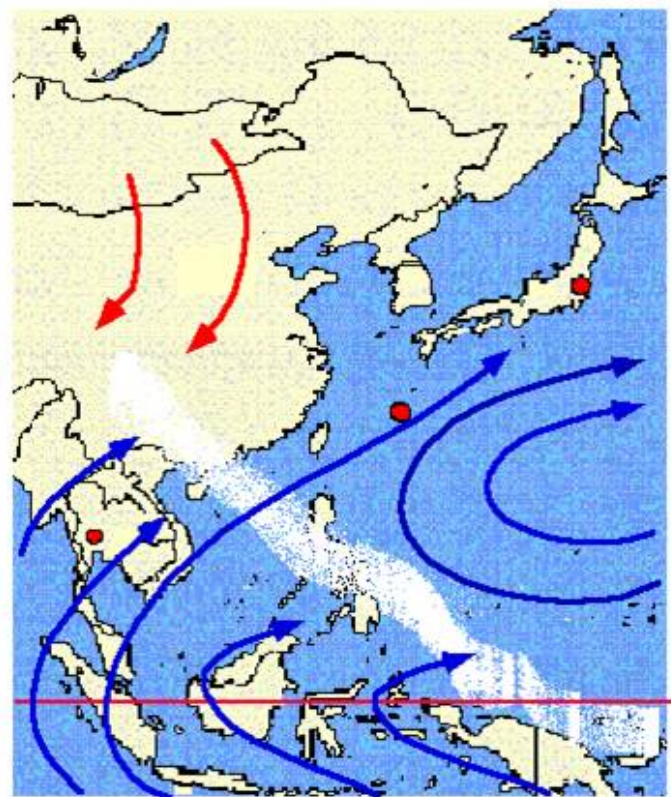
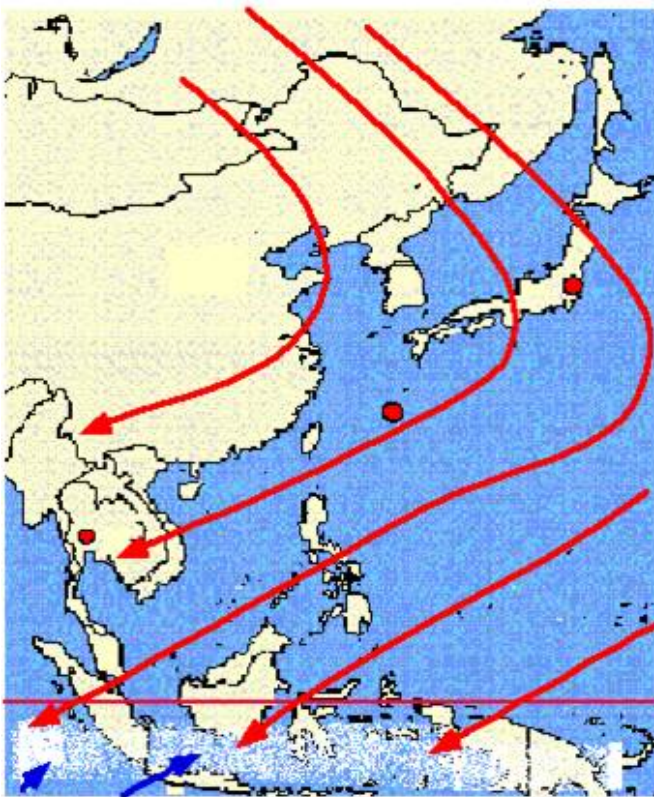


# Securing Nuclear Safety in Northeast Asia: ROK Proposal on Northeast Asia Nuclear Safety Mechanism

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by Park Younwon

5 May 2015

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## I. Introduction

Professor Park Younwon writes that given their 'inevitable expansion of nuclear energy use', Japan, Korea and China 'ultimately share a common fate in terms of nuclear power, which is why the need for cooperation remains large. But other than the Top Regulators Meeting (TRM), talks on a cooperative organization among the three countries remains yet to be seen.'

Park proposes that 'nuclear safety regulators must bolster three-way ties in order to overcome and outpace the TRM Work Frame-model and establish a cooperative body with more binding decision making power.'

Park Younwon is Professor in the Nuclear and Quantum Engineering Department at the Korea Advanced Institute of Science and Technology. This report was initially published in Korean by the Kim Dae-jung Library: <http://www.kdjlibrary.org/>

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## II. Special Report by Park Younwon

### **Securing Nuclear Safety in Northeast Asia:ROK Proposal on Northeast Asia Nuclear Safety Mechanism**

#### **Background**

The Fukushima nuclear disaster in Japan on March 11, 2011 produced much skepticism on the global community's nuclear power safety capacity as well as much distrust towards nuclear power in general from the people of respective nations. Korea and China raised the most concern back then, given their close vicinity with Japan. I hesitate to call it a saving grace, but most of the radioactive material was channeled to the Pacific due to westward winds, bringing down the radioactive damage in the Korean peninsula and China down to virtually none. But still, there is growing concern and a common understanding within Northeast Asia (NEA) on the need for a more progressive cooperation agreement on nuclear safety.

From an energy-demand standpoint, NEA (Korea, China and Japan) in large has many reasons to increase its use of nuclear power, despite the temporary reduction since the Fukushima crisis. Korea and Japan's overseas energy reliance stand at 97% and 84%, respectively. China's rate is lower than that of Korean and Japan but its heavy reliance on coal is blamed for its extreme air pollution. Therefore China cannot but increase its use of pollutant-free energy sources.

The state of trilateral nuclear safety cooperation remains at a rudimentary level. The countries' Top Regulators Meeting', or the TRM, launched in 2008 is held annually, but had remained mostly ceremonial and protocol-centric before the Fukushima disaster. Since then, it has touched upon the topic of information sharing in times of crises but has yet produced a common outcome.

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While the three countries share much in common culturally and historically, when it comes to nuclear safety, the nations have either resorted to self reliance or cooperation with the IAEA and other international agencies, or far more distant nations such as the United States or France, instead of consulting with regional neighbors. President Park Geun-hye in her Aug. 15 Independence Day speech last year proposed forming “Cooperative Organization of Nuclear Safety in Northeast Asia”. This proposal will become the foundation for the region’s nuclear safety cooperation body and ultimately contribute to securing regional nuclear safety.

### State of regional nuclear development and outlook

As seen in Fig. 1, as of 2014 Korea, China and Japan currently operate 24, 21 and 48 (halted) nuclear power plants, respectively. By 2050, the total is expected to increase to about 300, thus concentrating approximately 40% of the world’s nuclear power facilities in Northeast Asia. According to BERC(Berkeley Energy & Resources Collaborative), if China pushes on with its current nuclear power plant constructions, by 2035, nuclear power of China and OECD Asia (Korea, Japan, etc) will surpass that of the U.S. and Europe as seen in Fig. 2.

