The Lessons from the Insistence of the U.S.A. in Nuclear Energy Policy*

Wen-Hsiang KUNG, S.J.D.
Maurer School of Law, Indiana University, Bloomington; Assistant Professor, Law Department, Aletheia University, Taiwan
wkung@umail.iu.edu

Abstract. Taiwan would like to pursue energy policies based on the three main principles of "*no power rationing, maintaining reasonable power prices, and fulfilling the nation's pledges to the international community to reduce carbon emissions*." However, can we be sure the policy under the decision-making processes could be accountable and transparent in Taiwan? Especially the use of nuclear power seems to be dilemmatic in the modern society. Even though people pursue deregulation and free market, regarding the economic competition and environmental protection, can regulators ensure that a competitive electricity industry does not abuse our air, land, or water, or prematurely deplete our supply of non-renewable resources? From the perspective of the U.S. legal system, Obama Administration has announced its pro-nuclear energy policy. Although environmentalists seriously criticize his insistence on nuclear policy as the major solution to the issues of climate change, and people in Taiwan cannot totally agree with the pro-nuclear policy as well, the U.S. basic legal infrastructures, the approach of regulatory analysis, and the fundamental procedural requirements, which are solid grounds of its justification and legitimacy, are the lessons people should learn for improving the current energy legal system in Taiwan.

Аннотация. Тайвань в своей энергетической политике намерен следовать трем главным принципам: не нормировать энергопотребление; поддерживать разумные цены; выполнять обязательства страны перед международным сообществом по снижению выбросов углекислого газа. В статье рассматривается американский опыт законотворчества и правового регулирования вопросов энергетики с точки зрения применимости к ситуации в Тайване. Хотя экологи критикуют политику США в энергетической области за приверженность к атомной энергетике, для Тайваня американский опыт является очень ценным, и его необходимо использовать для улучшения энергетического регулирования в Тайване.

Key words: Risk assessment, risk management, risk communication, nuclear energy policy, environmental impact assessment, administrative procedural values.

I. INTRODUCTION

Energy law sits at the intersection of environmental law, natural resource law, and regulated industries. Energy issues are too important to be left to the vagaries of a free market. Energy issues must be considered and planned in light of the inextricable linkage between energy independence, national security, global economic competitiveness, and environmental quality.[1] Learning from the U.S. experience could be a good starting point.

a. SHORT HISTORY

For the U.S. Congress enacted the Atomic Energy Act (AEA) in 1946, one of the reasons was the evidence — the significance of the atomic bomb for military purposes in 1945. The U.S. dropped the first atomic bombs on Hiroshima and Nagasaki, Japan.[2] However, the question

* Использование опыта США при формировании политики в области атомной энергетики.

[1] Larry R. Foulke, *A Perspective: Status and Future of Nuclear Power in the United States*, 3 (Remarks at Americas Nuclear Energy Symposium, 10/16/2002).

[2] In August 1945, television sets and radios blared news that the Japanese cities of Hiroshima and Nagasaki were flattened by a new kind of weapon, the one that leaves cities devastated and ends wars without ground troops (J. Samuel Walker & Thomas R. Wellock, U.S. Nuclear Regulatory Commission, A Short History Of Nuclear Regulation 1946–2009 1, 2010). Since then, nuclear power made its powerful and horrific entrance on the international scene. *See* Jessica Riester and Kirsten Verclas, *Nuclear Energy in the U.S. and Germany: Weighing the Risks*, 2 (April, 2012). As a result, six months after the bombing of Hiroshima and Nagasaki, President Harry Truman signed the Atomic Energy Act of 1946 (also known as the MacMahon Act), the first U.S. law outlaying precisely how the federal government would control this new and powerful resource.

how nuclear energy could be harnessed for peaceful means was not yet resolved; technological know-how to make this a viable energy source was still in its infancy.

Under President Dwight D. Eisenhower, the "Atoms for Peace" program increased funding and resources to continue to expand research into the use of nuclear power as an energy source. The military was the first to use nuclear energy as fuel and launched the first nuclear-powered submarine in 1954. The first commercial nuclear power plant was opened in 1958 in Pennsylvania and the use of nuclear energy continued to grow in the U.S. throughout the 1960s and 1970s.[3]

But, during the 1970s, environmentalism had raised consequently a more critical view of nuclear power. The accident at the Three Mile Island (TMI) nuclear plant near Harrisburg, Pennsylvania, underlined this dramatically. On March 28, 1979, the power plant suffered a partial core meltdown and a small amount of radiation was released. Following the worst nuclear accident in U.S. history, already planned nuclear power plants were cancelled and no plans for new nuclear power plants were developed. Furthermore, the 1986 nuclear accident in Chernobyl, although not affecting the U.S. directly, also made the public get more concerned and hesitate for the nuclear policies.[4]

In short, today, the United States has 104 nuclear power plants connected to the grid. They generate 803.0 terawatt hours (net TWh), which represents about 20.3 percent of the country's electricity supply (figures from 2010).[5]

b. BASIC STRUCTURE OF LEGAL SETTING

The vast majority of U.S. energy production, transportation, and distribution resources are privately owned, including nuclear power plants. Hence, for realizing the basic structure of energy legal system, as the emphasis of free market and its competition, the relevant legal issues in the New Deal can be good examples. The New Deal marked the dawn of the era of contemporary federal energy regulation and reflected the growth of economic regulation more generally. Congress has continued to address major energy issues in a complex array of environmental and economic statutes.[6] The concept of de-regulation even prevailed in 1980s, revived by the Regan Administration.

Basically, the AEA has two fundamental purposes: to facilitate the use of atomic energy for domestic purpose and to assign to the federal government responsibility for the health and safety risks associated with the nuclear fuel cycle (42 U.S.C. § § 2011 *et. seq.)* However, these two are conflicting goals — on the one hand, the AEA promotes nuclear development, and on the other it imposes regulatory limitations — and the tension between them seriously influences the regulation of radiation hazards under the Act.[7]

Also, in U.S., the regulation of energy resources takes place within a legislative tangle of state and federal statutes, and for the judicial review, in addition to using administrative law principles, courts would address energy issues under common law rules of property and contracts, even in the global arena where private companies contract with government entities for the right to develop state-owned resources.[8]

Further, for government regulation, the overlapping jurisdiction of a wide variety of regulatory agencies has its own advantages and disadvantages. Taking the federal agencies as an instance, the agencies that most directly affect the energy industries are the Department of Energy (DOE), the Department of Interior (DOI), the Federal Energy Regulatory Commission (FERC), the Nuclear Regulatory Commission (NRC), and the Environmental Protection Agency (EPA).[9]

The DOE sponsors energy research and plays a key role in international issues. The DOI controls the federal lands, both onshore and offshore, from which much of coal, oil, and gas resources are extracted, and regulates the surface mining of coal. The FERC regulates the construction of hydroelectric facilities, and oversees the rates of natural gas and electricity to the extent they are transported in interstate commerce. The FERC also articulates policies for the structure of natural gas and electric power markets. The NRC regulates the construction and operation of nuclear power plants. The EPA administers a variety of environmen-

Daniel A. Dorfman, *The Changing Perspectives of U.S. and Japanese Nuclear Energy Policies in the Aftermath of the Fukushima Daiichi Disaster*, 30 Pace Envtl. L. Rev. 255, 258 (2012).

[3] Jessica Riester and Kirsten Verclas, *id*. The first American nuclear power plant came on line in 1957 in Shippingport, Pennsylvania, near Pittsburgh. Fred Bosselman *et al.*, Energy, Economics, and the Environment: Cases and Materials, 1115 (2006).

[4] Throughout the 1990s, the U.S had been shutting down eight reactors permanently and, in fact, until 2012 no new permits for power plants had been granted. Jessica Riester and Kirsten Verclas, *id*.

[5] Id. The 104th plant is TVA's Browns Ferry Unit 1. It is not a new construction reactor. After an extensive recovery effort, Unit 1 became the nation's first nuclear unit to come online in the 21st century when it was restarted on time in May 2007. Operating licenses for Browns Ferry Units 1, 2, and 3 were renewed in May 2006, which will allow continued operation of the units until 2033, 2034, and 2036. Relevant information, available at: http://www.tva.com.

