China's Efforts for Keeping the Safety of Nuclear Power Compatible with Economic Efficiency

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It is no exaggeration to say that keeping safety compatible with economic efficiency in nuclear power generation is an eternal challenge for international society. As an emerging country of nuclear power generation, China is no exception.

Since the Fukushima Daiichi accident on March 11, 2011, China has reviewed its plans for nuclear power development. Consequently, in October 2012, the State Council released the "Twelfth 5-year Plan on Nuclear Safety and Radioactive Contamination Prevention, and the Long-term Target for 2020", setting out the "Nuclear Power Safety Plan for 2011-2020" and the "Medium- to Long-term Nuclear Power Development Plan for 2011-2020". Subsequently, in July this year, the State Council revised the "National Nuclear Emergency Plan", and the National Development and Reform Commission issued a notice on the improved pricing mechanism for nuclear power electricity. Thus, the framework of related systems aimed at keeping safety compatible with economic efficiency has now been presented.

・Ensuring Safety as the Lifeblood of Nuclear Power

The plans consider safety as the lifeblood of nuclear power generation, and require that safety be given overriding priority in all stages including planning, construction, operation and decommissioning of the plants, and in all related industries.

Regarding those plants that are now in operation or under construction, the plans expressly require that the plants be renovated on a continuous basis with the latest mature technology to constantly improve their safety, and estimate that a total investment of 79.8 billion yuan (approx. 1.3 trillion yen) will be necessary for safety measures up to 2015. Regarding nuclear development in the future, the plans prohibit new plants construction in inland areas until 2015, and require all new reactors to comply with the third-generation safety standards[1]. Further, the plans set an installed nuclear capacity target of 40 GW by 2015, and revised the target for new constructions by 2015 downward to 16 GW, equal to 40% of the initially-planned 40 GW, as well as the installed capacity target by 2020 to 58 GW, significantly lower than the initial expectation of 70 to 80 GW.

[1] The exact definition of the third-generation safety standards, however, has not been clarified yet. Chinese experts assume that the criteria stated in the "Twelfth 5-year Plan on Nuclear Safety and Radioactive Contamination Prevention and the Long-term Target for 2020", which are a core damage probability of 1 in 100,000 per reactor/year or lower and a probability of a mass radioactive release accident of 1 in 1,000,000 or lower would serve as the reference criteria. At present, four American AP1000 reactors and two French EPRs, currently under construction, meet these criteria. Currently, the State Nuclear Power Technology Corporation is developing a third-generation reactor CAP1400 based on the AP1000, while the China National Nuclear Corporation and the China Guangdong Nuclear Power Corporation are each developing quasi-third generation reactors: ACP1000 based on the second-generation CP1000 by the former, and ACPR1000 and ACPR1000+ also based on CPR1000 by the latter. The construction of these plants is not expected to begin until 2014 at the earliest.

In addition to these preventive measures, the emergency measures for minimizing the damage in case of an accident have been revised. The "National Nuclear Emergency Plan 2013" has clarified the actions that must be taken by the state, the provinces and the nuclear power companies depending on the severity of the accident, as well as their responsibilities. For example, in case an off-site radioactive release accident is detected, a state accident response command center led by a State Council leader will be established as necessary to lead the comprehensive measures, including launching emergency measures (immediately taking measures such as injecting water to prevent core damage and the release of radioactive substances) and dispatching the state nuclear emergency special unit. Further, nuclear power companies are expressly required to respond to any accident on-site as the party in charge, and to bear any cost involved in preparing for emergencies by themselves.

- **Ensuring Economic Efficiency by Introducing a Benchmark Price**

Regarding economic efficiency, the government has so far adopted the overall cost-based system for deciding the sale price of grid-connected power, while also requiring nuclear power companies to improve the ratio of domestically-manufactured nuclear equipment and tighten controls on construction cost. The recent notice announced that a national benchmark price of 0.43 Yuan/kWh (approx. 6.9 yen/kWh) will be applied to electricity produced by all nuclear plants which have begun operation after January 1, 2013. Specifically, the sale price of electricity differs for each plant depending on when the plant went into operation and the benchmark price of coal power in the area where the plant is located (Table 1).

Table 1 Pricing Mechanism for Nuclear Electricity beyond 2013

<table>
<tr><th>Start of operation</th><th colspan="2">Benchmark price of nuclear electricity vs. coal electricity</th><th>Regional price of nuclear electricity</th></tr>
<tr><td rowspan="5">On or after January 1, 2013</td><td colspan="2">Nuclear electricity price is higher than coal electricity price</td><td>Benchmark coal electricity price</td></tr>
<tr><td colspan="2">Nuclear electricity price is equal to coal electricity price</td><td>Benchmark nuclear electricity price (= benchmark coal electricity price)</td></tr>
<tr><td colspan="2">Nuclear electricity price is lower than coal electricity price</td><td>(There are two cases)</td></tr>
<tr><td rowspan="2"></td><td>1) The first plant or plants built as part of model projects for introducing technologies from abroad or developing them independently, or projects for building critical plants within the country</td><td>No higher than the benchmark coal electricity price</td></tr>
<tr><td>2) Nuclear plants other than the above</td><td>Benchmark nuclear electricity price</td></tr>
<tr><td colspan="3">Existing nuclear plants which began operating before December 31, 2012</td><td>The price determined by the conventional overall cost-based pricing system</td></tr>
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Source: Prepared by Li Zhidong based on the notice on the improved pricing mechanism for nuclear power electricity issued by the National Development and Reform Commission.

Regarding new nuclear power plants, (a) if the national benchmark nuclear electricity price is higher than the local benchmark coal electricity price, the plant must align its electricity price with the benchmark coal electricity price; (b) if the benchmark nuclear electricity price is lower than the local benchmark coal electricity price, a nuclear plant may set its electricity sale price higher than the benchmark nuclear electricity price, provided that the plant is among the first plants built as part of model projects for introducing technologies from abroad or developing them independently, or projects for building critical plants within the country, and provided that the price is proposed by the provincial consumer price office and is approved by the National Development and Reform Commission; (c) for all other new nuclear plants, the benchmark nuclear electricity price must be applied. In other words, for all new nuclear plants, the benchmark coal electricity price at hosting regions will be the upper limit of their electricity sale price. The benchmark nuclear electricity price will be kept relatively stable, but will be revised to reflect technological progress, changes in electricity generation cost, and the supply-demand situation of electricity.

For those plants that started operation before December 31, 2012, the overall cost-based pricing system will continue to be applied.

- **First Step for Keeping Safety Compatible with Economic Efficiency**

Safety and economic efficiency are the two engines for developing nuclear power; both are indispensable for the nuclear business to continue to be justified.

While pursuing safety as the lifeblood of nuclear power, China has taken a first step toward keeping safety compatible with economic efficiency by setting an upper limit on the price of nuclear electricity. Going forward, the challenge will be how to ensure operability, transparency and verifiability of the framework of the system, including clarifying the decision-making criteria concerning the emergency measures in the event of a severe accident, handling the cost of high-level radioactive waste disposal in the cost of electricity generation, and refining the criteria for revising the benchmark electricity price.

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