

**THE STUDY OF PANIC TO NUCLEAR ENERGY ON PSYCHOLOGICAL AND
SOCIOLOGICAL ISSUES**

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ABSTRACT

Nuclear safety attracts many concerns from society especially after Fukushima accident. In recent years, although nuclear safety system has been continuously improved on the aspects of design functions, safety standards and safety assessment methods, etc., the public panic has not been reduced correspondingly. In some countries and regions, the public nuclear panic has a strong impact on the sustainable development of nuclear energy, which has been widely recognized by nuclear industries worldwide. In this paper, we studied the nuclear public panic from three aspects with the analysis of psychological and sociological methods, including: (1) Discussing the source of nuclear panic in the sense of Maslow's hierarchy of needs and psychoanalysis; (2) Systemically studying the irrational behaviors in nuclear accidents and the public nuclear culture with cognitive theory; (3) Giving out the general model of public nuclear panic. In the last, some suggestions of nuclear risk perception and communication were also shown as reference, which are significant for the future work.

1. INTRODUCTION

Public acceptance of nuclear power is essential for this industry and it becomes much more important after Fukushima nuclear accident than ever before. It is not easy to convince public to believe that nuclear power is safe enough as a kind of

clean energy and it becomes impossible to make public keep in peace after nuclear accidents. Nuclear accidents could bring physical and psychological impact on the public. Besides some casualties of radiation disease, aftermath sequelae could be intense and of long duration which represent stress, depression and anxiety. Because of the nuclear accidents in Chernobyl and Three Mile Island left horrible impression on the public and make people worry about anything related to nuclear power.

The two explanations of the degree of acceptance accorded nuclear power examined by former researchers are trust-based and technology-based on social acceptance of nuclear power [1]. The essence of the trust-based treatment is that when non-experts examine a controversial technology they are not actually trying to form an independent opinion concerning how well the technology will likely perform, but rather are trying to decide which group of people to trust concerning how it should be managed. The technology-based explanation is that people wish to decide by themselves whether a technology is acceptable, based upon understanding the available evidence regarding the technology. However, both of trust-based and technology-based theories are the representations of intrapsychic conflict of public but related studied in the sense of psychology and sociology are lack, which makes it difficult to improve the public acceptance of nuclear power in essence.

However, it is the time to take action to analyze the public acceptance of nuclear power with psychological and sociological methods because the pure technical improvement is little effect. In recent years, although nuclear safety system has been continuously improved on the aspects of design functions, safety standards and safety assessment methods, etc., the public panic has not been reduced correspondingly. In some countries and regions, the public nuclear panic has a strong impact on the sustainable development of nuclear energy, which has been widely recognized by nuclear industries worldwide. In this paper, we studied the nuclear public panic from three aspects with the analysis of psychological and sociological methods, including: (1) Discussing the source of nuclear panic in the sense of Maslow's hierarchy of needs and psychoanalysis; (2) Systemically studying the irrational behaviors in nuclear accident and the public nuclear culture with cognitive theory; (3) Giving out the general model of public nuclear panic. In the last, some suggestions of nuclear risk perception and communication were also shown as reference, which are significant for the future work.

2. THE ANALYSIS OF PUBLIC NUCLEAR PANIC WITH MASLOW'S HIERARCHY OF NEEDS THEORY

Maslow's proposed his theory on hierarchy of needs in 1943 and in this theory human motivations are divided into five aspects: physiological, safety, belongingness and love, esteem, and self-actualization [2]. These five levels are often described like a pyramid, with fundamental needs at the bottom and self-actualization at the top [3]. However, the level is not that strictly ordered and all needs can be occur and be treated at the same time with one at a dominate position[2,4]. With this theory, the nuclear panic originate from the lack of physiological and safety needs, which is the basis of "pyramid of hierarchy".

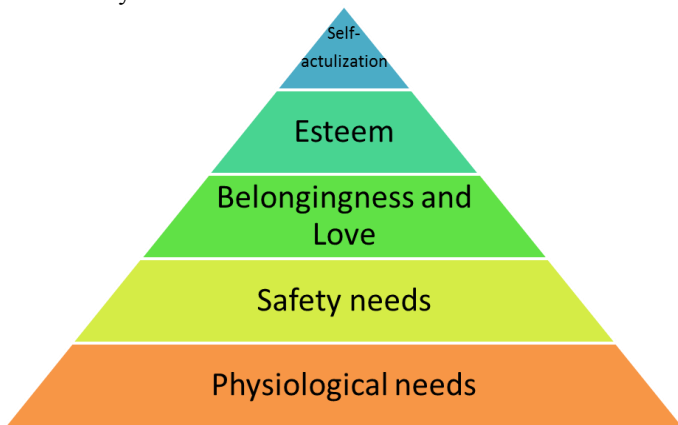


Fig.1 Maslow's Hierarchy of Needs

Physiological needs, which mainly include food, water, air, sleep, sex and so on, are the fundamental needs in human behavior and these basic needs play dominate roles and once it cannot be satisfied, a strong motivation will be aroused to

