

## RESEARCH ON PROCESS MANAGEMENT OF NUCLEAR POWER TECHNOLOGICAL INNOVATION

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### ABSTRACT

Different from the other technological innovation processes, the technological innovation process of nuclear power engineering project is influenced deeply by the extensive environmental factors, the technological innovation of nuclear power engineering project needs to make an effort to reduce environmental uncertainty. This paper had described the mechanism of connection technological innovation process of nuclear power engineering project with environmental factors, and issued a feasible method based on model of bargaining to incorporate technological innovation process management of nuclear power engineering project with environmental factors. This method has realistic meanings to guide the technological innovation of nuclear power engineering project.

**Keywords:** Nuclear power, Process management, Environmental factors, Model of bargaining

### 1. INTRODUCTION

The nuclear technology is an important part of the modern technologies, recognized as one of the contemporary sophisticated technologies. The great strength of the nuclear technology comes from the equation:  $E = mc^2$ , which was found by Einstein and published in one of his papers in 1905.

The nuclear technology was only regarded as the modern fatal weapon in the field of military at first. Besides, in fact the nuclear technology can be widely used in many others fields at present, which is mainly included nuclear power, isotope and radiating, etc<sup>[1]</sup>. The nuclear technology has already been bringing a lot of applications in industry, agriculture and medical science, for example MRI(Magnetic Resonance Imaging) in medicine and radioactive breeding, etc.

Among all the fields, the nuclear power engineering project is a kind of promising application of the nuclear technology, because in essence the nuclear technology offers a kind of new energy source. The nuclear power engineering project means that the nuclear technology can also be utilized peacefully, which has enormous potentiality. With the serious environmental pollution and the scarcity of energy, which the human being is facing to, the nuclear power engineering project is thought as the most hopeful method to solve all these problems. Compared with other energy forms, the nuclear power engineering project has many important advantages such as high-efficient, low-cost, low-pollution, etc<sup>[2]</sup>. In some developed countries, the nuclear power engineering project has already become important energy source, the proportion of nuclear power is up to 82% of the total amount of the power produced at France now, and the proportion of the power consumptive total amount is up to 77%, where the nuclear power has already become the most important energy source.

But the security of nuclear power technology has been emerging by some incidents such as which happened at the Three Mile Island of US in 1979 and at Chernobyl of Ukraine in 1986, the disasters that these accidents caused still fail to dispel absolutely so far. Therefore all these have been resulting in many disputes during the course of the development of nuclear power technology. Nuclear power technology brings upsets to people, though it brings exciting prospect.

To some extent, the current status as above has hindered the application and popularization of nuclear power technology nowadays, which is unfavorable for the nuclear power technological innovation.

## 2. THE FACTORS

The nuclear power is thought as the prime way to solve the energy crisis in the future, but some factors make the nuclear power technology difficult in its rapid application at present, hence it is necessary to analyze the obstacles which are hindering the application of nuclear power.

In economics, it is a kind of technological innovation behavior with which the application of nuclear power technology is going along. Technological innovation means a series of comprehensive processes of activities in which some enterprisers will introduce new product or new technology to the market just for the goal of regarding obtaining market interests<sup>[3]</sup>. Nuclear power technological innovation means the process by which it can supply energy with the characteristics: high-efficient and low-cost, which will truly meet with the need of energy market and energy crisis in the future.

Usually the technological innovation is the process full of high uncertainty, this kind of uncertainty comes from technology uncertainty, market uncertainty and environmental uncertainty<sup>[4]</sup>. As to the technological innovation of nuclear power, the uncertainty mainly comes from technological uncertainty and environmental uncertainty, because the expectation of the market has been existing for so long time and will continue all along, and the market uncertainty just results from the environmental uncertainty in essence<sup>[5]</sup>, this kind of environment factors include the law, the policy and public psychology, etc. Hence, for the technological innovation of nuclear power, there mainly exist technological uncertainty and environmental uncertainty, which is influenced more deeply by the extensive environmental uncertainty, and the environmental uncertainty comes from many environmental factors. With the analysis of these two kinds of uncertainty, It will redound to the push of technological innovation of nuclear power.

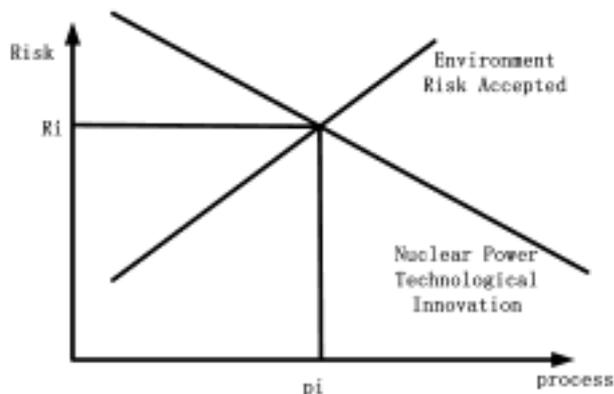
First of all, nuclear power technology is a greatly-strategic technology, which is in need of high-quality technicians and collective creative activities. So, the technological uncertainty of technological innovation of nuclear power mainly comes from the technicians and research conditions.