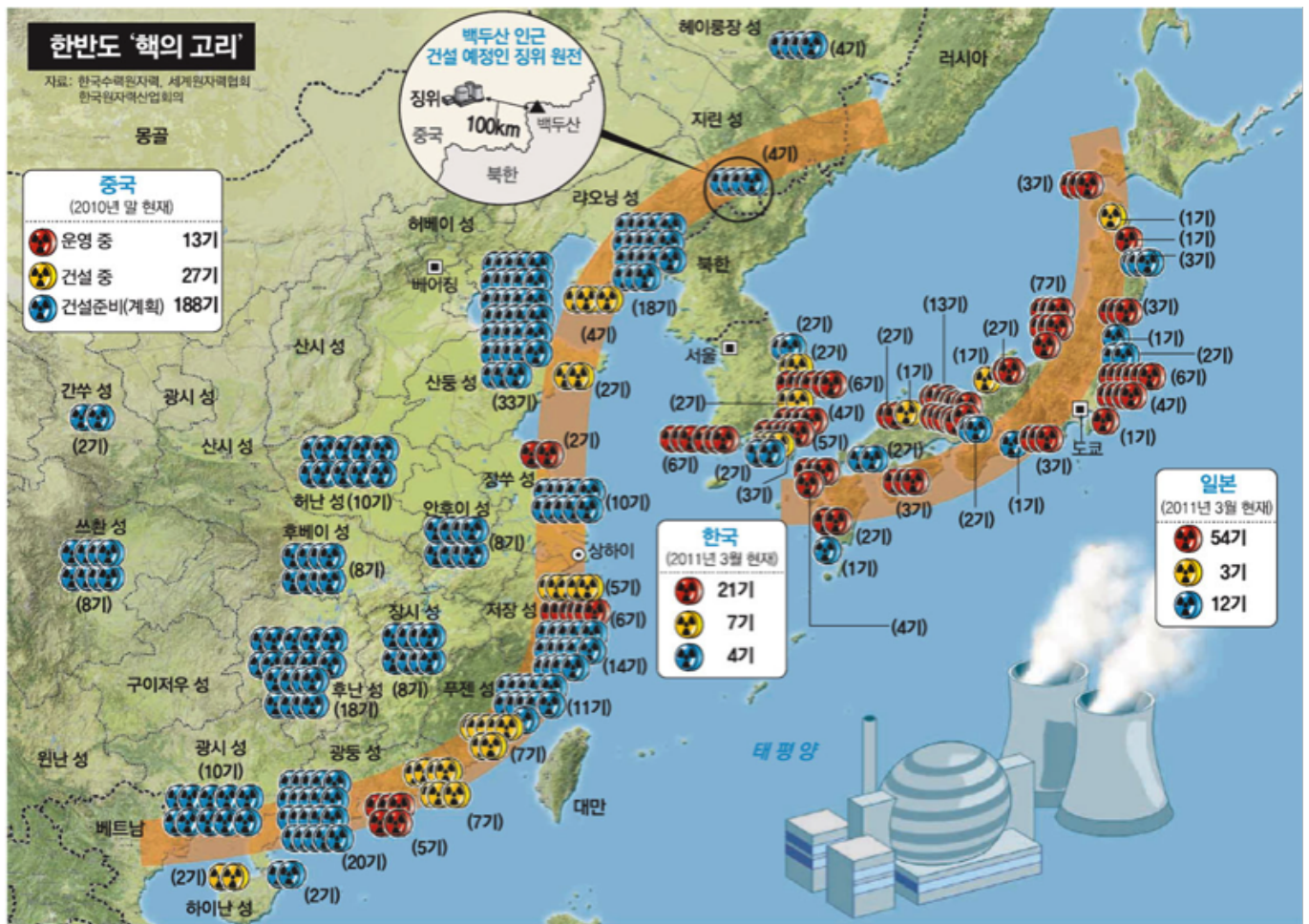


Fig. 1. Outlook of nuclear power in Northeast Asia (from Dongah daily journal, April 5 2011)

