Risk Society, Nuclear Energy, and India’s Response to the Fukushima Meltdown

A thesis presented to
the faculty of
the College of Arts and Sciences of Ohio University

In partial fulfillment
of the requirement for the degree
Master of Arts

Nikhilendu Deb
August 2015

© 2015 Nikhilendu Deb. All Rights Reserved.
This thesis titled
Risk Society, Nuclear Energy, and India’s Response to the Fukushima Meltdown

by
NIKHILENDU DEB

has been approved for
the Department of Sociology and Anthropology
and the College of Arts and Sciences by

Jieli Li
Professor of Sociology

Robert Frank
Dean, College of Arts and Sciences
ABSTRACT

DEB, NIKHILENDU, M.A., August 2015, Sociology

Risk Society, Nuclear Energy, and India’s Response to the Fukushima Meltdown

Director of Thesis: Jieli Li

Though the Fukushima meltdown accident is said to have shattered the long-lasting consensus about nuclear energy, nuclear powers around the world have not responded to this catastrophe in amicable ways. This research investigates the Fukushima meltdown as a vanguard to understand what role, if any, this disaster plays in nuclear energy policy, and the Indian nuclear energy policy, specifically. This theory-driven research investigates the Indian Nuclear Authority’s response to the Fukushima meltdown by utilizing content analysis of newspaper articles from five major newspapers published in English in India. This research also analyzes a number of organizational documents that includes, not limited to, Department of Atomic Energy, International Atomic Energy Agency, World Nuclear Association, Nuclear Power Corporation of India Ltd, and Indian National Reports. This study finds that India as one of the seven major nuclear powers has hardly made any meaningful response to the Fukushima meltdown. A nuclear phase-out in India is not only a far cry away; Indian nuclear and political authorities have little to no concern about the risks associated with nuclear reactor fallout. The “worst” Fukushima meltdown appears to fail to give any significant lesson to this nuclear power.
Mukhor—my son, who, I think, will complete what I failed and will fail to accomplish.

Nirendu Deb—my late father, a hand-to-mouth high school teacher, who may have thought I would accomplish his unfinished dreams.
ACKNOWLEDGEMENT

Thesis Committee. I express my deep gratitude to the Director of this thesis Dr. Jieli Li, for his valuable help since developing ideas to successfully carrying out the whole research. My grateful thanks go to Dr. Lary Burmesiter for his scholarly contribution to many aspects, especially theory and method, of this research. It would not have been possible to carry out this work without receiving help and courage from Dr. Steven Scanlan. I would like to mention his particular help for the method section of this paper. Finally, my appreciation goes to all of them for their constructive and critical comments on the minutiae of the draft of the thesis.

Department of Sociology. I appreciate all the help and support that the Department of Sociology and the Graduate committee offered me throughout my graduate studies at Ohio University. The Teaching responsibility has been a rewarding experience that I would cherish for the rest of my life. Thanks to the Graduate Committee for awarded me The Shelly Fund. Thanks to Dr. Debra Henderson, the Director of the Graduate Studies, for mentoring and making the complete process of teaching amazing.

Family. Graduate life sometimes turns into tediousness. My wife, my friend Taposi turns to me for comfort and advice. My six months old son burst me into laughter; he is the priceless asset that I could ever produce!

Special Thanks. MV Ramana, the author of The Power of Promise and Professor at Program on Science and Global Security at Princeton University and his assistant Ashwin Kumar for their help on collecting organizational documents. I like to thank Robert H. Whealey, Professor Emeritus of History at Ohio University for his erudite
thought on nuclear energy. I appreciate the help form Md. Abdullah Al Mamun, my friend, esp. for his simplified illustration about the basics of nuclear reactors.

I like to thank a lot Marshelle Woodward for her indefatigable help in organizing and presenting ideas in a more communicative way. There are many other people in my world—the space is too short to name them all—with whom this thesis would not have finished. I thank for all the support I received all the way.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>3</td>
</tr>
<tr>
<td>Dedication</td>
<td>4</td>
</tr>
<tr>
<td>Acknowledgement</td>
<td>5</td>
</tr>
<tr>
<td>List of Tables</td>
<td>9</td>
</tr>
<tr>
<td>List of Figures</td>
<td>10</td>
</tr>
<tr>
<td>Chapter One: Introduction</td>
<td>11</td>
</tr>
<tr>
<td>Statement and Background of the Problem</td>
<td>11</td>
</tr>
<tr>
<td>Historical Account of Nuclear Energy in India</td>
<td>17</td>
</tr>
<tr>
<td>Nuclear Energy: Rhetoric and Discourse</td>
<td>22</td>
</tr>
<tr>
<td>Chapter Two: Literature and Theory</td>
<td>28</td>
</tr>
<tr>
<td>Review of Related Literature</td>
<td>28</td>
</tr>
<tr>
<td>Theory: Modernity’s Oxymoron</td>
<td>40</td>
</tr>
<tr>
<td>Chapter Three: Method and Materials</td>
<td>49</td>
</tr>
<tr>
<td>Theory-driven Research</td>
<td>49</td>
</tr>
<tr>
<td>Content Analysis of Newspaper Articles and Organizational Documents</td>
<td>49</td>
</tr>
<tr>
<td>Response Categories and Critical Discourse Analysis</td>
<td>52</td>
</tr>
<tr>
<td>Chapter Four: Discussion of Findings</td>
<td>55</td>
</tr>
<tr>
<td>Introduction</td>
<td>55</td>
</tr>
<tr>
<td>Indian Nuclear Authority’s Response to the Fukushima Meltdown</td>
<td>56</td>
</tr>
<tr>
<td>India Learned Nothing</td>
<td>64</td>
</tr>
<tr>
<td>Conclusion</td>
<td>67</td>
</tr>
</tbody>
</table>
References........................................................................................................70