fulfill the demands [2]. Meanwhile, other higher needs, such as love or esteem, will give way to it and hide in the background. For instance, what a starving man concerns most is how to get enough food to support his life and his vision is to guarantee himself with as much food as he can but anything else is defined unimportant. When nuclear accident happened and radioactive substance release, people may think that the radioactive substance could affect the safety of food, air and water, worrying about whether they are polluted. It would be a great threat to the basic physiological needs and strong drive will lead people to seek for safety food, water and air and could be considered as the reason why people is scared by the nuclear accident.

Since the radiation cannot be seen or touched, people do not know whether they are under exposure unless using prospecting instruments. Though the exposure may not affect the health but the invisibility of radioactive substance adds the fear to a great extent—people know it is toxic but cannot trace them with naked eyes. In other words, people have nothing to do to keep away from it. It is easy to intake them unwittingly and can hardly keep away from them as long as they are spread. Thus, the polluted air, water and food are great physiological threats to human beings though they could not bring any physical and physiological damages.

Safety needs are also essential needs for human beings. Although Maslow describes safety needs as upper level over physiological needs, considering the whole organism is a safety-seeking-mechanism [2], there is nothing much more important than safety. Therefore, safety needs and physiological needs can emerge at the same time and both of them should be viewed as fundamental needs and motivations for human behavior. Generally speaking, people prefer the world to be safe, predictable, orderly and organized [2,4], while all unexpected and dangerous events would bring panic to public. The release of radioactive substance is such a high risk event which put mankind in danger. With the experience of Chernobyl nuclear accident, public believe that the radioactive substance may harm one's health severely and the peace and harmony of society will also be broken and an unpredictable and chaos world will be imagined due to the memory of nuclear blasting in Hiroshima and Nagasaki. In such situation, the safety needs are out of satisfaction and anxiety appears in public.

The fear of radioactive substance release is thus due to the uncertainty of safety and the inaccessible to ensure that food, water and air are available. Physiological and safety needs are the base of the pyramid and once they are unsatisfied, the whole pyramid seems unstable and will probably collapse—arousing nerve, anxiety and irrational behaviors. Under this circumstance, people feel that their lives are put under great threat and survival become a big issue, which drive them to do all they could to support themselves with a basic living system. Such powerful and primitive instincts are actually subliminal thoughts that would control people's mind, which also push all other higher level issues into secondary importance[2].

3. THE ANALYSIS OF IRRATIONAL BEHAVIORS IN NUCLEAR ACCIDENT WITH DEFENSE MECHANISMS

Sigmund Freud proposed a series of psychoanalytic theories, and ego defense mechanisms are the main part of his theoretical framework. Freud proposes three structures of the psyche: id, superego and ego[3]. A majority of our mind is unconscious, just like an iceberg hiding under the water. The id follows “pleasure principle” and search for instant gratification without concern for consequences. The superego stores individual’s conscience and moral attitudes. It tells people what should do and what should not do. The ego acts according to the “reality principle”, which reflects one’s conscious belief and help to satisfy oneself without undesirable consequences. Therefore, the id always wants pleasure but the superego insists on morality. A conflict is thus formed and the ego arranges a compromise to satisfy both [5].

Anxiety breaks out when conflicts emerge. The ego will employ defense mechanisms to protect the individual if the anxiety becomes too overwhelming. Defense mechanisms transfer the id impulses to acceptable forms to defend the conflicts, thus helping one to maintain in a favorable self-image and social acceptance [3,5]. Displacement is a defense mechanism that discharge pent-up feelings on less threatening target, which separates emotion from the original impulse in order to avoid dealing directly with what is unpleasant or threatening [5,6].

In other words, the defense mechanism is a way people to protect themselves when in a threatening environment. A specific mean is therefore adopted. No matter this method is really effective, as long as one thinks it can help, it makes sense. In essence, people like to deal with crisis actively other than passively endure them. Having the ability to solve problems give one a sense of self-efficacy and help to stay in a positive mood. Otherwise, one is prone to feel anxious and other negative emotions.