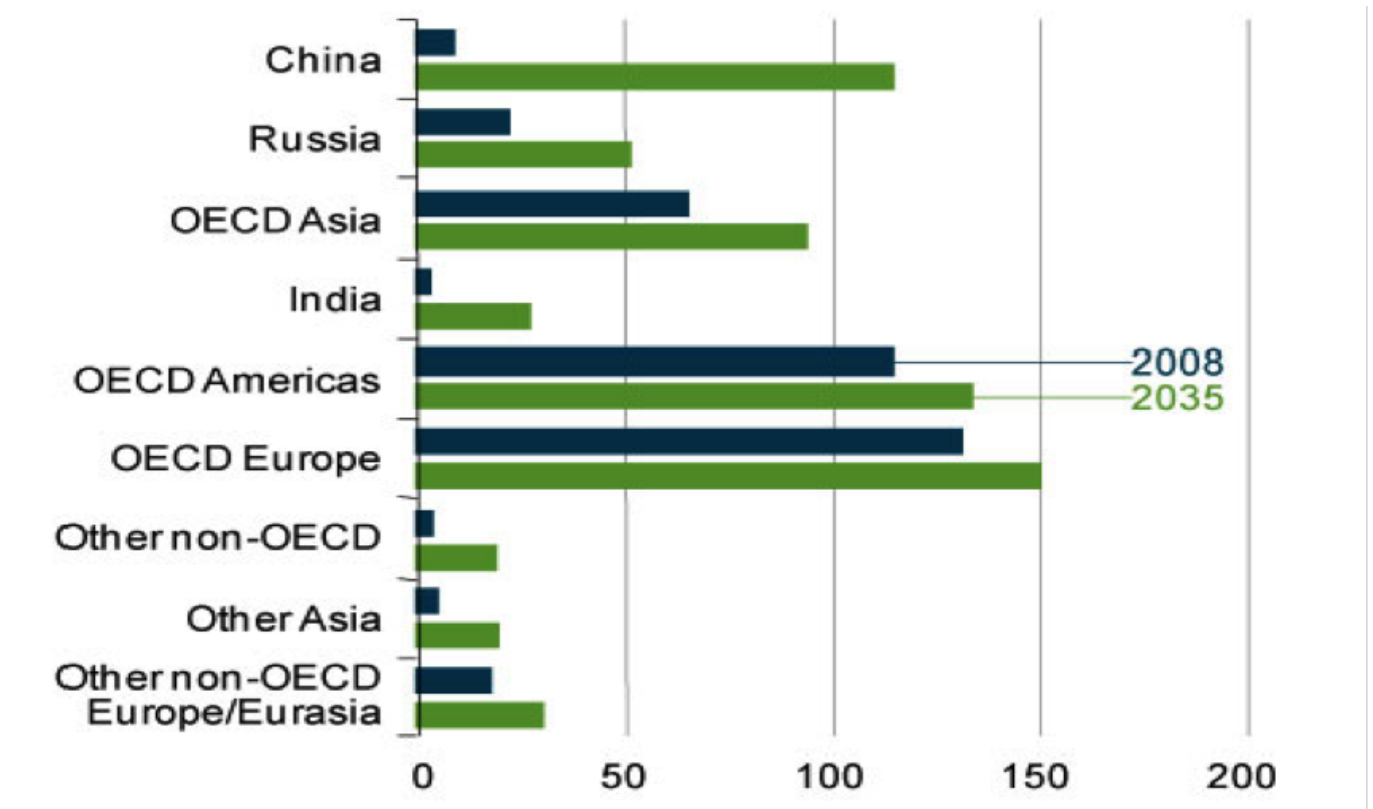


Fig. 2. Nuclear capacity outlook (from <http://berc.berkeley.edu/chinas-post-fukushima-attitude-toward-nuclear-energy/>)

## Northeast Asia's nuclear safety policy and safety related issues

### (1) Korea

By looking at Korea's energy resource make-up (Fig. 3), we can observe the dire state of Korea's energy situation. Of the country's \$519.6 billion imports in 2012, 36%, or \$184.8 billion was spent on merely energy imports. Among these \$54 billion worth of oil was reprocessed for exports, but still, a whopping \$130 billion of energy imports reveal Korea's dire energy situation. Korea, Japan and China's imports of the three major fossil fuels - coal, oil and natural gas- all rank in the top 5 list of import nations. NEA's level of dependence on fossil fuel and how much it spends on energy imports is clearly profound.

Korea's nuclear safety legal system, as seen in Fig. 4, is formed largely by the nuclear safety law, the presidential enforcement ordinance, enforcement regulation and the notification from the nuclear safety committee. Underneath are the technical regulatory standards, guidelines and the industry standards that govern machineries, production, installation and maintenance.

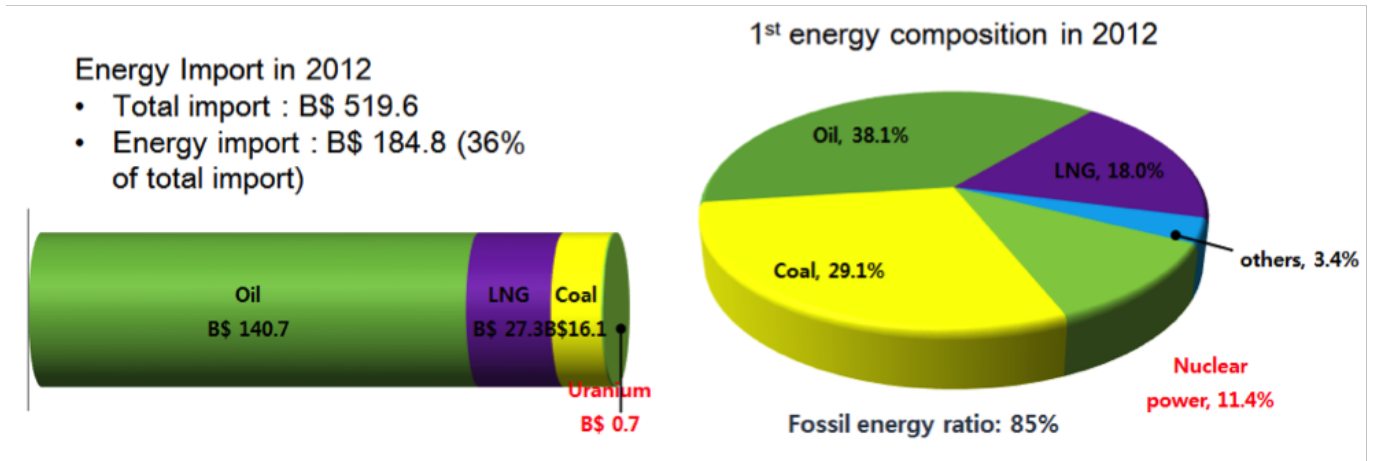


Fig. 3. Makeup of Korea's energy resource and its overseas reliance (from Korea Energy Economics Institute)

