2nd International Conference on Energy Systems and Technologies
18 – 21 Feb. 2013, Cairo, Egypt

APPLYING THE CONTINGENT APPROACH TO PUBLIC PARTICIPATION IN NUCLEAR POLICY

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To help resolving a longstanding dispute over nuclear electricity in Taiwan, this study evaluation the validity of Vroom-Yetton's contingency model apply to nuclear related policy for choosing an appropriate public involvement mechanisms. Participants from a variety of stakeholders described their thoughts about decision-making process for nuclear-related issues, and the decision quality, public acceptance, and the overall effectiveness of the final solution chosen in these situations. Findings suggest that the contingency theory adapts well to nuclear issues of public participation. This contingency framework incorporate seven problem attributes in decision process and shape the appropriate level of public involvement in decision making.

Keywords: *Public Involvement, Contingency Theory, Problem Attribute*

INTRODUCTION

Nuclear power provides about 13.5% of the world's electricity, almost 24% of electricity in OECD countries, and 34% in the EU. Its use is increasing [1]. Taiwan currently nuclear generation electricity is account for 19% of electricity generation [2], while renewable sources together account for 5.7% [3]. Taiwan currently operates 6 nuclear reactors since 1978 and the newest reactor (Gongliao Township) would be coming online in 2016. Reactors are initially granted 40-year operating licenses, but can apply for 20-year license renewals. If no license renewals, then the first of Shihmen Township nuclear facilities will be decommissioned after its 40-year life-span ends in 2018.

Social scientists noted that perception of risk is vary from person to person and is deep in our values, education, experiences, and stake in the outcome [4] [5]. Environmental concerns and NIMBY (Not in My Back Yard) syndrome have always been obstacles to fulfill nuclear policy exactly. Therefore, environmental, social and economic goals need to be taken into account in the nuclear decision-making process.

No matter how the rapid innovation of nuclear technology which solves many of its technological constraints and safety issues [6] [7], social acceptance for nuclear energy has been relatively low. Despite the lower risks and safety assessments from experts, opposition groups remain skeptical and untrusting of Taiwan Power Company (Taipower) ability to safely monitor a nuclear operation. This phenomena stress the dilemma between public

opinions and expertise.

In Taiwan, 61% of residents emphasize the importance of economy, 88% of support energy saving and carbon reduction [8], and most of Taiwanese support nuclear electricity, but not support to build it in their neighborhood. It explains another dilemma between individual interest and collective interest in Taiwan society. Public policies often have to deal with multiple values and involved personal judgments [9], and it can bring great benefits to some groups, whereas it also produce costs to other groups at the same time. Due to NIMBY syndrome, consensus among involved stakeholders is difficult to reach.

Taiwan's site selection committee declared in 2012 that the two sites are candidate sites for repository [10], and the next step is to held regional referendum. With this, the communities will be consulted and ask for their opinion. Previous studies have shown that local or regional referendums led to the rejection of a proposed storage [11]. The issue of nuclear waste is one of societal importance and political complexity, which cause potential conflict among individuals and various groups quite often. The question is how government and society can arrive at solutions. In Taiwan, the issue of continue use of nuclear energy will play a role in discussion about the storage of nuclear waste, because nuclear energy is an important source of nuclear waste. To date, the dialogue about storage of nuclear waste among various public groups has not reached an agreement. The main problem surrounding the distribution of risk and the asymmetries often involved in risk imposition [12].

Public involvement has been used to elicit informed opinion and to probe into public shared value. Compare with traditional top-down approaches, public involvement processes can increase the fit of public program to civilian needs and enhance community acceptance of program, and the same time also improve the effectiveness of the public policy and inspire citizen offer help in operation program [13]. Citizen involvement is a continuum from traditional manager-controlled making decision alone to manager partnership with citizens making decision together. Lin and Huang [14] define Public participation in the way that "when citizens or their representatives are involved in the decision-making process, they are given equal status in dialogue with government so that they can influence the result of decision-making with their collaborative opinion by the approach of free and transparent discussion. From a perspective of democratic review, whether the public opinion is carried out depend on the following three elements have met: citizen competence [15], information asymmetry [16], and consensus formation [17]. More citizen involvement at communication process in an open, inclusive and transparent manner can contribute the communication ongoing and reach consensus and satisfied outcomes between decision maker and participant, and the content of the policy is stipulated for national collective maximum interest. Citizen participation is critical to public management for improving social decision-making processes, especially with relation to science and technology. However, few studies have been discussed about nuclear energy issues and public involvement from a sociological point of view to identify critical factors influence public participation in the nuclear program decision process.