Secondly, because of the incidents happened and the fear of the nuclear power technology from the public, the environmental uncertainty emerges remarkably in the technological innovation of nuclear power. Besides, such environmental uncertainty still comes from the domestic and international laws, such as which are against the diffusion of nuclear technology and weapons, etc. Compared with the technology uncertainty as above, it is more difficult to overcome on the environmental uncertainty<sup>[6]</sup>, so the environmental uncertainty is its greatest obstacle in the technological innovation of nuclear power.

## 3. THE MECHANISM WITH PROCESS AND ENVIRONMENT

In detail the environmental uncertainty in technological innovation of nuclear power mainly includes these aspects: inclination of energy policy<sup>[7]</sup>, resource condition of nuclear material, technological security system of nuclear power, environmental protection policy, the public admit and the international treaty against the diffusion of nuclear technology, etc. In the process management of technological innovation of nuclear power, it is important to make an effort to reduce environmental uncertainty.

Nuclear power technological innovation is limited by the technology factors and these environmental factors as above, generally the reciprocity relation exists between technology and environment in the technological innovation of nuclear power which can be described as following: With the progress of nuclear power technological innovation, nuclear power technology will gradually mature, and the advancement can bring some changes of the environment, so that the public can accept the application of nuclear power to a greater extent, all these will result in the success of technological innovation of nuclear power finally. So, for the process of technological innovation of nuclear power, the process can be described by the model of bargaining<sup>[8]</sup>. As the following figure showing that:



*Fig.1 Model of Bargaining*

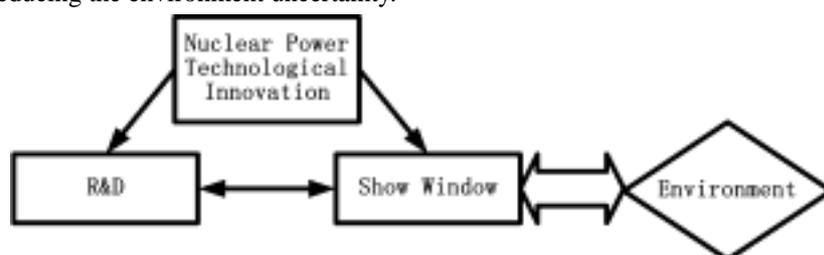
uncertainty is a kind of the probability of loss in fact, which is described as the risk here, then with the proceeding of technological innovation of nuclear power, generally the whole risk of technological innovation of nuclear power can be declined; And with the acquirement of technological innovation progress of nuclear power, the environment factors can accept this kind of technological innovation behavior on higher risk degree compared with the former risk status.

With the reciprocity, the trends of downward and upward will result in the arrival of the balance at a certain moment, namely all these can be described by the model of bargaining between the environment factors and the innovation, just like the figure described as above. These two kinds of risk can be balanced on the point of intersect, from that time it means that the innovation succeeds.

In order to arrive at the intersect point as soon as possible, the process of technological innovation of nuclear power need show a lot of inside information to outside environment, by which the technological innovation progress of nuclear power can be felt by the environment in time, and thus the technological innovation of the nuclear power can be realized soon.

#### 4. ORGANIZATION FRAMEWORK OF PROCESS MANAGEMENT

Through the above-mentioned analysis of the environment and the process of nuclear power technological innovation, as to the technological innovation of nuclear power, we know that it is important to pay close attention to the work from two aspects: improving in the engineering of nuclear power and showing enough information to the outside for reducing the environment uncertainty.



*Fig.2 Organization framework of process management*

By constructing a "show window" component here, which will be responsible for showing the status of the inside progress of technological innovation of nuclear power to outside in time, it will be useful to arrive at the intersect point in the model of bargaining as soon as possible.

The task of the R&D component is to solve the technology problems of nuclear power, such as material security, structure stability, operation reliability, et al.

Besides the showing of the progress of technology to outside, the "show window" component needs to feedback external reflection about the current technological innovation in time, in detail it includes the thoughts of the public, the persuasion to the government and the seeking for cooperative chance with other departments. The one that needs been emphasized is to form the rules of security system during the showing, and to prevent divulging secret for over-showing.

In fact, the public often misunderstand something about the nuclear power technology, for example a lot of people regard the invalid status of reactor as an equivalent to the disaster that the atomic bomb explodes, such subjective misunderstandings may cause some false views on the environmental pollution that the nuclear power plant will result in. So, showing information to the outside is as important as research and development inside.

The success of the technological innovation of nuclear power in France lies in the harmony between the two components of the R&D and the Show Window<sup>[7]</sup>. Firstly, in the term of R&D , by the standardization of the technology and the cooperation with outside technology source, France has set up high-efficient nuclear power industrial system; Secondly, in the term of showing, with the clear and long-term support from the government and the strict nuclear safety management system, it effectively reduces the uncertainty from the environment to a great extent.

## 5. CONCLUSIONS

The technological innovation process of nuclear power is influenced deeply by the extensive environmental factors, this kind of influence can be described by the model of bargaining with the technological innovation and the environment factors. In order to succeed in the innovation, it is necessary to reduce the uncertainty from environment, there are two aspects which we should pay close attention to: Firstly, improving the technological security and reliability of nuclear power, etc; Secondly, adequately showing the progress of technology to the outside and the cooperation under the safety management. When arriving at the intersect point in the model of bargaining, the technological innovation succeeds. This view described the mechanics of the process management in the technological innovation of nuclear power, it has realistic meanings for the technological innovation of nuclear power in engineering projects.

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