in 《Essay on the Fourth Nuclear Power Plant》, and listed practical solutions in 《Strategies for the Fourth Nuclear Power Plant》. Members of the Fourth Nuclear Power Plant Safety Monitoring Committee agreed unanimously to submit the reports to the president and

Minister of Executive; however, Head of the committee, Chuen Horng Tsai, refused to do so.

Extremely worried, Lin even wrote to President Ma to the officially presidential mailbox but only got a the following reply- Dear Commissioner Lin, thank you for your concern. We would pass on your opinions to related bodies institutions.

In an interview with Global Views reporters, Lin stated “it’s my last time to go for an interview. I had already stated all of my opinions.” Nevertheless, he still wrote every point down on a notepad to ensure it was clearly expressed. Since nuclear energy construction wass complicated, after the interview our reporters turned to him several times to further ask his opinions. Even though every conversation lasted for almost four hours, Lin still showed great patience all the time.

In this nuclear energy expert’s eyes, was it still plausible to say that NPP4, which had been procrastinating for more than 10 years and had suffered from incidents like fire, flood, and cable reset, is safe? Below were Lin’s advises:

Publicize all issues and solve with prudence

Would it still hopeful to improve NPP4’s safety? I would say yes, but it wouldn’t be achieved with the current construction approach.

I proposed 《Strategies for the Fourth Nuclear Power Plant》, and the first point was “Listing out all issues so far concerning design, equipment, construction, and test-operation.” In short, all existing problems must be solved thoroughly.

However, based on what I saw, they skipped this most crucial point and only put emphasis on solving digital instrumentation and control system and test-operation. That’s because TaiPower considered if these two issues were be solved first, they could put the fuel rod then! Once this operation’s done, the controversy issues over whether to build NPP4 or not would no longer exist as everything could become irreversible!

There are all kinds of issues there, but what TaiPower and the Atomic Energy Council had reported to Legislative Yuan sounded well supervised and easy to understand.

But what about hidden issues? So many obscure questions remain unsolved, and the

general public fined it difficult to understand.

For example, a broken valve of the circulation water basin led to flood in the plant, and surface of the equipment affected were checked. However, since the plant has been under construction for so long, is it possible that many qualitative changes had already happened? These facilities must be inspected, not just have their surfaces wiped. Plus, what works now doesn't guarantee it'll be problem-free in the future.

I think an independent program must be in place to execute the so-called "analysis of reliability" to thoroughly check every facility and component.

In addition, for the operations that contractors perform self-supervision, only those running into problems were exposed, but did that mean the remaining part was problem-free? Was it possible to re-check everything in a definite and rigorous manner?

Foreign consulting firms are no panacea

TaiPower used to execute everything without supporting from foreign consulting firms. This absolutely wouldn't work. Now they have resort to foreign consultants for help, which is the right way to do because TaiPower simply lacks capacity to build nuclear power plant by itself.

But what I fear most was that everyone felt relieved with foreigners' assistance.

People need to keep in mind that foreign firms are no panacea, and that their working experiences matter tremendously. Are they experienced enough to respond to NPP4's problems?

TaiPower states that they had sent test-operation procedures to foreign consulting firms to facilitate checkup, but what needed to be further questioned was that when they reviewed the procedures, did they carry out substantive examinations? How many practical suggestions did they come up with? Although it seem like the first edition of procedures had gone through a series of examinations, and a total of eight people signed, each of them only made two suggestions on average. This made almost no contributions. I randomly inspected three books and had come up with more than 100 suggestions.

I also wanted to ask what TaiPower had assigned these foreigners to do. NPP4 was

way different than the other three plants. Consultants didn't execute design-build construction projects. That also meant they didn't take the final responsibility but only get paid by work. They're hired to execute projects assigned by TaiPower. If these questions remain were unanswered, foreigners would only become a pretext to guarantee the safety of NPP4.

Detailed examinations of more than 300 systems on site are required

In fact, TaiPower was in a dilemma situation. To improve safety mean more money and must not haste. Yet the whole nation was watching closely to NPP4's future, and it had already been criticized with the issue of a huge money pit. Under this circumstance, TaiPower didn't really dare to act tough.

The Atomic Energy Council cannot tell all as they also face an awkward situation. Anti-nuclear activists will take advantage if the Council points out major problems with NPP4. Then NPP4 won't be built anymore. Furthermore, State-owned Enterprise Commission of Ministry of Economic Affairs just doesn't understand why it has been taking so long for NPP4 to construct?

I would suggest that the government form a project team and recruit talents around the world; for example, Americans, Japanese, and even retirees, to exam more than 300 systems thoroughly.

The Atomic Energy Council needs to find at least 150 staff members and group them to perform special tasks. 300 books of procedures need to be performed under the supervision of nuclear power, instruments, and mechanic engineering professionals on site. An expert with practical experience has to execute operations with TaiPower's staff while representatives of the Atomic Energy Council takes charge of supervision. Operations cannot be done by merely writing documents and being inspected randomly like the way it is now.

All of my advices have nothing to do with putting the fuel rod. It's all about whether this plant can operate safety for 40 years!