[6] Fred Bosselman, *supra* note 3, at 13–14.

[7] John S. Applegate Al ed., The Regulation of Toxic Substances and Hazardous Wastes 424 (2000).

[8] Fred Bosselman, *supra* note 3, at 14.

[9] Under the AEA, the Atomic Energy Commission (AEC) was the sole agency for the responsibility for the development and production of nuclear weapons as well as the development and safety regulation of the civilian uses of nuclear materials. NRC was established under the Energy Reorganization Act of 1974. The Act of 1974 split these functions into different agencies as presented in the context above.

tal programs that affect energy. For example, the Clean Air Act has a major impact on electric power plants.[10] However, EPA lacks the resources to monitor industries completely. Therefore, environmental enforcement and compliance heavily depends on cooperation. As the result, reflecting current risk regulation, EPA is exploring new avenues to fulfill its legal duty such as technical assistance, public education and outreach, comparative risk analysis, strategic planning, market incentives, voluntary agreements, public-private partnerships, and pollution prevention.[11]

Under the AEA, DOE is responsible for the promotion of nuclear energy, including the production of nuclear fuel and reactor-produced isotopes, and for the development, production and testing of nuclear weapons. Safety regulation is spread across several agencies. NRC has the primary responsibility for regulating nuclear safety and retains control over almost all risks associated with radioactive material. EPA coordinates federal regulation of radiation hazards that impact the ambient environment, such as airborne radiation releases and water-quality effects. For instance, if an NRC licensee adversely affects an EPA water-quality regulation, the NRC must require its licensee to correct the infraction. Also, DOE must comply with the AEA and EPA requirements in its weapons production and environmental remediation activities.[12]

In sum, the main government agency regulating nuclear energy in the U.S. is the NRC. The NRC is a self-funded agency, which means that its revenue is derived solely from the licensing fees it collects. The AEA directs that NRC regulations be in accord with the common defense and security and will provide adequate protection to the health and safety of the public (42 U.S.C. § 2232 (a)) NRC follows a "cradle-to-grave" philosophy: it regulates the possession, storage, use, and manufacture of nuclear materials, and the devices that contain these materials. Further, NRC promulgates technical requirements for the nuclear industry generally and for different categories of nuclear facilities; in addition, it licenses facilities such as hospitals and laboratories.[13] Besides, for other federal departments and agencies, the DOE and the EPA, as well as state and local bodies governing land use planning and economic development, also play different roles concerning the development and regulation of nuclear energy plants.[14] Taking the disposal facility as a more specific example, NRC specifies design and issues license for the disposal facilities, EPA sets the standards for environmental protection, and DOE (or commercial entities) owns and builds the physical facilities.[15]

In addition to the basic legal setting presented above, because of the complexity and burdensome decision-making processes for re-licensing and expansion of existing nuclear plants, applicants now are taking advantage of NRC's more flexible "risk-informed, performance-based" regulatory posture to apply for relief from overly conservative requirements. Further, the agency's new policy considers the probability and consequence of a potential safety problem, together with other factors, such as operating experience, in its "risk-informed regulation."[16] Even regarding new power plant construction, for individual projects, the NRC has established an Early Site Permit (ESP) program that is intended to resolve in advance all on-site environmental issues associated with the licensing of new reactor at a particular site.[17]

Hence, as we can see, coordination, as required and necessitated, is basically among, the DOE, the DOI, the FERC, the NRC, and the EPA.[18]

II. THE USE OF NUCLEAR ENERGY IN U.S.: THE BASIC POLICY AND ITS DEVELOPMENT AFTER FUKUSHIMA DAIICHI DISASTER

a. THE PUBLIC ATTITUDE AND FUNDAMENTAL POLICY FOR NUCLEAR ENERGY

According to the polls, although Americans were in general opposed to nuclear power, they believed it

[10] Further, the Department of Transportation, the U.S. Department of Defense, and the Department of Labor also have some roles to play.
[11] John S. Applegate, *supra* note 7, at 441.
[12] *Id*. at 425.
[13] *Id*. However, people criticize the overlap legal system, especially the role the NRC plays: NRC does not have a strongly adversarial relationship with its regulated industry. Hence, due to the foregoing reason, EPA has took a dramatic step of deciding that it would not adopt NRC radiation standards for its Superfund program because EPA thought that the NRC standards are too lenient. Not to mention the public "common sense," NRC is a *de facto* supporter of nuclear power. *Id*. at 426–26.
[14] Also, the development of nuclear energy in the U.S. would have been impossible without substantial involvement of the military as well as political support and this has ramifications for the use and management of nuclear energy even today. Jessica Riester and Kirsten Verclas, *supra* note 2, at 3.
[15] John S. Applegate, *supra* note 7, at 427.
[16] Fred Bosselman, *supra* note 3, at 1117–18.
[17] *Id*. at 1119.
[18] According to Fred Bosselman, the top ten list of current emerging issues in energy law and policy includes: 1) Land Availability, 2) Renewable Energy, 3) Federalism, 4) Regulatory Transitions (restructuring coming with the stranded cost issue), 5) Network Regulation, 6) International Climate Change, 7) Market Volatility (transmission expansion, reliability of electric power), 8) New Technologies and the Mix of Energy Uses, 9) Merger Policy and Antitrust, and 10) some other emerging environmental issues *Id*. at 2–4. Renewable resources include wind, solar, geothermal, hydroelectric, tidal bio-power, and storage. However, renewable energy policy and the environmental impact assessment will always interact with each other.

would be part of the nation's electricity mix in the future and thus favored keeping open the option of nuclear energy. Further, people thought nuclear power was generally seen to be better for the environment than coal or oil, more economical than oil, and the energy-to-electricity source the nation is least likely to run out of. Not to mention as being the useful method to reduce green house gases the majority of Americans favored.[19] In addition, concerns over U.S. dependence on foreign energy sources and Americans' desire for cheap energy have further gained the weights on the preference of nuclear energy policy in U.S.

Therefore, nuclear energy has profited from political support in terms of subsidies, loan guarantees, and insurance regulation. As the result, the policy of nuclear energy actually is not regarding the issues of environmental protection alone and will never do in U.S.[20] Nuclear energy once again has become touted as a technological solution and energy source that would guarantee energy independence and low CO_2 emissions.[21]

In 2011, President Barack Obama outlined his goal that "by 2035, 80 percent of America's electricity will come from clean energy sources." He explicitly mentioned that this would also include nuclear energy.[22]

Contrary to what matters most to Americans is how much they are paying to heat their homes and fuel their lifestyles. As scholars assert, probably only a serious nuclear accident or terrorist attack, especially after 9/11, on a nuclear power plant in the U.S. could change the basic attitudes of the public toward the nuclear energy policy.[23]

b. THE RESPONSE AND CHANGING PERSPECTIVE IN THE AFTERMATH OF FUKUSHIMA DAIICHI DISASTER

A Gallup poll conducted in March 2011, shortly after the Fukushima accident, found that 58 percent of Americans believe that nuclear energy is safe and 36 percent believe it is not. However, in the same poll Americans were split on the issue of building more nuclear power plants in the U.S. to help solve the country's current energy problem: 46 percent said nuclear power is necessary, 48 percent think that the dangers of nuclear energy are too great.[24] According to other report, 43 percent of those polled after the Fukushima disaster said they would approve building new facilities in the U.S. to generate electricity. Only three years earlier, 57 percent approved of new plants. As in the aftermath of Chernobyl, public perception formed quickly.[25] In other observation by conducting telephone survey of 1,000 U.S. adults in September 2011, 62 percent of respondents said they favor the use of nuclear energy as one of the ways to provide electricity in the United States, with 35 percent opposed.[26]

In sum, as we can also see, numerous surveys conducted over the past decade show that public support for nuclear energy topped 60 percent each year, rising as high as 74 percent of Americans in March 2010.[27] Therefore, " [W]hile there is some evidence of impact of the Fukushima events, support for nuclear energy continues at much higher levels than in earlier decades. Turmoil in oil-rich areas of the world and hikes in oil prices historically have focused opinion even more on nuclear energy, and may have helped to preclude serious impact of events in Japan on public attitudes."[28]

However, as presented above, many license applications filed with the NRC for proposed new reactors have been suspended or cancelled. As of October 2011, plans for about 30 new reactors in the United States have been whittled down to just four, despite the promise of large subsidies and President Barack Obama's support of nuclear power, which he reaffirmed

[19] Jessica Riester and Kirsten Verclas, *supra* note 2, at 3.