As is mentioned above, it is easy for us to understand why there is salt-buying panic in China during the period of Fukushima nuclear accident. Radioactive substance could not even be seen or felt, which makes people unable to take any efforts to deal with them. Therefore, people need a more concrete thing to outlet their strong emotion. Salt is then chosen as a displacement—it is common, necessary, easy to obtain and furthermore, it is sound like having strong relationship with “radiation protection”. It is learned that there is iodine in salt sought in China and the government would provide iodine plates in order to avoid the radioactive iodine I-131 gather in thyroid. With the above information, public establish the logical relationship of salt and radiation protection and buying salt is a feasible way to make themselves escape from radioactive substance. On the other hand, rumors about sea water being polluted and salt carrying radioactive substance spread out make people begin to regrate a great amount of salt in order to ensure the supply of daily salt in the family is

enough. Through such action, anxiety is released and people feel more comfortable with the situation. Salt works as a displacement of the nuclear panic and buying salt means avoiding nuclear matters under this defense mechanism.

Fortunately, Chinese government release out salt stored in the stock to meet market needs and people can buy as much as they want. Such method releases the anxiety and safeguards the social stability to a great extent. A sense of “ I am defense radioactive matters actively” is settled in the public. Once the public are satisfied, their nerve can be eased greatly.

4. THE ANALYSIS OF PUBLIC NUCLEAR CULTURE WITH COGNITIVE THEORY

Risk perception is the core in the study of nuclear panic. Risk perception is a complex progress but our main interest is the cognitive bias in the perception of threatening information. Under biased perception, people will overrate the possibility of accidents and overvalue the severe outcome. A pessimistic prediction can bring anxiety and anxiety brings more negative thoughts. Such a vicious circle is often observed in risks.

Foa proposed a theory on fear structure. They thought that the fear structure involves dangerous stimulus and response, as well as physiological activity preparatory for escape. New fear-related information will evoke the fear memory structure and integrate into it [7]. As long as the schema of fear is activated, people will use coping pattern they learned in the past to deal with the new situation. For the general public, nuclear has a notorious reputation and has already taken root in the fear structure. Disasters like the Japan nuclear bomb and Chernobyl accident left horrible impressions and any cue related to these catastrophes will recall them. In other words, what the public fear is not only the new situation alone, but the combination of the new accident and previous memories of disasters. Although the Fukushima accident has little similarity with Chernobyl, people treat it as seriously as Chernobyl because former accidents are in the deep mind and people retrieve them almost unconsciously.

Tversky and Kahneman [8] proposed three heuristics employed in judgment and decision making, representativeness, availability, anchoring and adjusting. Other than the hypothesis of rational man, our bounded rationality is prone to bring cognitive bias under uncertainty.

The representativeness heuristic focuses on similarity and resemblances. The processing progress is based on the main character of the event. When evaluating the possibility of the outcome, people tend to compare the new stimulus with prior events in memory and see if the new one resembles the old one and can represent it [8,9]. The base rate of possibility is neglected and similarity plays a vital role. In Fukushima accident, the chemical explosion of the plant represents the nuclear burst. Not many people have ever seen a real nuclear blast and in their eyes, the scene of chemical explosion is similar to the atomic burst—fire, smoke, slambang and all imaginary factors in an explosion are equipped. The public just ignore the low possibility of atomic burst and treat the

explosion of plant as a strong signal of the coming nuclear burst.

The availability heuristic refers to that people assess the probability of an event by the ease with which instances or occurrences can be brought to mind. If instances of a certain event can be recalled faster and better, people tend to predict a high possibility [8,9]. The radioactive accidents are very easy to recall: Hiroshima nuclear bomb and Chernobyl still dwell in people’s memory. Though the possibility of nuclear leaking is rather low, the availability of previous accidents increases people’s judgment on the possibility of a new leaking.

People like to estimate by adjusting from an initial value. The initial value is related to the formulation of the problem but the adjustment is insufficient. Different starting points lead to different estimations and this is called the anchoring/adjusting heuristic [8]. First impressions are most lasting and the given initial value can bias people’s evaluation of an incident. The Hiroshima nuclear bomb bring more than 100 thousand deaths and injuries while rumor says the Chernobyl made more than 40 million victims affected. Therefore, a nuclear accident anchors a massive casualty at the very first beginning. Although the Fukushima accident is far less severe than any previous accidents, a high anchoring number make people overvalue the consequence.

5. THE GENERAL MODEL OF PUBLIC NUCLEAR PANIC

From the above mentioned analysis, we proposed a general model of nuclear panic. Three sides are involved in this model: nuclear incident feature, government and media, public attitude. These three sides affect each other and integrate into a crisis.