The government had promised time and again NPP4 won't come into existence if its safety is not guaranteed. It sounds pretty reliable, but the point is, how safe should it be? The bare truth is- the stricter the safety requirement is, the more it's going to take-longer construction time, higher budget, and more human resources. To what extent

does the government want to achieve?

Tsung Yao Lin's six suggestions to NPP4

1. Review thoroughly unfinished projects and their contents, including but are not limited to design, equipment, construction, and quality assurance. A project plan also needs to be set up to deal with these issues.

2. In the future, scheduling of all projects, including test operations throughout the plant, should be headed by experienced veterans to strive for preciseness as much as possible.

3. Any test operation must be performed in accordance with its procedure instructions. Efforts must be put to make instructions correct, complete, and precise.

4. Test operations must be carried out by experienced test engineers, and they should do their best to identify all issues on design, equipment, construction, and supervision to lay the ground work for the following 40 years.

5. Nuclear power plant's operating staff cannot take on the jobs of test operation to avoid acting as both the player and the referee.

6. Atomic Energy Council must participate in on-site supervision and issue licenses accordingly.

People's view on nuke: Everyone has the right to decide NPP4's future/

Anti-nuke is not simply a political issue. It's becoming a civil campaign.

Movie director Yi Cheng Ko and Li Ren Dai initiated a campaign "I am human being and I refuse nuclear power". Famous entertainer Mayday and Chi Ling Lin also state their anti-nuke stance. Salarymen joined the so-called "No Nuker" organization, and a taxi driver even support the anti-nuke movement with free service. After 32 years, anti-nuke issue has rooted in Taiwan's civil society.

Fukushima nuclear disaster not only shook Japan, but also evoked many Taiwanese people's anti-nuke awareness.

In 2012 Taipei Film Festival, last best actor winner Pong Fong Wu suddenly took out a speech note upon giving an award and read, "I've been a big movie fan since I was a child, and I don't believe without nuclear power, we'll live without electricity and can't watch movies…Many people are very fearful about a huge money pit like the fourth nuclear power plant and also unrecoverable disasters triggered by nuclear power. So please don't let so many people live in fear. Please. Thank you."

The audience gave him a big round of applause; some even hold up their thumbs. This video gathered more than 67,000 hits on Youtube. Wu said before the ceremony he had been thinking about this issue for at least two to three days. Later, he asked his good friend, screenwriter of "Mad Hero" and "The Hospital" Luo Ying Wu, about what to say at the award-giving ceremony. Unexpectedly, Luo Ying Wu replied, "Of course something about anti-nuke!" Pong Fong Wu also agreed, "Instead of chatting about entertainers' privacies or joking, I'd rather share issues of immediate concern to every one."

Entertainers launched "I am human being and I refuse nuclear power"

In fact, in recent years the Taiwanese anti-nuke campaign has grown from minor or rare social event into a new major movement. On May 28, 2012, Movie directors, Yi Cheng Ko and Li Ren Dai, have initiated "I am human being and I refuse nuclear power" campaign. They made use of the traffic light and arranged a big "human being" in the Chinese character on Ketagalan Boulevard, right in from of the presidential office building, and yelled "I am human being and I refuse nuclear power!" This received a sizeable response.

While performing at Golden Melody Awards in 2012, influential band Mayday also showed their stance by shining "I am human and I refuse nuclear power" LED lighting on stage. Other famous entertainers, such as Chi Ling Lin, Zhu Ge Liang, Ella, and Lun Mei Kwai, have also publicly stated their anti-nuke attitude. Irene Chen, wife of Chairman of Fubon Financial Holding, entertainer Dee Hsu, and Matilda Tao, even formed an associate called "Mom's Alliance Against the Fourth Nuclear Power Plant" as a communication platform for anti-nuke knowledge.

Why anti-nuke? Pong Fong Wu explained, "Fukushima Nuclear Power Plant was located 250 km from Tokyo. The Second Nuclear Power Plant in Taiwan is only 20 km away from Taipei! If a disastrous event similar to the Japanese had happened in Taiwan, where can people flee to?" It's the most fundamental question. He added that Taiwan is already utilizing alternative energies like wind, water, solar, and the Kuroshio. Nuclear power could be never the only choice.

"Anti-nuke was regarded as a political issue. If you stated you're pro or con nuclear power, you would likely to be seen as a supporter of a specific political party. As a result, many people were reluctant to make remarks." Shuh Sin Tsui, long-time anti-nuke activist and also General Secretary at Green Citizen's Action Alliance, commented.

However, people felt empathetic when they saw the astounding images on TV about the Japanese nuclear disaster. This prompted them to take an active stance against nuclear power. "The nuclear disaster has broken down the political barrier," Tsui said. Anti-nuke is no longer just a political issue or an environmental one. It's also deemed as a safety issue.

Salarymen volunteered to join anti-nuke campaign

It's worth noting that in recent years not only public figures but the general public, including salarymen, have been joining the anti-nuke movement voluntarily.