[20] As the very first paragraph in his casebook of energy law, Fred Bosselman has already proclaimed "[The] energy sector… Old systems of regulation are being supplanted by policies that emphasizes competition." Fred Bosselman, *supra* note 3, at 1. But he also mentions that environmental concerns and environmental science raise increasingly complex issues, such as climate change and the meaning of sustainable development. *Id*.

[21] *Id.*

[22] *See* President Barack Obama, State of the Union Address, 25 January 2011, available at: http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address

[23] Jessica Riester and Kirsten Verclas, *supra* note 2, at 3.

[24] Gallup Politics, available at: http://www.gallup.com/poll/146939/majority- americans-say-nuclear-power-plants-safe.asp. *Also see* Frank Newport, *The Majority of Americans Say Nuclear Power Plants in the U.S. Are Safe* (April 4, 2011). Scholars points out it is difficult to assess under what circumstances a majority of the American public would support nuclear energy and it is not easy to tell how Americans value the trade-off between risk and safety. Jessica Riester and Kirsten Verclas, *id*. at 3.

[25] Daniel A. Dorfman, *supra* note 2, at 270–71.

[26] This survey was sponsored by the Nuclear Energy Institute. Details on the new survey are accessible at: http://www.nei.org/resourcesandstats/documentlibrary/reliableandaffordableenergy/reports/latest-trends-in-us-public-opinion-about-nuclear-energy-sept-2011.

[27] *See* PR Newswire, Americans' Support for Nuclear Energy Holds at Majority Level 6 Months After Japan Accident, available at: http://www.prnewswire.com/news-releases/americans-support-for-nuclear-energy-holds-at-majority-level-6-months-after-japan-accident-130981293.html

[28] *Id*. There are also some other polls presenting different perspectives from the public opinion. Moreover, in those reports not only the majority has be continually against new construction of nuclear power plants, but they also extend their focus to relicensing and expansion of existing nuclear plants.

after Fukushima.[29] Therefore, it is still quite uncertain whether the accident at Fukushima will have significant adverse effects on the continued operation of existing nuclear plants and the level of construction of new nuclear plants, both in the worldwide perspective and in the U.S.

The critics claim that there could be two potentially interdependent forces that would lead the Fukushima accident to affect (negatively) the future of nuclear power. Firstly, the lessons learned from the accident may affect safety criteria and procedures for existing and new nuclear generating units. Secondly, the accident and its consequences may adversely affect public and political support for nuclear power.[30]

Basically, we can point out that, although people might be more concerned about the safety of nuclear plants, in the U.S. the events at Fukushima have not yet had any direct effects on the future of existing nuclear plants. License extensions continue and no plants have been closed due to safety concerns.[31] Further, for all of the 104 operating nuclear units, the NRC had declared that the nuclear units operating in the U.S. are safe.[32]

The NRC also created a task force to identify near term lessons learned from Fukushima. It concluded that the basic NRC regulatory framework is sound and that a sequence of events such as occurred at Fukushima is unlikely at U.S. plants, and could be mitigated.[33] The Task Force also concluded that operation and licensing of nuclear plants could continue without posing a significant risk to public health and safety.[34]

But, the Task Force report did identify a number of general areas for improvement, rationalization and modernization of NRC regulatory procedures that have evolved over many years, and it made recommendations to codify and harmonize a large set of general and specific safety criteria and procedures so that the regulatory process can operate more efficiently. Specific recommendations that could affect some existing plants, if they are adopted by the NRC, include: reevaluating the design basis accident used to account for new data on earthquakes and floods; strengthening station blackout mitigation (loss of station power) for all existing and new units; improvements in hydrogen control and mitigation inside containments and other buildings; enhancing spent fuel water makeup capabilities; and strengthening emergency preparedness programs.[35]

As presented above, the energy policy and law are not solely environmental issues but much more about the questions of economy and national security, therefore, although the nuclear accident in Fukushima has quelled the renewed enthusiasm about nuclear energy to a certain extent, in February 2012 the NRC approved licenses to build two new nuclear reactors, the construction and operating license for additional reactors at a nuclear power plant in Georgia, the first such approval since 1978. The reactors will be built in Georgia at the Vogtle nuclear power plant complex about 170 miles east of Atlanta.[36]

President Obama has argued that clean energy encompasses all energy sources, so, this administration would assess risks and benefits of nuclear energy by taking true societal and governmental costs into account. Therefore, assessing costs, benefits, and risks of nuclear energy and other energy sources as well as developing a robust, comprehensive, and far-sighted energy policy is thus necessary.[37] Nevertheless, President Obama did not back down from his pro-nuclear stance, announcing that he continues to support the expansion of nuclear power in the United States, despite the crisis in Japan, and that nuclear energy is an important part of U.S. energy future.

III. RISK ASSESSMENT FOR NUCLEAR ENERGY POLICY AND ITS SPECIAL CONCERNS

Risk assessment, especially in terms of nuclear energy, is often focused on security assessment. For the nuclear energy regime, risk assessment has played a

[29] *See New York Times,* After Fukushima, Does Nuclear Power Have a Future? available at: http://www.nytimes.com/2011/10/11/business/energy-environment/after-fukushima-does-nuclear-power-have-a-future.html

[30] Paul L. Joskow and John E. Parsons, *The Future of Nuclear Power After Fukushima*, at 4. MIT Center for Energy and Environmental Policy Research (Feb. 2012).

[31] *Id*. at 14.

[32] Of the 104 units inspected, 91 were performing at the highest safety level with no special remedial action or special inspection regime required. Eight more plants needed to take actions to deal with relatively minor safety-related issues. Three other plants were identified as having more significant safety issues requiring remediation. More management attention and NRC inspections were proposed for these plants. Two of the 104 U.S. plants were determined to require a very high level of attention. *See* NRC, *NRC Issues Mid-Cycle Assessment for Nation's Nuclear Plants*, NRC NEWS No. 11–666 (Sept. 2011).

[33] NRC, *Recommendations for Enhancing Reactor Safety in the 21st Century: The Near-Term Task Force Review of Insights from The Fukushima Dai-Ichi Accident*, at 18, U.S. NRC (July 2011).

[34] *Id.*

[35] The Task Force's overarching recommendations include: *Clarifying the Regulatory Framework, Ensuring Protection, Enhancing Mitigation, Strengthening Emergency Preparedness, and Improving the Efficiency of NRC Programs*. *Id*.

[36] Daniel A. Dorfman, *supra* note 2, at 271–72. This approval for nuclear plant construction suggests that the Fukushima disaster did less to curb nuclear development in the U.S. than originally predicted. It could also be a solid predictor of the U.S. continuing in a pro-nuclear direction within the next few years. *Id*. at 272.

[37] Fred Bosselman, *supra* note 3, at 7.

significant role whether it is risk of nuclear energy, risk to the environment, or risk to people. In an age of heightened security concerns due to terrorism, the risk of security vulnerability has also become a consideration. Moreover, economic considerations should be considered as factors in the assessment of each of these types of risks, weighing the potential for investment and profit against the risk of economic losses at a time of economic uncertainty.[38] Furthermore, policymakers in the U.S. view nuclear energy as a solution to reduce American energy imports, that might cause the risk of dependence on other nations, and to reduce emissions of greenhouse gases as a green alternative to coal and natural gas plants.[39] However, the uncertain availability of uranium as a necessary resource and the unsolved question of where to store nuclear waste make the case for nuclear energy problematic.[40]

Therefore, if nuclear is too dangerous, fossil fuels are too dirty and renewable energy is too complicated, where are we supposed to get our energy? Also, in addition to the security risk, people might further raise the question, what is the cost of nuclear energy? And, does the risk outweigh the costs?