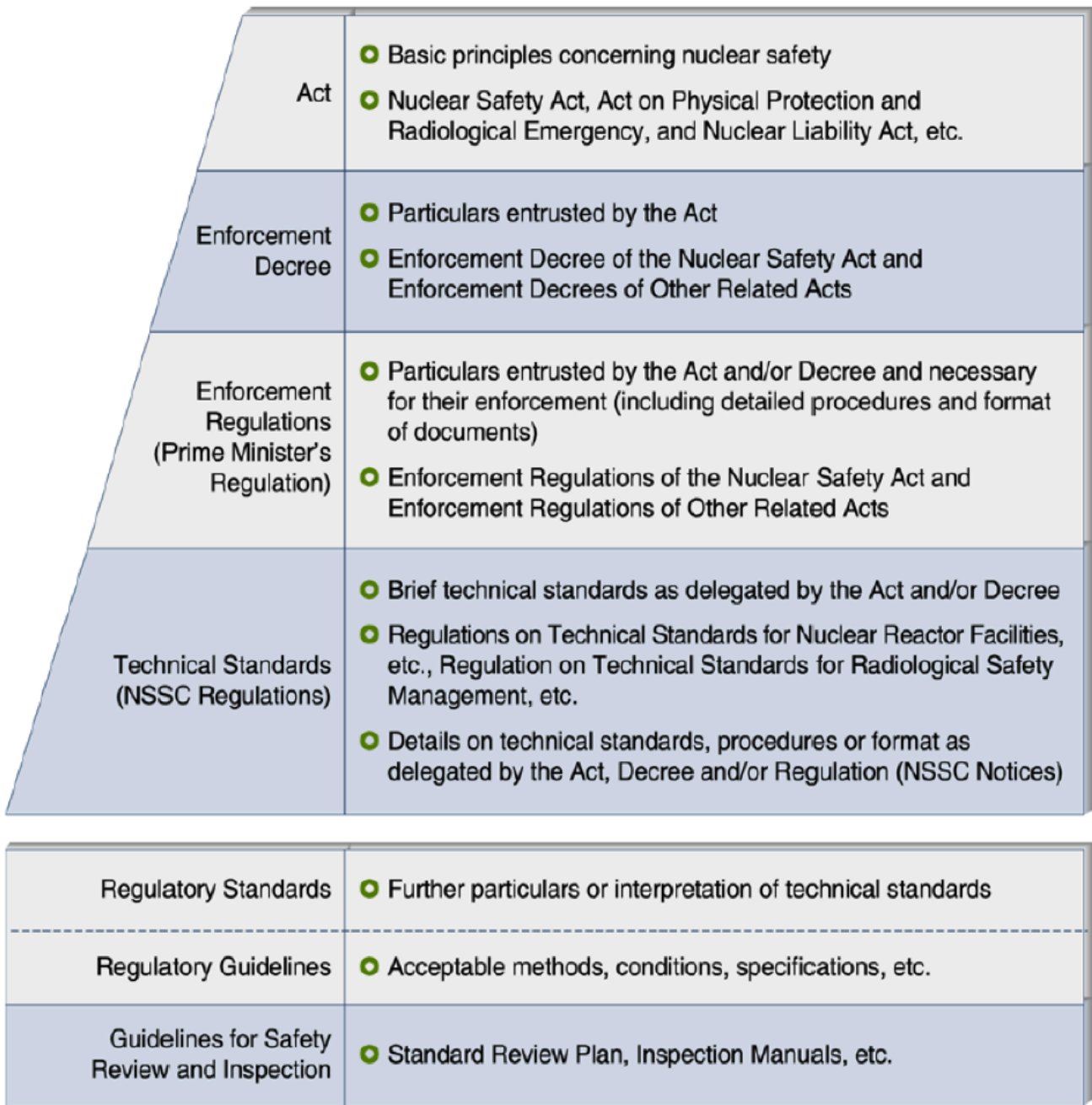


Fig. 4. Korea's nuclear safety legal system (from 6<sup>th</sup> National Report for the Convention on Nuclear Safety)

Nations around the world have concentrated effort in improving nuclear safety since the Fukushima nuclear disaster. In the past, construction of a plant had been focused mostly around 'design-basis accidents.' In the post-Fukushima era, safety of nuclear facilities have been drastically improved, with natural disasters and possible after affects and other factors being taken into much more consideration. In Korea, operational plants were thoroughly examined for any possible signs of a similar crisis-level disaster such as the Fukushima disaster, with regulators and experts producing step-by-step contingency plans as seen is Fig. 5.

## Inspection Results and Follow-up Actions

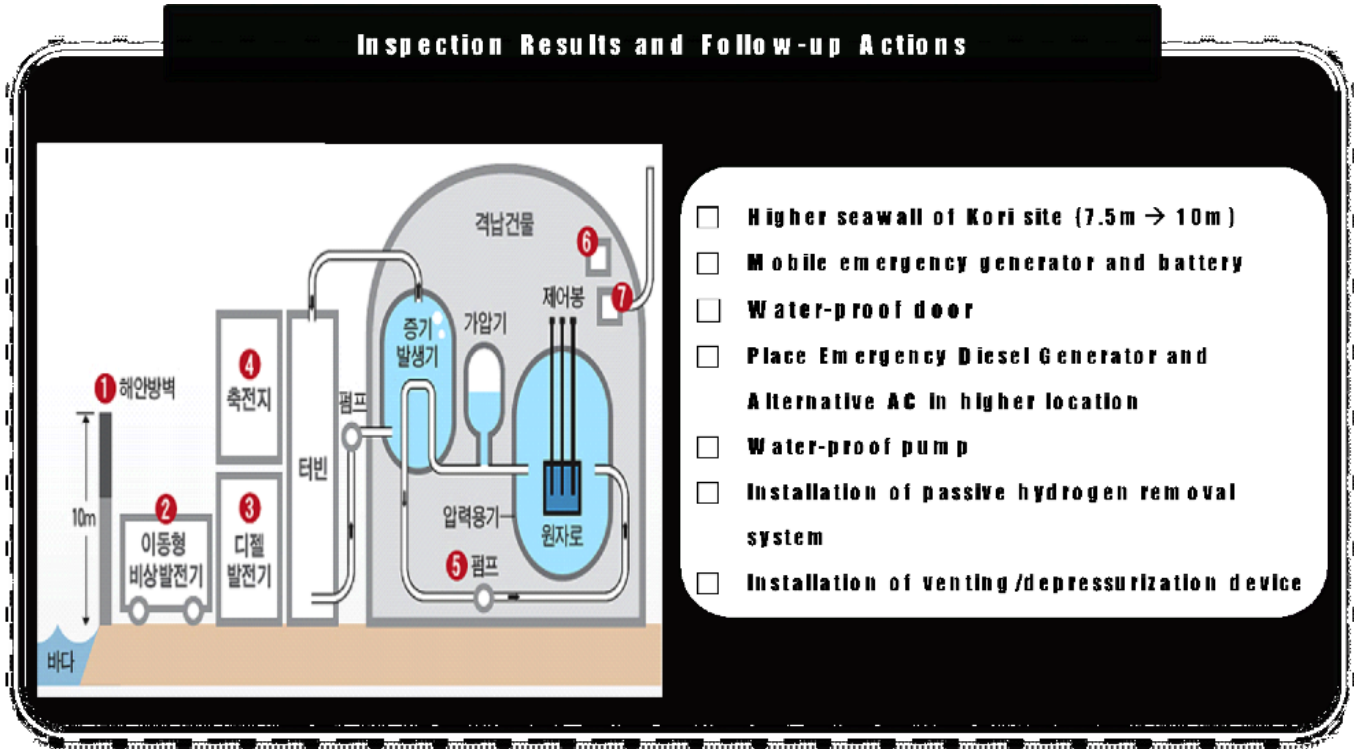


Fig. 5. Safety measures of Korean plants after the Fukushima debacle

As seen in Fig. 5, reinforcement of safety standstill mechanism of reactors in times of extreme environmental hazards and also in case of its failure, emergency power delivery and cooling mechanisms to prevent the core's meltdown were drastically improved. Assuming that these measures failed and the disaster further escalated, hydrogen explosion prevention, structural reinforcement of the primary reactor containment and supplementary crisis scenario manuals and directives have been put in place as well.

Despite such proactive measures, we have a long way to go until diverse nuclear issues to be resolved, such as a restart of the Wolsung unit 1 after getting approval of continued operation, selection of high level radioactive waste disposal site, making available of land for future nuclear power plant construction, etc. This is especially due to the down trodden public trust amid revelations of use of parts with fabricated safety documentations.

## (2) China

China's energy source make up for electricity production, as seen in Fig. 6, is 70~80% thermal power, 10~20% hydro power. A mere 1.3% comes from nuclear power.