This paper focuses on the approaches of social decision making, and tries to capture the principal degrees of public involvement and improve the governmental effectiveness. Applying the contingency theory in public management can explain the impact of involvement on decision effectiveness [18]. Most important is the theory can resolve the tension between decision quality and decision acceptance which are concerns by public manager of policy decision-making. Manager decision effectiveness hinges on decision quality and decision acceptance [19]. To be sure, citizen participation in decision process can increase public acceptance of policy, whereas the risks of weakening that quality may be as great, for delaying or distorting the pursuit of important public goals. In summary, the

purpose of this study is to build a contingency model of public involvement to select appropriate public involvement mechanisms in resolving any given nuclear issue. The Vroom-Yetton model for selecting decision process options is reviewed and applied to nuclear-based public management.

This study is conducted using literature review, data from previously reported cases and focus group. Our contingency model of public involvement builds through following steps. First, we review literature about conflicts between pro-nuclear and antinuclear parties and find critical characteristics of nuclear issues which based on social and political environment. Next, we identify the problem attributes of nuclear issues which affecting the public involvement. Third, we based on public involvement of V-Y contingency model modified by Thomas [18] to present a version of it adapted to a nuclear policy involvement contingency model.

CHARACTERISTICS OF NUCLEAR ISSUES

We first discuss the nature of nuclear issues in order to understand what factors influence public attitudes and involvement in those situations.

1- The Trade-Off between Economy and Environment

The economic development of a nation largely depends on how its energy requirements are satisfied. For the majority of the human being the quality of life is closely related to the level of per capita energy availability [20]. Therefore, a nation's well-being is hinges on power engineering and energy consumption. Electricity demand is increasing twice as fast as overall energy use and is likely to rise 76% to 2030 [1]. It seems reasonable for developing nations seeking nuclear as a cleaner, more reliable and efficient energy sources to improve their citizens' quality of life and meet the energy demands of increasingly industrialized, urbanized, and mobile societies. Taiwan is among those developing countries, however, its energy system faces two major challenges in the coming decades: the threat of environmental damage caused by energy production and use [21] and the growing risk of disruptions to energy supply [22]- the need to decommission a large amount of existing nuclear energy supply facilities in the future - leading to a potential energy gap.

Compared to other countries, Taiwan's energy development faces more severe challenges for it long depends on imported energy up to 99%. After considering cost-efficiency, environmental impact and potential for development, Taiwan has put natural gas and renewable energy high priority in the energy supply structure in the future [2]. To meet the challenge of high energy prices and global warming, nuclear energy is inevitable to become an important role in energy structure by now; about 19% Taiwan's electricity is from nuclear fuel [1]. However, the lack of a solution for the disposal of nuclear waste remains a serious problem for the nuclear industry, one made worse by the 2011 Fukushima Daiichi accident. Average Taiwan generation cost was 7.0 c/kWh in 2008, with coal-fired generation US$ 5.8 cents/kWh, LNG US$ 11.25 cents/kWh, and nuclear US$ 1.9 cents/kWh [23]. Thus, fuel costs are much more critical to their economic viability over the long term (Nuclear fuel only 16% per cent of power generation costs, unlike steam power generation up to 67%). Nuclear became highlighted due to its distinguishable economic and environmental advantage over other energy resources including non-hydroelectric renewable [24]. In the near future, nuclear is expected to be accepted as one of the promising alternatives which can achieve both energy security supply and prevention of climate change [25].

2- Deeply Held Values and Different Worldviews

Nuclear energy has some vulnerable points in the view of social acceptance due to the history of its development and previous accidents related with nuclear power plants. Anti-nuclear group's main discourse is the value proposition of environmental justice and generational justice. In addition, it also involves the disparity and fairness issues between urban and rural. As espoused by the New Environmental Paradigm (NEP), local governments are charged with balancing both economic growth and environmental quality. The NEP emphasizes the potential need to limit growth, balancing the needs of nature and recognizing the finite availability of natural resources [26]. However, nuclear supporters demanded secure, cheap, climate friendly energy and argued that nuclear and coal had to remain part of the energy mix. Above all, nuclear plants should be a time-limited bridge technology to back up unreliable renewable power until it could be replaced by dependable 'green' energy.