There are many kinds of risks around the decision-making for the nuclear energy policy. In Part III, I will present the basic recommendations made by the NRC, generally from regulatory aspect, to see what legal system can do for improving and enhancing the safety of nuclear energy policy. Also, I will further focus on the risk regulation from the health and environmental perspectives to see what risk assessment, risk management, and risk communication are supposed to be. Finally, I will also provide some further considerations for the development of nuclear power policy in U.S.

a. THE NRC RECOMMENDATIONS FOR ENHANCING REACTOR SAFETY FROM REGULATORY PERSPECTIVE

Basically, as presented above, the Task Force recommends establishing a logical, systematic, and coherent regulatory framework for adequate protection that appropriately balances defense-in-depth and risk considerations. It even further provides the following steps:

1. Drafting a policy statement that articulates a risk-informed defense-in-depth framework that includes extended design-basis requirements in the NRC's regulations as essential elements for ensuring adequate protection.

2. Initiating rulemaking to implement a risk-informed, defense-in-depth framework consistent with the above recommended policy statement.

3. Modifying the regulatory analysis guidelines to more effectively implement the "defense-in-depth philosophy" in balance with the current emphasis on risk-based guidelines.[41]

The key to the so-called defense-in-depth approach is to create multiple independent and redundant layers of defense to compensate for potential failures and external hazards so that no single layer is exclusively relied on to protect the public and the environment. In its application of the defense-in-depth philosophy, the Task Force has addressed protection from design-basis natural phenomena, mitigation of the consequences of accidents. The elements of the NRC regulatory framework provide protection from "design-basis events" — protection against seismic and flooding events; "beyond-design-basis event" (as reasonable expectations) — protection for loss of all AC power; and mitigation of severe accidents — addressing the core damage and subsequent containment performance from the beyond-design-basis events (as in Fukushima accident).[42]

In a new regulatory framework, risk assessment and defense-in-depth would be combined more formally.[43] For example, the current NRC approach to land contamination relies on preventing the release of radioactive material through the first two levels of defense-in-depth, namely protection and mitigation.[44] In sum, as the NRC provided, the philosophy of "defense-in-depth" is including design-basis re-

[38] For example, even though Germany has made its decision to return to the phase-out plan, without producing its own nuclear energy, German reliance on foreign sources will not only increase, but its energy needs will still be met by nuclear sources provided by its neighbors. This might cause the energy security unstable. Therefore, although anti-nuclear sentiment has swept the EU, weighing the risk of nuclear versus the risk of foreign energy sources or increased CO_2 emissions is an ongoing debate. Jessica Riester and Kirsten Verclas, *supra* note 2, at 5–6.

[39] *Id*. at 3.

[40] While nuclear energy emits almost no CO_2 when plants are running, if we take into account the lifecycle assessments of nuclear power plants, including the building of plants, the procurement of uranium, and the transportation and storage of waste, critics would emphasize the different emissions picture. *Id*. Also, a comparison by the Union of Concerned Scientists of the levelized costs for the proposed Levy nuclear power plant in Florida with alternative energy sources shows that nuclear energy is not necessarily the cheapest option: "the mid-range levelized cost estimate for the Levy reactors, $164 per megawatt-hour (MWh), was higher than that of most other energy solutions, including improved energy efficiency to reduce electricity use, natural gas, biomass, land-based wind, solar photovoltaic, and even coal." Nuclear energy has high up-front and decommissioning costs. *Id*. at 4.

[41] NRC, *supra* note 33, at 122–23.

[42] *Id*. at 15. The last layer of defense-in-depth, mitigation, is an essential element of adequate protection of public health and safety. *Id*. at 20.

[43] *Id*. at 21.

[44] The Task Force concluded that the NRC's current approach to the issue of land contamination from reactor accidents is sound. *Id*.

quirements and additional risk reduction requirements.[45]

The Task Force recommends the safety improvements added from the 1980s to the present to produce a regulatory structure well suited to licensing and overseeing the operation of nuclear power plants for decades to come. Further, as this report asserted, adequate protection should continue to be an evolving safety standard supported by new scientific information, technologies, methods, and operating experience.[46] Therefore, as new information and new analytical techniques are developed, safety standards need to be reviewed, evaluated, and changed, as necessary, to insure that they continue to address the NRC's requirements to provide reasonable assurance of adequate protection of public health and safety.[47]

b. BASIC STRUCTURE OF RISK REGULATION: RISK ASSESSMENT, RISK MANAGEMENT, AND RISK COMMUNICATION

From the foregoing introduction to NRC's recommendations, we should know the general regulatory framework for safety of the current nuclear energy. In this section, I will further focus on the risk regulation from the perspectives of health and environment (toxics regulation and pollution control). I will use the structure of risk regulation to analyze, including risk assessment, risk management, and risk communication, which would be consistent with the requirements of due process for decision-makers: accountability, transparency, and participation, the so-called fundamental procedural values.

As presented above, when new information and new analytical techniques are provided, safety standards need to be reviewed and evaluated. But, before standards are changed, decision-makers must considerably go though decision-making procedures for risk management, based on risk assessment and getting the public involved as supportive foundation for the final action, for ensuring the public health and safety.

Risk regulation (or so-called risk-based standards), as an effective regulatory analysis, depends on the ability and even adaptability of regulators to produce quality regulations well-grounded in sound science, economics, and law.[48] Hence, more flexible statutory language will be needed to produce a more adaptive and dynamic regulatory process that is able to implement sound scientific evidence more easily. And, this approach will also prevent the agency from misallocating resources and missing the need to the regulation of significant risks.[49] Hence, risk assessment is a critical tool for helping the NRC, EPA, and some other relevant agencies to set priorities under the current legal system.

Although legal framework needs to be more flexible, according to the NRC 1983 report (*the Red Book*), for risk regulation, it endorsed a bipartite system by which scientific data was used to assess the risk posed by a given commodity in a process kept separate from a decision-making process based on specific data.[50] In short, this approach is to separate the scientific process, risk assessment, from the political process, risk management, because the latter, as *the Red Book* asserted, unlike risk assessment, explicitly involves political, social, and economic policy questions, such as the acceptable level of risk and the appropriate regulatory response.[51]

The purpose of separation in *the Red Book* is not only to prevent the exercise of policy judgment when evaluating science, but also to prevent risk managers from influencing the type of information that assessors would collect, analyze, or present. Moreover, according to Prof. Applegate's analysis to *the Red Book's* approach, he furthered that even though judgment would be actually required during the phase of risk assessment, the science-policy judgments that EPA (or other agencies) makes in the course of risk assessment would also be improved because decision-makers would be more clearly informed by the agency's priorities and goals in risk management.[52] Therefore,

[45] The concept of design-basis events has been equated to adequate protection, and the concept of beyond-design-basis events has been equated to beyond adequate protection such as safety enhancements. *Id*. at 15.

[46] *Id*. at 18.

[47] *Id*.

[48] Andrew J. Miller, Note, *The Food Quality Protection Act of 1996: Science and Law at A Crossroads*, 7 Duke Envtl. L. & Pol'y F. 393, at 418 (1997).

[49] Of course, regulatory analysis must be performed by well-qualified and multi-disciplinary individuals. *Id*, at 419; also *see*, NRC, Understanding Risk, Informing Decisions in a Democratic Society, at 24 (1996). People even try to use social and behavioral science to analyze how environmental decision could be made effectively and efficiently. And, people also emphasize that decision making should have adaptive ability to change in science and society. *See*, National Research Council, Decision Making for the Environment, social and behavioral science research priorities (2005).

[50] *See*, NRC, Risk Assessment in the Federal Government: Management the Process, at 151 (1983). As a complement to the Red Book, the NRC's 2008 report embeds these concepts within a broader framework for risk-based decision making. This report furthered that risk assessment has become a dominant public policy tool for making choices, based on limited resources and facing a number of significant challenges, to protect public helath and the environment. *See*, NRC, Science and Decision: Advancing Risk Assessment (2008).

[51] *See*, NRC, RISK ASSESSMENT, *id*.