A nuclear incident has some extraordinary features. Unlike other risks like infectious diseases or earthquakes, uncertainty and vagueness are the main traits of nuclear crisis. As is discussed above, radioactive substance is invisible and hard to trace. Its uncertainty adds to people’s fear and its vagueness is prone to produce rumors. With the help of the internet and especially social networks, rumors can be spread widely and instantly. Different and contradictive information fulfills the society and brings great anxiety and suspicion. Due to the lack of truth and professional knowledge, the public tend to follow the rumor, which may lead to mass disturbance.

The government and media play the vital role in a nuclear crisis and whether they can convey timely and correct information or not will determine the success of solving crisis. High government credibility is needed to calm down the panic public and give leading advice. Suppress the truth and cheat citizens shall never be adopted but unfortunately some nations tend to conceal the fact till the crisis is out of control [10]. Experts are often invited by government and media to give professional advice but the effect is sometimes disappointing. Public think the government and experts work in collusion with each other and the experts are manipulated by the authority. Their awkward attempt to convince the public merely adds to

public’s revolt and distrust, which serves oppositely to solve the crisis. The media also has its own problem. In order to catch people’s attention, the press tends to use exaggerated ways and horrible words to report news. They convey too many negative message concerning disaster, death and crisis, which will definitely arouse the public’s anxiety and nerve [9,10]. However, positive news like the efforts are being made and the scientific knowledge about nuclear safety is seldom get emphasized and as a results, public know very few about the positive information, which make the public panic much more serious.

As for the public side, their fear of the uncertainty of nuclear, the trust verses government and experts, misleading by media and psychological factors mentioned above making the nuclear panic sophisticated and difficult to solve. Besides psychological factors discussed above, the group effect should also be considered. The nuclear panic is group behavior and the population effect can enlarge individual problems. One man’s fear to nuclear is easy to control but the accumulation panic of a group is destructive. Any individual in the group does not need to be responsible for what the whole group do and the lack of duty leads to exaggerated and over emotional behavior, what even worse is that such behavior is supported and encouraged by each other. Individual’s action is prone to infect others and leading to conformity, which is thought to be the most tough thing in a group [11].

Therefore, as is illustrated in the model, the public’s cognitive bias and group effect bring panic in the nuclear accident and the distrust of government and misleading of media adds to the vagueness of information and the uncertainty of the accident, which make the panic much more serious. However, from this model, it is also easy to know that making efforts to ameliorate some sides in the model will be helpful to avoid the public nuclear panic.

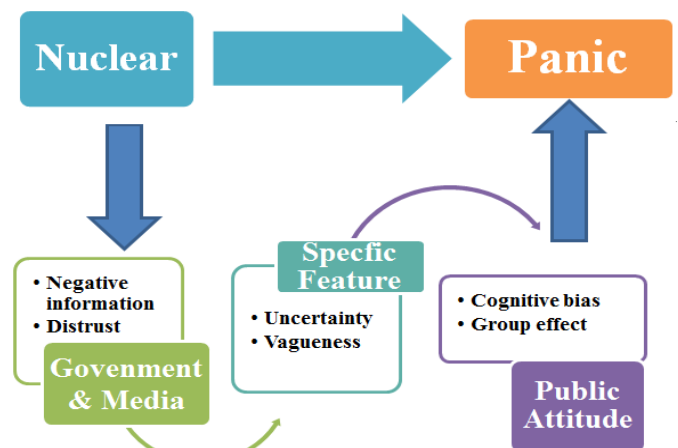


Fig.2 The general model of public nuclear panic

6. THE FEASIBLE SUGGESTION FOR ELEMENATING THE PUBLIC NUCLEAR PANIC

A. Spreading the notion that nuclear power is safe enough

Based on the previous research, nuclear plant is much safer than other industrial systems in the sense of accident so it is necessary for administrative department to take advantage of the media to build a healthy and positive image of nuclear power. Although developing nuclear power has some potential dangerous, but pros weigh much heavier than cons especially for those countries whose energy gap is large. Nuclear power could bring huge amount of energy and bring economic growth, while using less nature resource and producing almost no pollution. However, the public do not know much about how important nuclear is to economic growth and environmental protection because the media only report nuclear accidents, which leaves a horrible image to public. Thus, it is time to ask the press to spread the positive side of nuclear energy.

In addition, improving the interactions between nuclear power and public is also helpful. The reason why public is fear of nuclear power is that they never get touch with it except those who live near the nuclear plant. As long as they get familiar with nuclear power, they will have a better understanding of it. Therefore, it is helpful to invite public to visit the nuclear plants and companies in order to shorten the physical and mental distance between public and nuclear power. At the same time, nuclear scientists and professional staffs should make speech on their personal experience with nuclear power to help public eliminate the panic of nuclear power. Meanwhile, the government should take the leading position in eliminating panic and do their best to show the safety to public. For instance, it is effective to demonstrate that the nuclear power is safe if the government office buildings are built near by the nuclear plant. What the public focus on is the attitudes of government and in this sense, the demonstration actions of government are better than any other homiletic sentences.