The outlook for nuclear power globally was mixed even before Fukushima. There are now 436 nuclear plants operating worldwide, producing about 370 GWe of electricity. Prior to the accident, there were 56 reactors under construction worldwide: 21 in China, nine in Russia, six in South Korea, and five in India [2]. Indeed, after Fukushima the International Energy Agency reduced by one-half its estimate of new nuclear installations over the next 25 years [27]. Japan, Germany, and Switzerland have subsequently announced plans to phase out their reactors.

3- Multiple Parties and Issues

Stakeholder is any actor, institution, group or individual, with an interest or a potential role to play in the societal decision-making around radioactive waste management. Stakeholder's involvement in nuclear energy policy is crucial in developing public support and influence the message [28]. Nuclear industries, academic fields, local community, environmental groups and the people who could be most affected by a problem with nuclear facilities have concerns or interests in risks and benefits of nuclear electricity. Recognizing the stake all of these individuals and groups have, government should build a platform permitting of reaching consensus of opinion among them and engaging them in planning for the future.

External forces (such as environmental groups, public hearings committee) have intervened in the dispute, making the range of rational discussion is compressed. As a result, nuclear power plant site really created tension among local residents. Even in the national level, there has been a fierce debate between proponents and opponents of nuclear power and interest conflict among diversity of stakeholders. However, if from the beginning of any public policy, include diverse stakeholders and involved them in decision-making procedure can improve mutual understanding and fair process [29].

4- Lack of Trust: The Importance of Information and Communication

Berg & Damveld [11] recognized that the lack of a clear policy on the future of nuclear energy made it difficult for the public to develop trust. Clear policy and executive institution's commitment on it are crucial to energy development. In addition to related-issues involved, public should obviously know the impact on long-term economic, environmental and energy-security interests along the path of energy policy.

Liu [30] indicates that many flaws of nuclear safety system, such as supervision and control, lack legitimacy, disaster prevention and relief, command and communications

systems, media communication problems, the integration of Central and local resources, and nuclear safety drills are subject to review and improvement. Yang [31] argued that nuclear safety supervision mechanism involving the Central government, local government, community, Taipower company, the media, and so on.

THE CONTINGENT MODEL FOR NUCLEAR POLICY

The link between Vroom-Yetton and public involvement has been developed by Thomas [18]. He suggests a modified model which is useful to public policy demanding public involvement. The contingency analysis in the Vroom-Yetton model involves seven questions that are asked sequentially.

1- Identifying the Problem Attributes of Nuclear Issues

According to the theory [19], two types of rules underlie the Vroom-Yetton model the quality of decision and the acceptance and commitment to the decision, and we obtained 7 problem attributes for nuclear policy decision-making.

(1) Quality Requirement.

These quality requirements refer to physical constraints, energy supply security, cost constraint, legislatively mandated requirements and scientific considerations, etc. Is it possible that one solution is likely to be preferable to another? Failure to make a quality decision would lead to a potential energy gap, impact the effect of CO2 emissions on the environment, and increase consumer utility bills. However, it remains unclear how far a nuclear renaissance would mitigate these pressures. The quality requirement is depend on if citizens expect its results to have a reasonable quality, such as nuclear new build should not proceed until there is an acceptable solution for the permanent management of long-lived solid nuclear waste [32]. Lin and Huang [14] indicated that any kind of citizen participation can enhance the quality of decisions.

(2) Sufficient Information and trust in officials

Does the government have sufficient information to make a high-quality decision? If a decision requires considerable learning in both the short-term and long-term, it should take various group opinions into account. The Finnish EIA provides an example of open and interactive planning to get information on public preference, in which public opinion may be integrated with traditional decision making process (Hokkanen, 2001) [33].

(3) Structured Problem

Is the problem structured such that alternative solutions are not likely to be acceptable? This question refers to the government's strategic latitude that has to develop new alternatives, and that ability is situational defined. Daniels, Lawrence & Alig [34] indicated the concept of nuclear issues are sufficient ambiguity, and enough ways in which it might be defined and implemented, imply that in general there is considerable room for redefinition. As the social dimension are often the most vague and least explicit in practical attempts to shape energy sustainable development [35].