"No Nuker" is an anti-nuclear organization established in March 12, 2012, one year after Fukushima nuclear disaster took place. Unlike general environment groups, No Nuker has no office and isn't supported by fundraising. Most of the members do not know each other and are salarymen. So far there are almost 3000 members on Facebook.

These people gather for the same anti-nuke cause. Some of them with excellent

foreign language proficiency translate the latest nuclear power trend abroad and post on Facebook; some who work as art editors design anti-nuke advertising placards and posters; some good at internet applications help set up exclusive anti-nuke video channels. Every one of them contributes their strength and work extra hours for anti-nuke campaign.

Yu Ling Chu, who used to be a reporter for an English newspaper agency and now works as a volunteer for No Nuker's media sector, said "Although many countries have nuclear power plants, none of them has experienced such frequent earthquakes like Taiwan. We should learn a lesson from Japan. Paying attention to nuclear disaster is way more important than 100 corruption cases."

In order to promote anti-nuke idea and petition at 2012 Taiwan International Sea Festival Gongliao, No Nukers created stickers similar to the tattoo of the Taiwanese aboriginal people, Seediq, with a slogan "I am human and I refuse nuclear power". Inspired by the movie "V for Vendetta", they also made anti-nuke folding fans as a symbol of people power. Combining with cinematic ingenuity, No Nuker has made a serious issue easily identified with the young generation.

Anti-nuke became the main theme at the Hohaiyan Rock Festival in Gongliao, Taiwan

Members of No Nukers even stayed up late to make folding fans. They also camped at Gongliao, and they were not deterred even though local residents warned there might be snakes.

In total 280 thousand people came to this festival. No Nukers, with comparatively small participants, utilized creativity and indeed caused significant influence. Anti-nuke stickers and folding fans they distributed became hit items at the festival. There were so many youngsters that asked for the items that they even needed to wait in line. Even beer stands nearby volunteered to help with distribution.

No Nukers also felt touched one time when they were organizing a seminar. A taxi driver drove them to the venue for free when he noticed they brought strips of cloth and flyers. The driver told them with a smile on his face, "I won't charge you because what you guys are doing is what I intend to do but have no time to put into practice."

"We used to feel very frustrated when organizing anti-nuke petition. When we walked on the street, many people simply avoided making any contact with us. They just

didn't want to be bothered, but now we're often very touched by passionate strangers." Volunteer Chi Mi Chen recalled.

Taking a closer look and we can tell there are certain common basic principles held by anti-nuke scholars and groups.

Abolishing nuclear would lead to power shortage? "It's a lie," refute anti-Nuke organizations

Based on geographical locations, anti-nuke activists claim the first three nuclear power plants are all located in populated areas in northern Taiwan. In addition, Taiwan is located at the boundary between two plates with frequent earthquakes. Once nuclear disaster took place, the consequence would be really beyond imagination.

National Taiwan University atmospheric sciences Professor Gloria Hsu points out that NPP1 and NPP2 are 7 km and 5 km away from Chinshan fault respectively; NPP3 is merely 1.5 km away from Hengchun fault; NPP4 is 3.5 km away from Hsintien fault. "It's simply ridiculous to build nuclear power plants right on the fault zone," Hsu commented.

As for the most concerned issue- power shortage, anti-nuke activists think in the Taiwanese percent reserve margin is of at least 20%. That's already too high and thus there is no need to worry about power shortage.

Besides, is nuclear power a necessary energy? Most of the anti-nuke activists believe that based on the TaiPower's information, nuclear power accounts for 12.4% of gross generation in 2011. That's not a high percentage, so why can't it be substituted by alterative energies? Renowned anti-nuke legislator Qiu Jin Tian shared that when she visited a German's Department of Energy official, she was told "Only wind and sun are free of charge."

Of course it's not electricity bills the official was referring to. It means those resources won't pollute the environment; neither will they threaten people's lives and health. "Things that can be solved with money are minor" Qiu Jin Tian said.

She further suggested that the NPP4 has had so many problem now , instead of clearing up the mess, it would be better to rebuild the site as a nuclear power museum to serve as a permanent platform for environmental education.

Furthermore, nuclear waste derived from nuclear power plants is another prominent issue. The authority still can't find a final place for nuclear reservation. How can we continue to build a nuclear power plant while we're incapable of finding a place to reserve nuclear waste?

"TaiPower is a state-owned enterprise, which means citizens are all shareholders. We citizens of course have the right to discuss and decide our future!" Yu Ling Chu stated.

Nowadays, the anti-nuke strength keeps gaining momentum in the society. Many once unimaginable sectors start to launch a petition for this cause. In August 2012, an illustrator group sought to cooperate with Green Citizen's Action Alliance to launch "Anti nuclear posters exhibition" throughout Taiwan. Eslite Bookstore which has held the "Rooftop Live" every September, the bookstore also actively looked for opportunities to promote anti-nuclear thoughts in 2012. Young college students also contacted No Nukers, hoping to develop the anti-nuke stance into student movements.

In the past, anti-nuke activists took to the street to confront the tough with toughness. Now, a new generation of young people expresses their anti-nuke spirits in diverse manners like music, poetry, and drawings. They portray their affection to this land and have made anti-nuke campaign more rooted to the civil society.