B. Giving proper and instant information

When a nuclear accident happen, it is vital to give proper information to the public instantly. Though it is unavoidable to convey nervous message to warn the possible damage, positive information should also be present to alleviate anxiety. Research has shown that negative information can catch more attention and people have cognitive bias for threatening message [12]. Negative information may occupy the cognitive resource and play a dominate role when making decisions. Some social media will inevitably use horrible words and exaggerate ways to catch people's eye when reporting accidents, but this will increase the public's anxiety and fear, as well as adding difficulty to the risk management for the government. For instance, the death rate never exceeded 6% while more than 90% victims get recovery when SARS outbreak in China in 2003[9]. However, the social media put emphasis on how many people died rather than how many

recovered, making the public overrate the dread of SARS. If only we can change the saying and focus on the optimistic side, which will definitely bring confidence and peace.

Each time an accident happens, the professional opinions given by experts are also important. The function of experts is to give explanations to clarify certain issues and give advices to calm down the public. However, in China, the public have little faith in experts and think a majority of experts are manipulated by the government to conceal the truth and cheat the public. In fact, most experts will comply with their profession and give an objective view nowadays, but in the past decades, some black sheep cheated the public and left a very bad impression [10]. The trust may take years to build, but it can be ruined in a moment. The government and experts themselves should cherish the respect given to professionals and never lie to the public. However, it is inevitable that the situation of accident may be not clear so sometimes the experts have to overthrow what they talked about the comment on the accident before, which is very possible to make public lose trust on experts. So it is important for the experts to make much more explanations to the current situation but avoid making forecast to the accident on the social media. In fact, nobody could accurately predict the trend of accident and this unreliable prediction will ruin the faith of public and have no effect to release public's anxiety.

Another important aspect is the discrepancy in cognition between experts and public [9]. Experts are rich in professional knowledge in this field compared with the people who do not have an adequate background. It is found that due to the difference in role, profit and knowledge, experts develop distinct cognition pattern when evaluate risks [9,13]. With an overall view, experts will have a solid consideration and think more thoroughly while the general public's incomplete thoughts may lead to irrationality. The communication between experts and the public is not on the same level, and furthermore, they even do not reach agreements on several basic concepts. It is common that experts think the public are ignorant and over worried while the public doubt the viability of what experts said. Such communication is invalid and can only bring troubles. Therefore, to make the public accept professional advice, decreasing the gap in cognition and common premise should be set. The non-specialist descriptions and explanations are necessary in the experts' talk about nuclear accident and furthermore, the gentle mode, fluent expression and creditable sentences are also easy to accept by the public.

C. Enhancing communication and be modest

During the period of reconstruction after nuclear accident, the government should focus on communication and be in modest manners. The communication between the public and government is reciprocity but in fact, they are not equal in status. The public always act as the passive side and only receive information from the government. While the government always take the DAD pattern—decide, announce,

defend [9,14] to the public. Whether the government can treat the public as “partner” is vital to the efficacy and validity of communication. The government should always keep a modest and courteous manner. They should never think the public are stupid and gullible. Any policy of obscurantism will definitely fail and unless giving enough respect, the government cannot gain trust and support from the community. The government should believe that a majority of people have the ability to understand scientific knowledge if the manner is appropriate. Efforts should be made to build a multiple communication network where authority, experts, media and public can be integrated organically and have a good interaction.

Specifically, the government and experts should stand on the public’s position and concern what the public concern. Generic items and professional sentences should be used as less as possible. Experts should try to explain in a clear and easy way to make it understandable. Superiority is by no means the attitude experts should take, while they should care more about the public’s worry and concern and give popular advice to cater to the masses. It is not wise to invite a pedant to give comments on nuclear accident with lots of technical terms but with poor presentation skill through social media, which has been proofed by amount of instances.

7. CONCLUSIONS

In this article, we study the panic to nuclear energy on psychological and sociological issues and some related analysis and effective measures are given. The fear to radioactive substance is due to the worry of inaccessibility to food, air, water and other basic physiological needs as well as the uncertainty of safety, so it is not easy to find path to eliminate public aversion about it. As nuclear engineering experts, what we should do is not only tell public the nuclear energy is not horrible in technical terms but also should consider that why the public feel horrible. That is the future breakthrough in the study of nuclear public acceptance.

8. ACKNOWLEDGMENTS

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