■ 火电 ( Thermal power )      ■ 水电 ( Hydropower )  
■ 核电 ( Nuclear Power )      ■ 其他(Others)

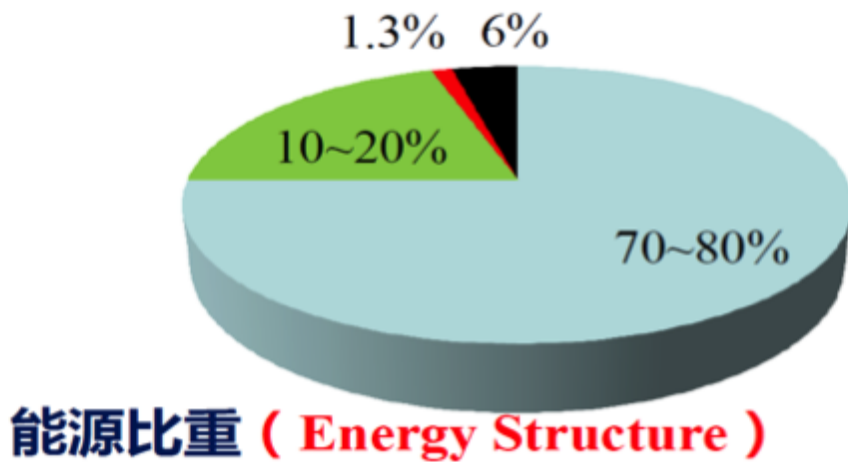


Fig. 6. China's energy source make up (presented at IAEA meeting of TWG-LWR, June 18-20 2013)

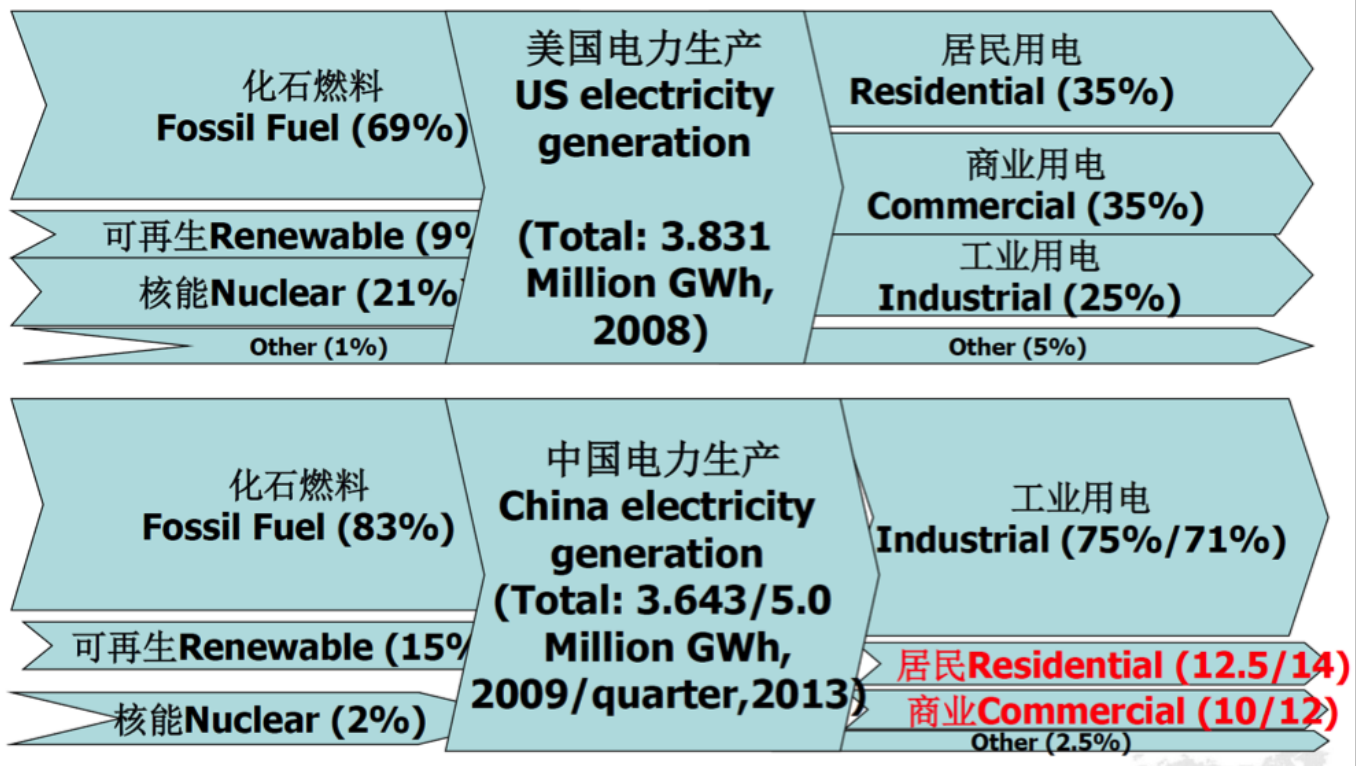


Fig. 7. Current and future state of China's nuclear energy perspective (presented at IAEA meeting of TWG-LWR, June 18-20 2013)

As seen in Fig. 7, the United States, which in terms of electricity production nearly equals that of China, produces 20% of its electricity via nuclear power. Household, commercial and industrial consumptions are spread across fairly equally, 35%, 35%, 25% respectively. China, on the other hand, channels 75% of its power to industrial use, 12.5% towards household consumption and 10% towards commercial use. The imbalance in power spending underlines the need for China to prop up its investment in power production facilities. China, in the future, plans to produce 10% of its

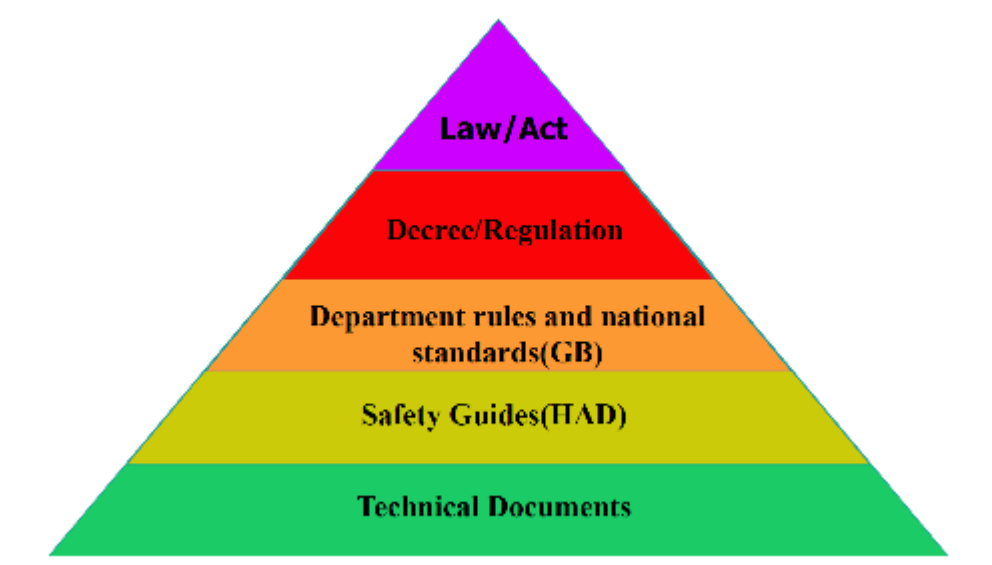


electric power via nuclear means. Chinese leadership's strong will towards this is evident as seen in Fig. 8.