[52] John S Applegate, *Learning From NEPA: Some Guidelines for Response Federal Risk Legislation*, 23 Harv. Envtl. L. Rev. 93, 98 (1999).

protecting the scientific integrity in risk assessment, while building more productive linkages to make risk assessment more accurate and relevant to risk management, will be essential as the agency proceeds to regulate the given risks.[53]

From the perspective of unclear energy policy, the health effects of radiation have been studied in considerable detail, but, even though the mechanism and higher-dose health effects are understood relatively well, compared to chemicals, the effects at very low doses are not free from doubt.[54] Further, how can radiation cause damage? The combined effects of type of radioactivity, chemical stability, biological uptake, dose and dose rate, and dose location make the risk posed by even a simple radiation exposure difficult to estimate.[55] Taking cancer as an example, chronic effects are of greater concern, however, because many human activities release low levels of radiation, including medical x-rays and television viewing, the precise effects of low-level radiation continue to be controversial.[56]

According to the current practice, the average annual effective dose to the U.S. public from all sources is about 360 millirem, of which 200 mrem is from radon and 100 mrem from cosmic, terrestrial, and internal sources. By comparison, NRC's annual limits are 5000 mrem for occupational exposures and 100 mrem for the general public; EPA seeks to achieve a 15 mrem standard for remediation sites, because that level achieves an appropriate level.[57] However, there is a lively debate about low-dose effects of ionizing radiation. Since the low-dose effects of radiation on human are difficult to study directly, whether or not there is a threshold below which the effects disappear also remains contested.[58]

Therefore, under risk regulation (risk-based regulatory approach has been the dominant position for the regulation of environment, health, and safety), because of the characters and limitation of scientific information, in addition to risk assessment and risk management, for risk communication throughout the previous two processes, the general public should have the fundamental right to know critical information. Public perceptions of risk and expert perceptions of risk are divergent and a regulatory process with limited resources cannot accomplish such divergent goals, so risk regulation must include risk communication to produce more synchronistic goals.[59]

Improving risk communication will also depend on the procedural requirements, including transparency, accountability, and public participation, for the decision making process, which will be further discussed below.[60] Although the nature of some of these choices cannot be easily communicated to the public because of expert disagreements and a lack of reliable scientific results,[61] the NRC report concluded that: " [I]t is mistaken to expect improved risk communication to always reduce conflict and smooth risk management ... But even though good risk communication cannot always be expected to improve a situation, poor risk communication will nearly always make it worse."[62] Hence, the public participation for risk communication will improve communication channels between scientists, policy-makers, and the public.[63] Further, it is essential that scientists be able to communicate with the public in a clear and non-technical manner about the tradeoffs associated with alternative health and environmental issues.[64]

Under risk communication, greater stakeholder involvement is necessary to ensure that the process is transparent and that risk-based decision-making would proceed effectively, efficiently, and credibly.[65] As the result, for improving risk communication, we need to ensure that the public has the opportunity to access and the ability to understand the needed information to provide positive input into the decision-making process. Hence, from this point of view, meaningful public participation will be criti-

[53] *Id.*

[54] John S. Applegate, *supra* note 7, at 419.

[55] *Id.* at 420.

[56] *Id.* at 419.

[57] *Id.* at 422.

[58] *Id*. Further, as presented above, NRC does not have a strongly adversarial relationship with its regulated industry and this is the reason why EPA had decided that it would not adopt NRC radiation standards for its Superfund program (just because EPA believed that the NRC standards are too lenient). *Id*. at 426.

[59] Andrew J. Miller, *supra note* 48, at 422.

[60] The establishment of a leader for the regulatory process who will be trusted and can serve as an icon of risk analysis can help guide public perceptions toward creation of a safer society. NRC, Understanding Risk, *supra note* 49, at 24. Also *see*, National Research Council, Public Participation in Environmental Assessment and Decision Making (2008).

[61] Andrew J. Miller, *supra note* 48, at 421.

[62] NRC, Improving Risk Communication, at 3 (1989).

[63] NRC, The Future Role of Pesticides in US Agriculture, at 86–87 (2000).

[64] John S. Applegate, *The Government Role in Scientific Research: Who Should Bridge the Data Gap in Chemical Regulation*, in Rescuing Science From Politics, Regulation and the Distortion of Scientific Research 255, 268. (Wendy Wagner and Rena Steinzor ed., 2006).

[65] Further, stakeholder involvement needs to be an integral part of the risk-based decision-making framework, even beginning with problem formulation and scoping. See NRC, Public Participation, *supra note* 60, at 12. For helping the understanding of true risks, risk comparisons can be a good way in context for standard setting or priority setting. *Id*. According to the NRC report in 1996, coping with a risk situation requires a broad understanding of the relevant losses, harms, or consequences to the interested and affected parties and needs to address social, economic, ecological, and ethical outcomes as well as consequences for human health and safety. NRC, Understanding Risk, *supra* note 49, at 156–57.

cal for helping the agency to make better decisions (such as adequate standards for radiation exposures), which will be also more acceptable for the public.

c. SPECIAL CONCERNS AND RESPONSES IN POLICY AND REGULATIONS

After understanding the general regulatory framework in nuclear power policy and detailed discussion of risk regulation for environmental and health regulations including standards set for radiation exposure for the public safety, the following sections will further observe other factors the agencies might concern for their final decision-making in the nuclear energy policy.

CLIMATE CHANGE

As presented above, nuclear energy is an important part of President Obama's plan to resolve the issues of global warming. Moreover, taking Germany as an example, under its phase-out plan, Germany will need to turn to fossil fuels to replace nuclear which might raise another serious concern. According to some estimates, Germany's policy could add 370 metric tons of greenhouse gas emissions through 2020 — an annual equivalent of Slovakia's emissions. Fossil fuels currently provide about 40 percent of German energy; greater reliance indeed poses an environmental risk of potentially higher likelihood than nuclear risk.[66] Therefore, unless Germany is able to rapidly expand renewable energy, it will continue to require nuclear energy — imported from its neighbors. By the same time, Germans are actually pushing that risk on its neighbors. As critics assert, in some ways, this seems a shortsighted action, because Germany will undoubtedly suffer once a nuclear disaster takes place next door, but it will lack the over-sight controls to try and prevent such a disaster.[67]

In U.S., according to reports, since the mid-1970s, nuclear energy has enabled the United States to avoid emitting over 80 million tons of sulfur dioxide and about 40 million tons of nitrogen oxides.[68] In 2002, a group of environmental analysts argued that nuclear power could play a significant role in mitigating climate change. This position received strong support, and in 2003, a report conducted at MIT entitled *The Future of Nuclear Power* explained that fossil fuels were not the answer. Instead, it concluded that nuclear power was a viable option and called for financial incentives to promote the construction of new nuclear plants.[69]

In President Obama's plan to tackle global warming, announced on June 2013, his administration is instituting stringent mandatory restrictions on greenhouse gas emissions by power plants, factories and other industrial sources. These sources combined account for roughly 40 percent of all greenhouse gas emissions across the U.S. The goal is to reduce overall greenhouse gas emissions nationally by four percent below 1990 levels within the next seven years. However, some other critics asserted that Obama's plan is too modest and will fall short by failing to set a nationwide pollution cap for carbon dioxide. Further, they also criticized that his plan is not big enough and does not move fast enough to match the terrifying magnitude of the climate crisis.[70] But, on the other hand, undeterred by the Fukushima nuclear disaster, Obama pledged just two weeks following the initial explosions at the Daiichi facility that nuclear power should be revived in the U.S., as it provides "electricity without adding carbon dioxide to the atmosphere." Hence, nuclear power, as President Obama insists, might make up for the gap and as the foregoing criticism anticipated, as long as Obama remains in office, nuclear will remain a big part of U.S. near term energy future.[71]

TERRORISM

After the terrorist attacks of September 11, 2001, concerns that terrorist groups might target nuclear plants in the U.S. grew. Also, the nuclear accident in Fukushima has caused increased concern about the impact of natural disasters on nuclear power plants. As the immediate response for Fukushima disaster, the NRC had required nuclear power plant operators to increase safety and security measures after both incidents. Also, the NRC had placed the 103 operating nuclear power plants and other significant licensees on the highest

