# A Study for Appropriateness of National Nuclear Policy by using Economic Analysis Methodology after Fukusima accident.

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## 1. Introduction

In the aftermath of the Fukushima accident recognized as the world's worst nuclear disaster since the Chernobyl, there are some changes in the nuclear energy policy of various countries. Germany, for example, called a halt to operate Nuclear Power Plant (NPP) which accounts for about 7.5% of the national power generation capacity of 6.3GW. In developing countries such as China and India they conducted the safety check of the nuclear power plants again before preceding their nuclear business. Korea government announced "The 6th Basic Plan for Long-term Electricity Supply and Demand (BPE)", considering the safety and general public acceptance of the nuclear power plants. According to BPE, they postponed a plan for additional NPP construction, except for constructions that had been already reflected in the 5th BPE. All told, the responses for nuclear energy policy of countries are different depending on their own circumstances. The aim of this paper is to clarify the appropriateness of national nuclear policy in BPE of Korea from an economic perspective. To do this, this paper only focus on the economic analysis methodology without any considering other conditions such as political, cultural, or historical things.

## 2. Summary of Fukushima Accident

A magnitude 9.0 earthquake (Richter scale) occurred off the east coast of Japan's Honshu Island, triggering a tsunami that afterward shrouds the Fukushima Daiichi nuclear power plant and its reactors on March 11, 2011.

Despite the automatic shutdown of the operating reactors, the loss of off-site power and a flooded emergency diesel-generator system caused the station to lose its ability to cool the reactor core and spent fuel ponds down. As the result, the reactors were overheated and consequently three of the six reactors to experience core meltdown resulting in the release of huge amounts of radioactive materials.

## 3. Change of global nuclear policy

Fukushima nuclear accident causes the significant change in the policy direction on the global nuclear energy. Whilst Germany and Japan show some changes in their nuclear energy policy, the United State displays changes in the private sector.

First of all, the German government declared temporary shutdown of the seven oldest nuclear power plants, and also considered permanent closing the NPPs in the long term. In addition, the supports for the expansion of renewable energy are expected to be growing. Secondly, the Japanese government is going to delay the policy that supports renewable energy because of the additional funding for nuclear accident. Finally, in the United States, investment for new nuclear power plant was on hiatus in the private sector. All told, the national nuclear policies are interrupted in the different direction at the response of Fukushima accident.

## 4. Change of national nuclear policy of Korea

### *4.1 Public Opinion for nuclear policy*

When it comes to the national nuclear policy which is very sensitive and complex, the balance is especially important. To find the rational management plan of nuclear energy and the medium to long term plan of alternative energy source, we also need to review the overall change in the public opinion after the Fukushima accident. First, in March 2011, Gallup International Association (GIA) conducted a survey targeted at 47 countries around the world including South Korea. According to this survey, 64% of the Koreans are still in favor of nuclear power plants after the Fukushima accident, which was decreased from 65% before the accident. On the other hand, the disapproval rating is increased from 10% to 24%. On average, an approval rating of 47 countries is plunged from 57% to 49% whereas the disapproval rating is increase from 37% to 43% after Fukushima disaster. This survey shows that the opposition against NPP is on the rise. Moreover, the controversy over the construction of the NPP is expected to be stronger in the near future. Another similar poll was conducted by the Science and Technology Policy Institute (STEPI) in November 2011. In this survey, 49.6% of the respondents in general group believe that NPPs in Korea are safe and 75.6% of the expert group believes that also. With this result, we assume that negative opinion is insignificant. It can be explained that social consensus for the energy security and possibility of development in NPP is contributed to it among Koreans.

### *4.2 Nuclear policy of The 6th Basic Plan for Long-term Electricity Supply and Demand (2013~2027)*

Basic Plan for Long-term Electricity Supply and Demand (BEP) is set up every two years in accordance with Article 25 of the Electricity Act by the Minister of Knowledge Economy and the power equipment facility planning to assure the stability for long-term electric power supply over the next 10 years. BPE forecasts long-term electric power demands and sets targets to meet the demand. BPE also contains the electric power facility construction. Based on the safety and the public acceptance for nuclear energy after Fukushima accident, Korean government announced that they postponed the additional construction of NPP, except for nuclear power plants that had been reflected in the 5th BEP. In order to reduce the cost of electricity supply, they also plan the expansion of the coal-fired power and LNG combined cycle power plants to maintain the stability of supply and demand. In this 6th BEP, the government decides to construct the Shin-Kori unit 5, 6, 7, 8 and Shin-Hanul unit 3, 4 that were already applied in the 5th BEP.

However, the additional construction of four NPPs to be completed during the period from 2025 to 2027 will be decided by the 2nd National Energy Basic plan. Although 6th BEP does not include the additional four NPPs, the nuclear proportion is foreseen similar to the current level in the long-term nuclear energy policy of the energy mix. It can explain that the government is fully aware of the benefits and necessity of nuclear power in terms of economic and environmental performance. Therefore, the additional construction of nuclear power plants is expected to ensure a reliable electricity power supply in the foreseeable future.

## 5. Economic Analysis for Nuclear Energy

### *5.1 Methodology of Analysis*

Generally, the economic analysis for NPP is used to find optimal generating alternative by comparing each levelized generation cost from the different type of power plant. For this, the probabilistic economic analysis is very useful method. Therefore, we will analyze the levelized cost and conduct the sensitivity analysis between NPP and coal-power plant by using “Crystalball” software. Crystal Ball includes analysis tools for Monte Carlo simulation as well as developer kits for building custom interfaces and processes.

### *5.2 Levelized Cost Comparison*

In business investment, it is almost impossible to accurately predict the variables that occur in the future, so there can be no absolute way to evaluate the affordability for electric generating business. However in the nuclear industry, the levelized cost method is generally used to forecast the economic feasibility of new nuclear power plant.

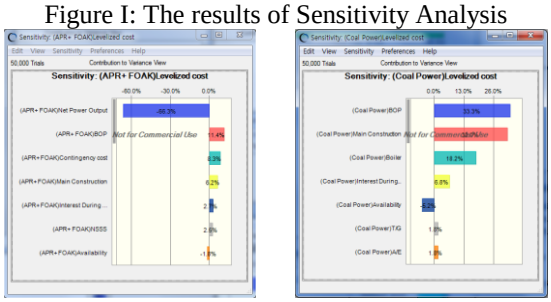
Table I: The results of Levelized Cost Estimation

| | levelized cost(won / kW), |
|---|---|
| 1000MWe coal-fired plant | 57.55807 |
| APR + FOAK | 44.45749 |
| APR + NOAK | 40.20200 |

### *5.3 Sensitivity Analysis*

The levelized cost comparison method has been adapted to conduct the economic evaluation. In this analysis, the results are affected by the function of the input variables. To consider the effect of input variables, this study employs the sensitivity analysis. With the results of Crystalball simulation, the most critical emements are Net power output (-65.7%, -54.9%) for NPP levelized cost and BOP cost (33.6%) for coal power plant.

Figure I: The results of Sensitivity Analysis




## 6. Conclusions

In a number of countries, especially Korea, nuclear energy policy is keeping the status quo after Fukushima accident. However the nation's nuclear policy may vary depending on the choice of people. Thus, to make the right decisions, it is important to deliver accurate information and knowledge about nuclear energy to the people.

As proven in this paper, the levelized cost of nuclear power is the most inexpensive among the base load units. As the reliance on nuclear power is getting stronger through the economic logic, the nuclear safety and environmental elements will be strengthened. Based on this, national nuclear policy should be promoted.

## REFERENCES

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