On Friday, China's President Xi Jinping told a government meeting that development of nuclear energy should be accelerated. "By adopting top international standards and ensuring safety, China should lose no time in constructing nuclear power projects in eastern coastal regions," Xi said, as state-run Xinhua newswire reported. At the end of 2013, China's 17 operational nuclear power plants were generating about 2 percent of the country's total energy, according to Xinhua. But Ye Qizhen, an expert in nuclear energy at the Chinese Academy of Engineering, told the newswire that China should aim to get 10 percent of total energy from nuclear power. (from Bloomberg Businessweek, 2014. 6. 17)

Fig. 8. Chinese leadership's apparent intent in developing nuclear power

China's legal system governing nuclear safety, however, remains relatively feeble amid the country's grand nuclear energy vision. China in 1984 first came up with a draft for its nuclear law but failed to ratify it due to conflict of ideas and interest within the government. Such problems still persist, hence a basic nuclear law governing production, use, safety management yet remains to be seen. The current law, as seen in Fig. 9, is formed merely of the radiation pollution prevention act legislated in 2003 along with 8 administrative regulation, 27 partial provisions, 6 local regulations.



➤ **Laws** — Issued by the Congress (**Mandatory**).

Law on Prevention and Control of Radioactive Pollution, 2003

Law on Environmental Impact Evaluation

➤ **Regulations**— Issued by the State Council (**Mandatory**).

- Regulation on Surveillance of Civilian Nuclear Installations, 1986
- Regulation on Nuclear Materials Control, 1989
- Regulation on Nuclear Accident Emergency Management in NPPs, 1993
- Regulation on Safety and Protection of Radioisotope and Radioactive Ray-Emitting Devices, 2005
- Regulation on Surveillance of Civilian Nuclear Safety Equipment, 2007
- Regulation on Surveillance of Radioactive Substance Transportation, 2009
- Regulation on Surveillance of Radwaste, 2011

➤ **Departmental rules and national Standards (more than 20)**

— Department rules are issued by MEP(NNSA)

- Code on the Safety of Nuclear Power Plant: Siting (1991)
- Code on the Safety of Nuclear Power Plant: Design (2004)
- Code on the Safety of Nuclear Power Plant: Operation (2004)
- Code on the Safety of Nuclear Power Plant Quality Assurance (1991)

...etc.

— Mandatory standards on nuclear safety and radiation protection are issued jointly by MEP and China Commission of Standards

Fig. 9. China's nuclear safety legal system (from Presentation of NNSA, Nov. 7 2012)

Fig. 10 shows China's nuclear power development program, which is very similar to that of Korea's. The country is developing its very-own CAP-1000 model by benchmarking the Westing House AP1000 from the U.S. and plans to bolster its capacity to create an upgraded CAP-1400 model. This is similar to the Korean model based on CE technology, completing development of ORP-1000 and further expanding it to APR-1400.

In the end, Korea, China and Japan all have its nuclear technology based on that of America. They have later boosted their in-house development to improve upon the technologies and have similarly produced nuclear products for exports. In this respect, the three countries are in unique positions of competition while at the same time in the need for close cooperation.