[66] Jessica Riester and Kirsten Verclas, *supra* note 2, at 6.
[67] *Id*.
[68] Larry R. Foulke, *supra* note 1, at 1. He also furthered that over the past 20 years, the average capacity factor has increased from about 60% to over 90%. This increased capacity translates into an additional 23,000 megawatts of power on the grid — the equivalent of building 23 new plants. *Id*.
[69] Daniel A. Dorfman, *supra* note 2, at 269.
[70] Business Ethic, *Environmentalists Assess Barack Obama's Climate Change Initiative* (June 2013), available at: http://business-ethics.com/2013/06/29/1146-environmentalists-assessbarack-obamas-climate-change-initiative.
[71] However, it also emphasized that nuclear power is counterproductive to efforts to address climate change effectively and in time… funding diverted to new nuclear power plants deprives real climate change solutions, like solar, wind and geothermal energy, of essential resources. Business Ethic, *After Fukushima: Obama's Nuclear Policy* (June 2011), available at: http://business-ethics.com/2011/06/17/2448-after-fukushima-obamas-nuclear-policy.

level of alert immediately after the September 11, 2001 attacks.[72]

The NRC is responsible for assuring protection of the public health and safety in the civilian use of nuclear material. This includes ensuring that commercial nuclear power plant licensees provide a program of physical protection in accordance with the requirements in Title 10 of the Code of Federal Regulations, Section 73.55. Before September 11, 2001, the security measures in place provided reasonable assurance that the health and safety of the public would be protected in the event of an attack within the design basis threat (DBT) of radiological sabotage in 10 CFR 73.1. Since September 11, 2001, the defensive capability of the industry has been significantly enhanced as a result of the actions taken by licensees voluntarily and in response to the advisories issued by the NRC after September 11, 2001, and the orders issued on February 25, 2002. In addition, on April 29, 2003, NRC issued a revised DBT against that licensees must be prepared to defend. The enhancements include security measures against an insider, waterborne attacks, vehicle bombs, and land-based assault threats. Additional measures will be considered in the future as necessary.[73]

The NRC has overseen the implementation of enhanced security measures over since 2011. Licensees throughout the nuclear industry have significantly enhanced security by upgrading security measures and coordinating with local, state, and federal agencies to better prepare for a significant terrorist event. Some of the specific measures implemented by the licensees in response to the NRC advisories and orders included increased patrols, augmented security forces and capabilities, additional security posts, installation of additional physical barriers, vehicle checks at greater stand-off distances, enhanced coordination with law enforcement and military authorities, and more restrictive site access controls for all personnel.[74]

SPENT NUCLEAR WASTE DISPOSAL

Spent nuclear waste disposal is also another important issue for nuclear energy policy, and the Yucca Mountain Nuclear Waste Repository could be a good example, which is an ongoing debate.

This nuclear waste repository was supposed to be a deep geological repository storage facility for spent nuclear reactor fuel and other high level radioactive waste. It was to be located on federal land adjacent to the Nevada Test Site in Nye County, Nevada, about 80 mi (130 km) northwest of the Las Vegas Valley. This proposed repository was within Yucca Mountain, a ridge-line in the south-central part of Nevada near its border with California.

For this repository, EPA established the Yucca Mountain standards, as original ones, in June 2001.[75] The storage standards set a dose limit of 15 millirem per year for the public outside the Yucca Mountain site. The disposal standards consisted of three components: (1) an individual dose standard, (2) a standard evaluating the impacts of human intrusion into the repository, and (3) a groundwater protection standard. The individual-protection and human intrusion standards set a limit of 15 millirem per year to a reasonably maximally exposed individual, who would be among the most highly exposed members of the public. The groundwater protection standard is consistent with EPA's Safe Drinking Water Act standards, which the Agency applies in many situations as a pollution prevention measure. The original disposal standards were set for the application for a period of 10,000 years after the facility is closed. Dose assessments were to continue beyond 10,000 years and be placed in DOE's Environmental Impact Statement. The 10,000 year period for compliance assessment is consistent with EPA's generally applicable standards developed under the Nuclear Waste Policy Act. It also reflects international guidance regarding the level of confidence that can be placed in numerical projections over very long periods of time.

However, shortly after the EPA first established these standards in 2001, the nuclear industry, several environmental and public interest groups, and the State of Nevada challenged the standards in court. In July 2004, the Court of Appeals for the District of Columbia Circuit found in favor of the Agency on all counts, except the 10,000 year regulatory time frame. The court ruled that EPA's 10,000-year compliance period for isolation of radioactive waste was not consistent with National Academy of Sciences (NAS) recommendations and was too short.[76] The NAS report had recommended standards be set for the time of peak risk, which might approach a period of one million years.[77]

Although according to the ruling, in 2009, EPA published in the Federal Register a final rule, limiting radiation doses from Yucca Mountain for up to 1,000,000

[72] Jessica Riester and Kirsten Verclas, *supra* note 2, at 4.

[73] Additional information on this subject can be found in the testimony provided by former Chairman Meserve to the U.S. House of Representatives on April 11, 2002. Further, Frequently Asked Questions About NRC's Response to the 9/11/01 Events, available at: http://www.nrc.gov/security/faq-911.html

[74] *Id*.

[75] EPA, EPA's Proposed Public Health and Environmental Radiation Protection Standards for Yucca Mountain (October 2005).

[76] *Nuclear Energy Institute v. EPA*, 373 F.3d 1251 (D.C. Cir. 2004).

[77] NRC, Committee on Technical Bases for Yucca Mountain Standards (1995).

years after it closes,[78] there were still other environmental concerns against the plan, such as the issues of the environmental impacts of transportation of waste and earthquakes. For the earthquake issue, Nevada ranks fourth in the nation for current seismic activity. Even though DOE has stated that seismic and tectonic effects on the natural systems at Yucca Mountain will not significantly affect repository performance, in September 2007, it was discovered that the ridge fault line ran underneath the facility, which would cause serious safety problems. Also, cities under the routes of the waste transportation are concerned about the transport of radioactive waste on highways and railroads that may pass through heavily populated areas and cause harmful release of radioactive material.[79]

In addition, cultural influence should be weighted under the processes of decision-making as well. Native Americans used the immediate vicinity of Yucca Mountain on a temporary or seasonal basis. Yucca Mountain and surrounding lands were central in the lives of the Southern Paiute, Western Shoshone, Owens Valley Paiute and Shoshone peoples, who shared them for religious ceremonies, resource uses, and social events. They believe that this repository project overlooks traditional accounts of farming that occurred before European contact.[80]

Although the location has been highly contested by environmentalists, Congress had approved it in 2002. However, since debates presented above, under the Obama Administration, funding for development of Yucca Mountain waste site was terminated, in pursuant to the amendment to the Department of Defense and Full-Year Continuing Appropriations Act, passed by Congress on April 14, 2011.

In this case, we can observe what the roles the administrative, legislative and judicial branches play, and see how important risk assessment is. Although, according to the estimate, $12 billion had already been spent to study the project and build it[81] and some experts even asserted that for this project, the NRC has promulgated a modern licensing process including an early site approval process and pre-certification of reactor designs,[82] once the transparency, accountability, and public involvement of the decision-making cannot be fulfilled, because of the requirements of due process, the final action, based on expertise, would still be withdrawn or overturned.

OTHERS

In addition to providing clean energy, a dazzling array of nuclear technologies actually helps to improve medical diagnosis, protect livestock health, develop water resources, preserve food, promote agricultural productivity, cure human illness, enhance human nutrition, advance environmental science, eradicate virulent pests, and strengthen industrial quality control.[83] These might also be the critical factors for the decision-makers to make the final nuclear energy policy.

VI. RECOMMENDATIONS FROM U.S. EXPERIENCE FOR US: TRANSPARENCY, ACCOUNTABILITY, AND PARTICIPATION FOR NUCLEAR ENERGY POLICY

As Americans are less self-conscious about how unattainable a high-energy society is and less aware of its anomaly, the policymakers need to reflect seriously on how the behavior of Americans will change in reaction to legal and economic incentives for dealing with the issues of intersection of environmental protection and nuclear energy policy.[84] This would be the same prerequisite for people in Taiwan to pay attention to for the further development. But, no matter what energy policy would be in Taiwan, the basic legal approach, the U.S. experience, successful or failure, even including the insistence in nuclear energy policy the Administration has, shall be good lessons for us to learn.