(4) Citizen Acceptance

Is public acceptance of the decision critical to effective implementation? It is important to be openness in decision-making and clear what alternatives are fit these criteria, if the decision criteria and process is not made public and would provoke strong emotions over the decision implementation. More important is the spirit of deliberation giving citizens' confidence in the legalization process of policy and strength the legitimacy of the policy [36].

Public participation as a political instrument can legitimize the decision process [33]. The main challenge for nuclear waste management is the control of social factors. An essential element in the implementation of the plan is therefore the political struggle over its acceptability [33].

(5) Citizen Competence

If public acceptance is necessary, is the citizen having the willingness and competence to attend the decision process? Participation is always seen as an *action with aims*, which is connected to interests, and to the realization of goals [33]. All communities which express a willingness to participate must be able to understand the extent of the commitment they are making [32]. A randomly selected Citizen's Panel had to study literature and hear witnesses to form an opinion on nuclear waste policy. It was perceived that there was an imbalance between pro- and anti-nuclear witnesses and visitors. Zimmerman, et al. [37] found psychological empowerment enable one to participate in community organizations, which includes intrapersonal, interactional, and behavioral components. It is a self-perception that includes domain-specific perceived control [38], self-efficacy, motivation to exert control, and perceived competence.

(6) Consensus Formation

The industry is also plagued by lingering public concerns over reactor safety and environmental contamination, which could greatly complicate efforts to site nuclear plants and waste disposal, especially the country of Taiwan with frequency of earthquake. The consensus talks at a political level have reached little, which was caused by the fact that the government had no clear idea on what issues consensus should be reached. In another way, it was not able to reach consensus on the storage of nuclear waste because of the different opinions that existed about nuclear energy.

The various communication settings provided for possibilities to explore common goals and to enhance mutual understanding, while acknowledging that some value conflicts may persist. The decision-making process should allow individuals and institutions to update their goals during the process, to express their views as well as to draw on their empirical and emotional factors [39].

(7) Conflict over Solution among Stakeholders

Is conflict within the public likely to result from the preferred solution? Authority should consider is it obvious that there are major conflicts over the nuclear facilities decision afterward, regarding the timetable, ethical issues that arise, and also concerning various technical details etc. Nuclear policy has become highly politicized in recent years. There have been serious trust issues among stakeholders, with the result that, in an attempt to overcome these issues, various participatory processes have become necessary [40].

2- Using Attributes Derived from Step1 to Build Contingency Model

The evaluative problem attributes derived from the step 1 are reviewed by the participating stakeholder groups and serve as contingency indicators for evaluating the level of civic participation. Each of these indicators involves a yes/no response. With the application of the rules proposed by Vroom and Jago (1978) [44] that define the feasible set of participation, the seven problem attributes constitutes the decision processes and lead the particular types of public participation. The rules are: leader information rule, goal congruence rule, unstructured problem rule, acceptance rule, conflict rule fairness rule and acceptance priority rule. The first three rules are intended to protect the quality of the decision; the remaining rules are intended to protect the decision are accepted by public. As figure 1 shows the decision process flow chart.