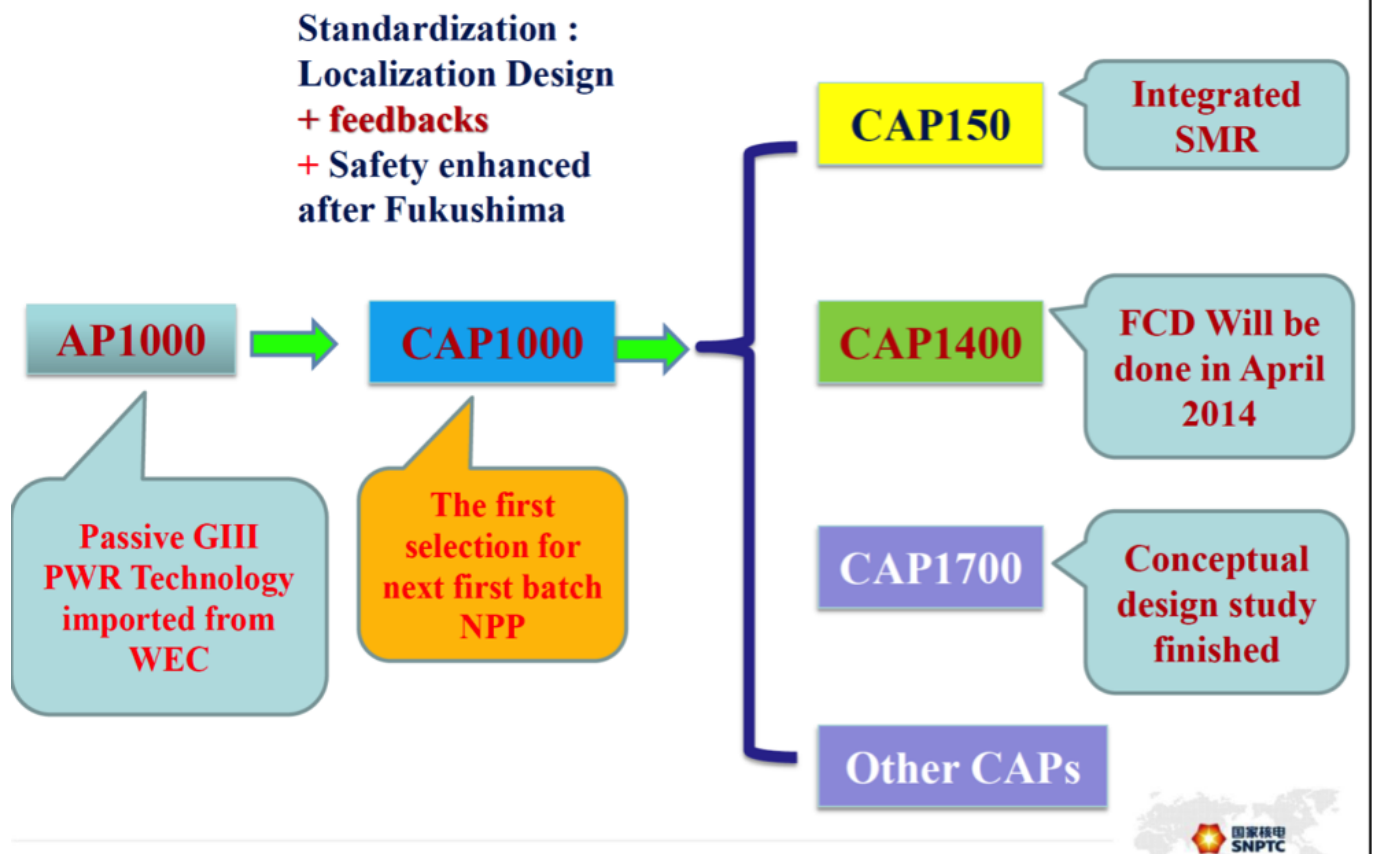


Fig. 10. China's plan towards nuclear technology independence and nuclear reactor standardization (presented at IAEA meeting of TWG-LWR, June 18-20 2013)

### (3) Japan

84% of Japan's energy is reliant on overseas imports. In terms of electricity, the country's 54 reactors produce approximately 30% of its power, but this has all been replaced by fossil fuel since the Fukushima crisis. As of now, safety revisions of 48 reactors are being conducted, as Fukushima 1's four reactors and 5 and 6 reactors from Fukushima 2 were decided to be completely shut down. Japan, since the end of World War II has persisted in its nuclear endeavors and have acquired high levels of enrichment and reprocessing technology. Public objection towards nuclear power remains high but the country is not in a situation to simply give up its nuclear program.

Since the Fukushima crisis, Japan has given much change to its nuclear safety regulation agency and required each nuclear plants to drastically improve upon its' safety measures. For example, it required plants to raise the level of breakwater to cope with severe natural disasters, while also ensuring the safe supply of emergency power and cooling capabilities towards the core. As the Fukushima crisis was further escalated due to a common cause failure from the massive tsunami, regulators improved upon various options in order to avoid common cause failures in the future. While safety evaluation in the past was conducted strictly through deterministic means, post-Fukushima evaluation will take into consideration a higher level of performance-based requirements. It also modified the basic requisites of nuclear safety regulations so that individual nuclear operators can set their own performance goals and meet their respective safety requirements.

Pre-Fukushima, there have been a string of criticism towards Japan's nuclear safety governance, such as lack of consistency, a convoluted command/control structure, lack of regulatory independence and confounding business and regulations. Japan ignored much of these. As its nuclear safety regulators failed to fulfill its contingency missions, the country came to drastically

repair its regulatory system as pointed out by the IAEA and other international agencies. As seen in Fig. 11, regulatory functions were dispersed among different agencies before. They are now consolidated under the NRA.

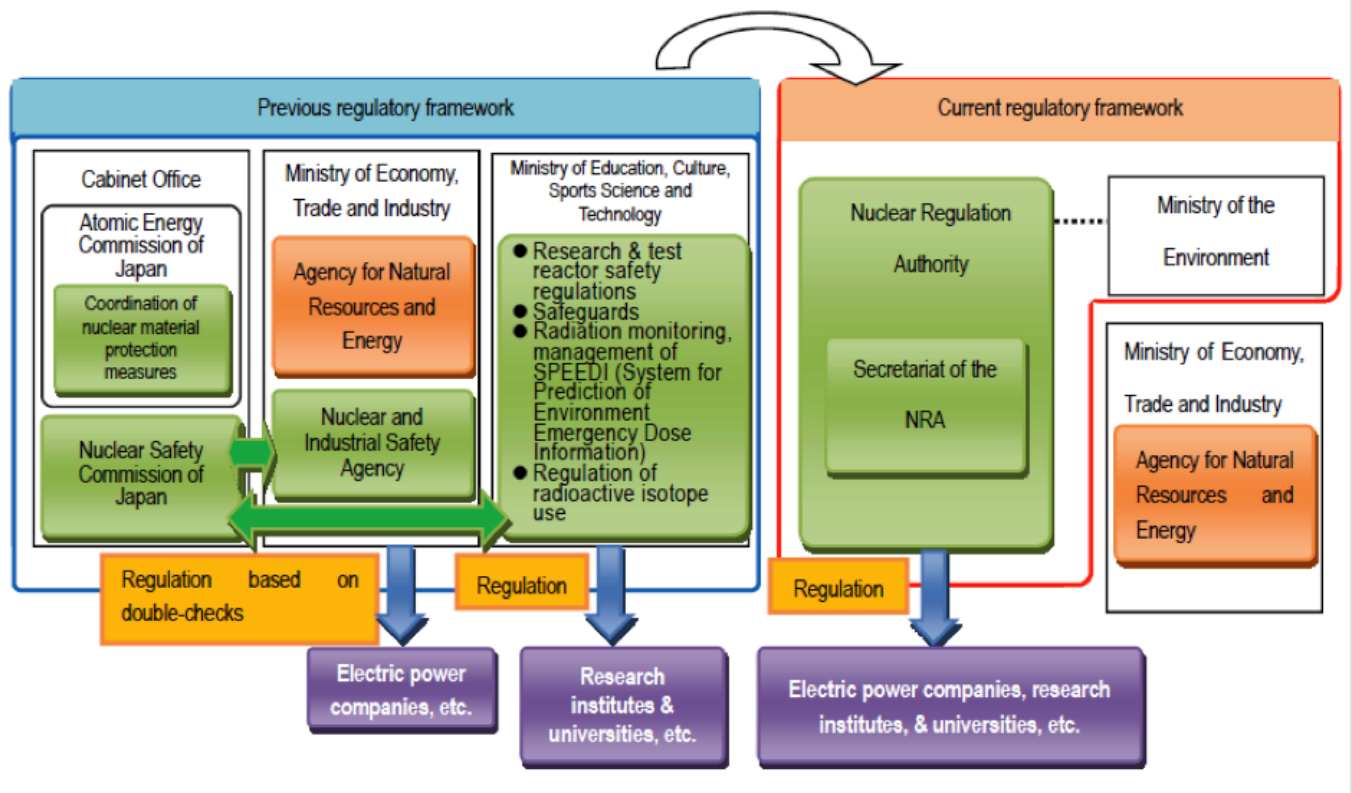


Fig. 11. The change in Japan's nuclear safety regulatory system after the Fukushima incident (from Convention on Nuclear Safety National Report of Japan for 6<sup>th</sup> Review Meeting)

## Progress in the direction of forming an Organization for Nuclear Safety Cooperation in Northeast Asia

### (1) Factors of consideration

In order to build an Organization for Nuclear Safety Cooperation in Northeast Asia (named hereinafter, CONSA: Cooperative Organization for Nuclear Safety in Asia), one must first observe and seek to find out if there are other similar organizations in the regions. Europe in 1999 launched and is operating WENRA, which is noteworthy. WENRA for the past 10 years set the common standard for nuclear development within Europe. It has received high appreciations from respective European countries for having achieved much public trust in terms of nuclear safety. Within 10 days following the Fukushima disaster, WENRA issued an order to all nuclear plants within its jurisdiction to conduct stress tests and prove their safety. It has played a critical role in ensuring nuclear safety and alleviating Europe's anxieties towards nuclear plants.