As presented above, for the procedures for decision-making, including the regulatory analysis — risk assessment and risk management, the most important thing is to fulfill the fundamental values of due pro-

[78] Within that regulatory time frame, the EPA has two dose standards that would apply based on the number of years from the time the facility is closed. For the first 10,000 years, the EPA would retain the 2001 final rule's dose limit of 15 millirem per year. This is protection at the level of the most stringent radiation regulations in the U.S. today. From 10,000 to one million years, EPA established a dose limit of 100 millirem per year. EPA's rule requires the Department of Energy to show that Yucca Mountain can safely contain wastes, considering the effects of earthquakes, volcanic activity, climate change, and container corrosion, over one million years. The current analysis indicates that the repository will cause less than 1 mrem/year public dose through 1,000,000 years.

[79] For its EIS, *see* "Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada; DOE/EIS-0250". Office of Civilian Radioactive Waste Management, U.S. DOE (February 2002).

[80] For environmental justice study, see "Environmental Justice Case Study: The Yucca Mountain High-Level Nuclear Waste Repository and the Western Shoshone".

[81] As the result, U.S. has no any long-term storage site for high-level radioactive waste, which is currently stored on-site at various nuclear facilities around the country. The Department of Energy is reviewing other options for a high level waste repository. According to its final report, the Blue Ribbon Commission, established by the Secretary of Energy, emphasized urgency to find a consolidated, geological repository. *See* Blue Ribbon Commission on America's Nuclear Future Final Report (Jan. 2012).

[82] Larry R. Foulke, *supra* note 1, at 1.

[83] *Id*. at 1–2. Some people even said that the renaissance of nuclear power in the United States is inevitable. *Id*. at 2.

[84] Fred Bosselman, *supra* note 3, at 11.

cess — accountability, transparency, and participation, through the current legal system of administrative (environmental) law. Moreover, according to Prof. Aman, due processes for the decision-making, including policy or regulatory setting, are not only to protect individuals from inappropriate governmental action, but also to allow for, even to require, input by citizens regarding policy under review.[85] Especially from the perspective of environmental and health laws, due to the expertise and discretion, since the legal system of delegation is unavoidable, the relevant issues will be more complicated and costs for dealing with will be carried more obviously. Therefore, transparent and accountable procedures for the decision-making shall be realized.[86]

For example, for the requirements of procedural due process, the easier it is for the public to discover and understand the political trade-off made by agency personnel, the easier it is to hold agencies politically accountable for the ways in which they choose to exercise their discretion.[87] Further, in order to enhance transparency, Congress would mandate public disclosure of the recommendations or reports of agency scientists. Where Congress has directed agencies to use the best available scientific information in their decisions, the public is entitled to know what agency scientists think of the scientific data, without filtering it by political appointees.[88] In addition, for the agency to enhance its transparency and accountability, public participation is also an important mechanism to fulfill the goals of modern legal system.[89] The NRC report of 1996, dealing with how governmental institutions and procedures should be structured to make decisions better and more broadly acceptable, also emphasized that participation from interested and affected parties and improvement of understanding risk should be enhanced in risk decisions.[90]

In sum, accountability for risk assessment of nuclear energy policy shall take nuclear proliferation, the question of transparency on nuclear accidents and waste storage, and the question of energy production without nuclear energy into account. In addition, the public participation will also be the prerequisite for the decision-making. According to the NRC report in 1996, coping with a risk situation requires a broad understanding of the relevant losses, harms, or consequences to the interested and affected parties and needs to address social, economic, ecological, and ethical outcomes as well as consequences for human health and safety.[91] Therefore, decision-makers must be accountable for the final nuclear energy policy; transparency and public involvement will be essential in whole energy system. In order to answer the questions raised above, it is necessary for the United States to develop a comprehensive energy strategy, which entails a cost-benefit and risk analysis of available energy resources and energy efficiency measures.[92]

V. CONCLUSION — A TWIST: THE LESSONS FOR RENEWABLE RESOURCE POLICY

Of the paper I discussed above regarding the insistence of U.S. in nuclear energy policy, not the pros or cons for the policy, the main focus is to realize the importance of due process for making the final energy policy.[93] Further, risk assessment is a critical stage for the ongoing process. For the application, environmental impact assessment (EIS) for developing project could be another suitable case for the understanding (EIA in Taiwan has been twisted and seriously lacks accountability, transparency, and participation.) Even for the renewable energies, in addition, there are still many environmental impacts we need to concern about, such as the issues of siting and permitting.

For the renewable resources with siting issues, while proponents cite the environmental, economic, and energy security benefits to be gained from these projects, opponents cite the negative impacts, which often include potential damage to local ecosystems, loss of aesthetic value to the natural landscape, and the opportunity cost of land use. Biomass and biofuels, for example, require large amounts of land that could instead be used for agricultural purposes. Hydro-power is becoming increasingly difficult to site; most major

[85] *See*, Alfred C. Aman, Jr., The Democracy Deficit: Taming Globalization through Law reform, at 13–14 (2004). Prof Aman furthers that administrative law is to provide the infrastructure necessary for the exercise of participatory rights by citizens. *Id*, at 14.

[86] Holly Doremus, *Using Science in a Political World: The Importance of Transparency in Nature Resource Regulation*, in Rescuing Science From Politics, Regulation and the Distortion of Scientific Research 143, 144 (Wendy Wagner and Rena Steinzor ed., 2006).

[87] *Id*. at 145.

[88] With this approach, when an agency discloses internal scientific advice counter to its decision, it will face both political and judicial pressure to explain the discrepancy and provide the reason for its final decision.

[89] As the justification of the use of science discussed above, under the democratic approach broad public participation is also viewed as the antidote to abuses of expert testimony. Sheila Jasanoff, The Fifth Branch: Science Advisers as Policymakers, at 1 (1990).

[90] NRC, Understanding Risk, *supra note* 49.

[91] *Id*, at 156–57.

[92] Jessica Riester and Kirsten Verclas, *supra* note 2, at 4.

[93] The primary legal system should be like the following structure. Congress, as the political institution, should provide, at the least, the general kinds of policy guidance for the Agency to engage in rationalist decision-making processes and for the courts to fulfill their competence in judicial review. John S. Applegate, *Worst Thing First: Risk, Information, and Regulatory Structure in Toxic Substances Control*, 9 YALE J. ON REG. 277, at 296–97 (1992).

potential sites are already being used, and ecological considerations are preventing the exploitation of remaining ones. Siting renewable energy projects can also pit environmentalists against one another. In Cape Cod, Massachusetts, local residents who fear harm to aquatic life have fought the construction of 130 wind turbines; in southern California, advocates of solar power face resistance from environmental groups that fear potential disruption to the Mojave Desert ecosystem.[94]

Hence, as the fundamental requirements of risk regulation, including risk assessment, risk management, and risk communication, environmental impact assessment (i.e. environmental assessment, environmental impact statement, or even programmatic environmental impact statement — all are significant processes for the nuclear energy policy to be made) should be conducted on the way of fulfilling the procedural values: transparency, accountability and public participation.

For instance, for the wind power, the most prominent issues of concern are land use and the possible impacts on birds and bats. Also, concerns have been raised about noise, aesthetics, and the use of herbicides to clear and maintain sites, particularly where endangered species are involved. For setting a comprehensive process, the American Wind Energy Association (AWEA) even enacts a siting handbook, covering the components of a typical wind power project: the stages of a wind power project; the federal, state, and local regulatory frameworks relevant for wind power; and the array of environmental and human impacts to consider when siting wind power.[95]

In addition, the purpose of the NRC's serial studies are to develop an analytical framework for impact evaluation to inform siting decisions for wind-energy projects. The study organized impacts assessment into a three-dimensional action space that includes the relevant spatial jurisdictions (local, state/regional, and federal), project stage (pre-project, construction, operational, and post-operational), and environmental and human impacts (NRC, 2007). The NRC (2007) study found that because wind energy is new to many state and local governments, the quality of the permitting process is uneven, and it pointed out that a coordinated and consistent process would greatly aid planning and regulating wind-energy development at smaller scales. The report recommended that representatives of federal, state, and local governments work with wind developers and interested parties to develop guidance and permitting guidelines (NRC, 2007).[96]

As the result, even in the deployment of renewable electricity facilities, significant increase will thus entail concomitant increases in the highly specific, administratively complex, environmental impact and siting review processes. While this situation is not unique to renewable electricity, nevertheless, a significant acceleration of its deployment will require some level of coordination and standardization of siting and impact assessment processes.[97]

Finally, from the insistence of U.S. on nuclear energy policy to the possibility of renewable energy policy, no matter which one we prefer in Taiwan, we must considerably enact our own comprehensive regulatory analytical structure for the decision-making process. Especially for risk regulation, the processes must include risk assessment, risk management, and risk communication. For the procedural requirements, we also need to ensure the realization of accountability, transparency, and participation. Without these basic infrastructures, there will be no justification and legitimacy for whatever we might make for our energy policy and all other relevant regulations.