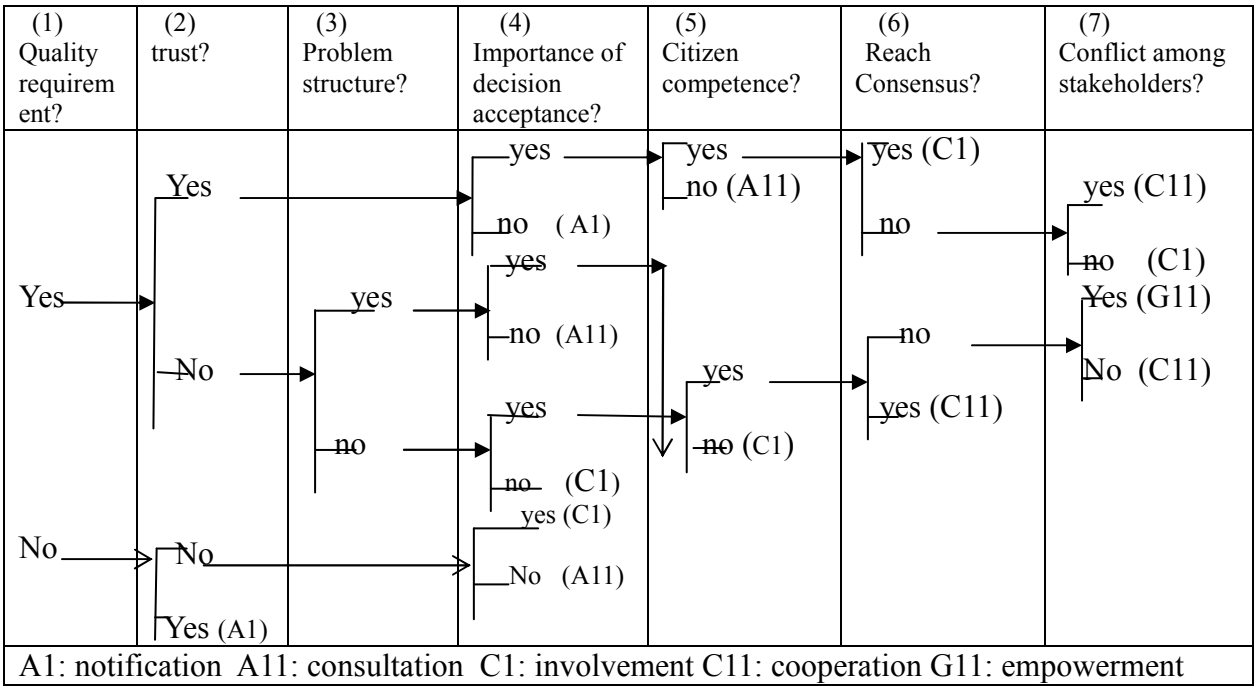

Figure 1. Contingency Decision Model

3- Evaluation of Public Involvement and Decision Effectiveness

It is important to consider the level of public participation and the effectiveness of such participation to a given problem. In general, concerns for decision quality recommend less involvement, and concerns for acceptability recommend more [18].

Table 1. Characteristics of the public involvement decision.

Characteristics	Mean
Problem ***Attributes:***	
Quality requirement	4.5
Trust in official	4.83
Problem structure	3.50
Importance of decision acceptance	3.67
Citizen competence	3.50
Consensus formation	3.83
Conflict among stakeholders	3.67
Agreement rate of public involvement of nuclear issues:	
Total	50.00%
Nuclear development	50.00%
Decommission	66.67%
Waste disposal	33.33%
Effectiveness ratings of contingency model:	
Total	3.50
Nuclear development	3.83
Decommission	3.50
Waste disposal T	

This study asked various sets of groups, (one group acquainted with the public administration, one young group, one general public group, and one expert group familiar

with nuclear industry), each without any prior familiarity with the V-Y contingency model. Each group was asked to (1) report of the things they concerned participating the decision making and judge the influence of each problem attributes on nuclear issues policy, (2) specify the process employed in solving the nuclear policy problem, (3) apply the contingency model to each nuclear issue by asking each relevant question in the decision flow chart provided, and circle the answer they chose for each question as well as the public involvement in resolving a given problem (each question involves a yes/no response), and (4) evaluate on 5-point scales the effectiveness of public participation type on each nuclear issues. Rated the overall effectiveness of the outcome, decision quality, public acceptance, and the decision achieved.

For each nuclear issue, the participant report of their preference the method of dealing with the issue was compared with the recommended by the contingency model processes prescribed. Table 1 report results of the characteristics of the public involvement decisions and the compared outcomes. As Table 1 shows, most of the attributes are quite relevant to the contingency model, from 3.50to 4.83. On 11 of 21 cases, the participant's decision fell right within the methods prescribed by the model. This complete agreement was achieved 50.0%. This result is surprisingly close to the values of 68% reported by Vroom and Yetton (1973). [45] The model even appears to fit the issue of waste disposal with agreement 71.4%. In addition, the effectiveness of each decision on nuclear issues according the model recommended is 3.50.

CONCLUSION

This modified Vroom-Yetton version provides a framework for designing public participation styles based on the 7 attributes of the underlying decision at a given situation. The public participation approach is an open, interactive process, involving not only governmental actors, but also actors representing stakeholders and civil society. The involvement should starts in the earliest stages of the planning process to give the stakeholders and public an opportunity to come forward with their own interests and ideas. The models described in this study can serve as both a guide to administrators and citizens wishing to develop appropriate involvement processes and to predict which public participation style is most likely to contribute positively to the development and implementation of nuclear-related program.

ACKNOWLEDGEMNTS

This work was supported by the National Science Council, Taipei, Taiwan, R.O.C., Project no. NSC101-3113-P-032-001.

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