Northeast Asian countries since 2008 operates TRM as a regulators' cooperation framework, but is merely a perfunctory apparatus. After Fukushima disaster, the three nations have become keenly aware of the need for mutual cooperation in nuclear safety, thus raising the qualitative talks and operations within TRM, but still remains away from the high level of safety standards incorporations and requirements of the parties' compliance.

As mentioned before, the three nations collectively face the inevitable expansion of nuclear energy use, and getting public approval regarding nuclear safety remains the utmost priority in raising

regional partnership and cooperation. Korea and Japan face an uphill public battle concerning nuclear expansion and China, while the public anger remains dormant due to its political system, is also sure to face similar obstacles in terms of establishing its nuclear policy. The countries ultimately share a common fate in terms of nuclear power, which is why the need for cooperation remains large. But other than the TRM talks on a cooperative organization among the three countries remains yet to be seen.

## **(2) Why the need for a NEA consultative body?**

President Park Geun-hye first underscored the need for and proposed on the formation of a nuclear safety cooperative body in the northeast asian region. But China and Japan have not reacted favourably. Thus an analysis of why China and Japan, despite the apparent need for close cooperation, remain lukewarm is necessary. Unlike Korea, the proposer, China and Japan lacks the common understanding on why there must be a nuclear safety cooperative body. The most pressing matter is drawing out, from the two countries, the common understanding on the practical goals that such body can deliver.

Northeast Asian region will soon be the most concentrated area in the world in terms of nuclear facilities. Therefore it is required to develop and maintain world's most leading nuclear safety measures. The U.S., which accounts for a quarter of the world's 400 active nuclear plants, at the moment leads in global nuclear safety initiatives. But if China comes in possession of over 200 nuclear plants, I believe it will naturally behold the leading role in nuclear safety. This serves as a good reason for China to step forward in forming CONSA. For Japan, it has already received much flack for the Fukushima disaster. Tokyo has put a great deal of effort into overcoming such hurdle, despite relatively negative public opinion. But this is no longer Japan's own problem; Japan must not only build upon its own nuclear safety measures but also vastly improve China's nuclear safety to a highly reliable level. The fact that plants within the three countries are relatively younger than those of the U.S. or Europe, and also that plants under construction are all of third-generation-and higher and with drastically improved safety, allows a higher level of safety resilience than that of European counterparts.

Since the Fukushima crisis, nearly all in the nuclear industry has come to agree that securing the public's trust relating to nuclear safety is the most important factor in sustaining the industry as a whole. To this end, upping the game in terms of nuclear safety is important. But also as important is allowing the people better access towards nuclear safety information and raising the level of its transparency. While China is soon to become the world's largest possessor of nuclear plants, it is also one of IAEA members that does not disclose its IAEA nuclear safety convention report. Therefore it is imperative that China raises its transparency regarding nuclear safety. Wikileaks also expressed deep concern over China's opaque nuclear bidding procedure and the government's excessive influence<sup>[1]</sup>. As state policy, China is aggressively pursuing the development of nuclear plants. But its speed of nuclear expansion is accelerating to the point where the country is unable to build upon its experiences and ultimately raising the possibilities of future disasters to an alarming level<sup>[2]</sup>. In the end, China's nuclear expansion policy can end up becoming a safety liability for Korea and Japan, hence demanding contingencies to mitigate such concerns.

Nuclear plant constructions are again gaining ground, as well as parts replacement for operating plants. But no single country in the world has the capacity to self-produce all parts that go into their nuclear power plants. All parts are made and traded within the global market, hence signifying the need for increased efforts in transnational cooperation in tackling fake parts and documentation. For example, in Korea, a consumer dish holder product sold in a supermarket contained abnormal levels of radiation. The product was checked and was later discovered that it was made of China-made stainless steel. China of course did not on purpose export such a product. The incident was a

cautionary tale on the need to improve cooperation in terms of customs, tracking and overall measure in dealing with nuclear-related issues. In the case of large number of imported parts, it is virtually impossible for the importing nation to inspect every single vendor. This calls for a system to utilize and inspection results from the export nation. The NRC of the U.S. has issued a report (SECY-11-0154) after having discovered several cases of fraudulent Chinese parts used in American nuclear plants. This is a case signaling the importance of trilateral cooperation of northeast asia region relating to nuclear safety.

## **(2) What should be done?**

The following three plans can be proposed in forming a trilateral cooperative organization for nuclear safety in this region.

- (Proposal 1) Upgrading the current TRM into a WENRA-level body (centered around Korea, China and Japan)
- (Proposal 2) A two-track approach: one with the three countries' regulators and the other with industry groups (centered around Korea, China and Japan)
- (Proposal 3) An expanded trilateral body with the willing participation of other Asian members as observing states (adjustment of the TRM+ model)

To this end, nuclear safety regulators must bolster three-way ties in order to overcome and outpace the TRM Work Frame-model and establish a cooperative body with more binding decision making power similar to that of WENRA:

- Setting common safety goals: Developing common safety standards, and harmonization process
- Drawing up action plan and working group formation to achieve the above goals
- Declaration of a common nuclear safety statement

Also, unlike its European counterparts, the three nations, besides Korea, do not appear to strongly agree on the need for a nuclear safety cooperative body. The Korean government should focus on forming a common understanding on such need with Beijing and Tokyo.

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## **III. References**

[1] [Jonathan Watts](#), WikiLeaks cables reveal fears over China's nuclear safety, The Guardian 26 August 2011, <http://www.theguardian.com/environment/2011/aug/25/wikileaks-fears-china-nuclear-safety>

[2] [He Zuoxiu](#), Chinese nuclear disaster “highly probable” by 2030, China Dialogue, 19 March 2013, <https://www.chinadialogue.net/article/show/single/en/5808-Chinese-nuclear-disaster-highly-probable-by-2-3->

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