REFERENCES

Books:

Aman, Alfred C. Jr. (2004), *The Democracy Deficit: Taming Globalization through Law reform*, New York, NY: New York University Press

Applegate, John S. (2000). *The Regulation of Toxic Substances and Hazardous Wastes*, New York, NY: Foundation Press.

Bosselman, Fred (2006), Energy, Economics, and the Environment: Cases and Materials, New York, NY: Foundation Press.

Environmental Protection Agency (2005), EPA's Proposed Public Health and Environmental Radiation Protection Standards for Yucca Mountain. Washington, D.C.

Jasanoff, Sheila (1990). *The Fifth Branch: Science Advisers as Policymakers*, Cambridge, Mass: Harvard University Press.

[94] National Academy of Science, *Electricity from Renewable Resources: Status, Prospects, and Impediments*, 219 (2010).

[95] *Id*. at 220 and 223.

[96] *Id*. at 223–24. In order to better assess possible wildlife impacts of wind power, Secretary of the Interior Dirk Kempthorne in 2007 announced the creation of the Wind Turbine Guidelines Advisory Committee, which will function in accordance with the Federal Advisory Committee Act (FACA). The scope and objective of the committee, as outlined in its charter, is to provide advice and recommendations to the Interior Secretary on developing effective measures to avoid or minimize impacts on wildlife and habitats related to land-based wind energy facilities. The committee members represent the varied interests associated with wind energy development and wildlife management. Another group that will address fauna issues is the recently formed American Wind Wildlife Institute, created through cooperation between members of the environmental community and the wind industry. The institute will focus on efforts to facilitate timely and responsible development of wind energy while protecting wildlife and wildlife habitat. It will do this through research, mapping, mitigation, and public education on best practices in wind farm siting and wildlife-habitat protection. *Id*. at 224.

[97] *Id*. at 228.

National Research Council (2011), *NRC Issues Mid-Cycle Assessment for Nation's Nuclear Plants*, NRC NEWS No. 11–666.

National Research Council (2011), *Recommendations for Enhancing Reactor Safety in the 21st Century: The Near-Term Task Force Review of Insights from The Fukushima Dai-Ichi Accident*. Washington, D.C.: National Academy Press.

National Research Council (2008). *Science and Decision: Advancing Risk Assessment*. Washington, D.C.: National Academy Press.

National Research Council (2008). *Public Participation in Environmental Assessment and Decision Making*, Washington D.C.: National Academy Press.

National Research Council (2006). *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report*, Washington D.C.: National Academy Press.

National Research Council (2005). *Decision Making for the Environment, social and behavioral science research priorities*, Washington D.C.: National Academy Press.

National Research Council (2000). *The Future Role of Pesticides in US Agriculture*. Washington D.C.: National Academy Press.

National Research Council (1996). Understanding Risk, Informing Decisions in a Democratic Society, Washington D.C.: National Academy Press.

National Research Council (1995), *Committee on Technical Bases for Yucca Mountain Standards*. Washington D.C.: National Academy Press.

National Research Council (1989). Improving Risk Communication, Washington D.C.: National Academy Press.

National Research Council (1983). *Risk Assessment in the Federal Government: Management the Process*. Washington D.C.: National Academy Press.

National Academy of Science (2010), *Electricity from Renewable Resources: Status, Prospects, and Impediments*.

Walker, J. Samuel & Wellock, Thomas R. (2010), U.S. Nuclear Regulatory Commission, A Short History of Unclear Regulation 1946–2009.

Chapters in edited books:

Applegate, John S. (2006). The Government Role in Scientific Research: Who Should Bridge the Data Gap in Chemical Regulation. In: Wendy Wagner and Rena Steinzor (eds.), *Rescuing Science From Politics, Regulation and the Distortion of Scientific Research* (pp. 255–78). Cambridge: Cambridge University Press.

Doremus, Holly (2006). Using Science in a Political World: The Importance of Transparency in Nature Resource Regulation. In: Wendy Wagner and Rena Steinzor (eds.), *Rescuing Science From Politics, Regulation and the Distortion of Scientific Research* (pp. 143–64). Cambridge: Cambridge University Press.

Articles:

Applegate, John S. (1999). Learning From NEPA: Some Guidelines for Response Federal Risk Legislation, *Harvard Environmental Law Review*, 23:93.

Applegate, John S. (1992). Worst Thing First: Risk, Information, and Regulatory Structure in Toxic Substances Control. *Yale Journal On Regulation*, 9:277.

Dorfman, Daniel A. (2012). The Changing Perspectives of U.S. and Japanese Nuclear Energy Policies in the Aftermath of the Fukushima Daiichi Disaster, *Pace Environmental Law Review*, 30:255.

Foulke, Larry R. (2002), *A Perspective: Status and Future of Nuclear Power in the United States* (Remarks at Americas Nuclear Energy Symposium).

Joskow, Paul L. and Parsons, John E. (2012), *The Future of Nuclear Power After Fukushima*, MIT Center for Energy and Environmental Policy Research.

Miller, Andrew J. (1997). The Food Quality Protection Act of 1996: Science and Law at A Crossroads, *Duke Environmental Law and Policy Forum*, 7:393.

Newport, Frank (2011), *The Majority of Americans Say Nuclear Power Plants in the U.S. Are Safe*.

Riester, Jessica and Verclas, Kirsten (2012), *Nuclear Energy in the U.S. and Germany: Weighing the Risks*.

Online Sources:

President Barack Obama (2011), "State of the Union Address", http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address.

Business Ethic (2013), "Environmentalists Assess Barack Obama's Climate Change Initiative", http://business-ethics.com/2013/06/29/1146-environmentalists-assessbarack-obamas-climate-change-initiative.

Business Ethic (2011), "After Fukushima: Obama's Nuclear Policy", http://business-ethics.com/2011/06/17/2448-after-fukushima-obamas-nuclear-policy.

"Environmental Justice Case Study: The Yucca Mountain High-Level Nuclear Waste Repository and the Western Shoshone", http://www.umich.edu/~snre492/kendziuk.html.

Gallup Politics (2011), http://www.gallup.com/poll/146939/majority-americans-say-nuclear-power-plants-safe.asp.

National Research Council (2001), "Frequently Asked Questions About NRC's Response to the 9/11/01 Events", http://www.nrc.gov/security/faq-911.html.

New York Time (2011), "After Fukushima, Does Nuclear Power Have a Future?", http://www.nytimes.com/2011/10/11/business/energy-environment/after-fukushima-does-nuclear-power-have-a-future.html.

Nuclear Energy Institute (2011), "Latest Trends in U.S. Public Opinion about Nuclear Energy", http://www.nei.org/resourcesandstats/documentlibrary/reliableandaffordableenergy/reports/latest-trends-in-us-public-opinion-about-nuclear-energy-sept-2011.

Office of Civilian Radioactive Waste Management, U.S. DOE (2002), "Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada; DOE/EIS-0250", http://pbadupws.nrc.gov/docs/ML0817/ML081750212.pdf.

PR Newswire (2010), "Americans" Support for Nuclear Energy", http://www.prnewswire.com/news-releases/americans-support-for-nuclear-energy-holds-at-majority-level-6-months-after-japan-accident-130981293.html.

TVA's Browns Ferry Units, http://www.tva.com.