Appendix A: Supplemental Tables........................................................................81

Appendix B: Nuclear Infrastructure in India..........................................................82
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Nuclear Power Reactors Operating in India</td>
<td>21</td>
</tr>
<tr>
<td>Table 2</td>
<td>Total Number of Articles and Articles Related to Indian Response</td>
<td>51</td>
</tr>
<tr>
<td>Table 3</td>
<td>Total Articles on Nuclear Authorities Response to Fukushima</td>
<td>81</td>
</tr>
<tr>
<td>Table 4</td>
<td>Nuclear Authorities Response to the Fukushima Meltdown</td>
<td>81</td>
</tr>
<tr>
<td>Figure 1: Theoretical Model</td>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER ONE: INTRODUCTION

Statement and Background of the Problem

Living with dangers and disasters is not new. Since the beginning of civilization, there have always been a variety of dangers and disasters in human society. But the number, the extent, and the nature of risk, particularly after the invention of nuclear weapons in 1945, are fundamentally different than previous times. With the advent of modernity, new dynamics of risks are taking effect every day. A profusion of uncertainties is widespread in the current world, where society has become, as Ulrich Beck points out, “a laboratory and there is absolutely nobody in charge” (1998:9). The notion of risk, or a sense of uncertainty, has become acute as a result of repeated nuclear meltdowns, especially after the one in March 2011 at Tokyo Electrical Power Company’s (TEPCO) Fukushima Daiichi Nuclear Power Plant (FDD-NPP). The Fukushima meltdown accident clearly revealed a fundamental truth about the ‘modern’ world in which we live today: it is a society of alarming and terrifying risks.

This thesis research uses the risk society (Beck, 1992; Giddens 1999) and normal accidents (1984) theoretical frameworks to explore and investigate the response of India, a major nuclear power, to the Fukushima crisis by performing a content analysis of five major newspapers as well as analyzing a number of organizational documents.

Risks in the double-edged modernity

In the past few decades, three major nuclear accidents—the Three Mile Island accident in 1979, the Chernobyl accident in 1986, and the 2011 Fukushima accident—captured the unprecedented pattern of risks in contemporary society. These risks allude to a “double-edged reality” in which the process of trying to control the future, and, thereby,
reduce uncertainty, produces the very risks or uncertainties that threaten the future of humankind. Or, as Giddens states, these risks are the results of “our attempts to control the future” (2003:26).

Social scientists usually differentiate between two types of risks: involuntary and voluntary. Involuntary risks take place without our prior knowledge about the subject whereas voluntary risks are associated with the activities of our own volition (Smith 2013). Most of the risky enterprises in the current world of “high-risk technologies” are examples of voluntary risks because these risks are the ‘manufactured’ consequences of complex industrial and modern systems in contemporary society. Risk, therefore, in the current world, must be understood as a practice of “manufacturing uncertainties,” which is different than external risk coming from outside or nature (Beck, 2014; Giddens, 2003; Smith 2013).

Additionally, most of these enterprises have high catastrophic potential, “the ability to take the lives of hundreds of people in one blow, and to shorten or cripple the lives of thousands or millions more” (Perrow 1984/1999:3). The nuclear meltdown in Fukushima epitomizes such catastrophe. Though a few experts claim to know and to control the future, these risks are unavoidable and incalculable. The incalculability is largely due to the “deteritorialization of risks,” because these risks can neither be confined to any specific nation and territory nor be limited to any specific period of time (Lash and Wynne, 1992; Urry 2004/2014). The risks therefore have lost their ultimate “point of reference”¹ that scholars used earlier to explain dangers in preceding times.

¹ The institutional aspects of risks are theorized by Ulrich Beck and Anthony Giddens in their analysis of the changing pattern of risks in the post-industrial, risk society.
(Adam and Loon, 2000; Beck 1998). In many cases, technology-driven hazards, such as nuclear meltdowns, not only remain inaccessible to the senses until the moment at which the accidents happen, but also cannot be “insured against” (Beck 1998).

In addition to the unprecedented features of risks in the current world, the peculiarity of these risks is encapsulated by the concept of “Normal Accidents.” Charles Perrow proposes that “given the system characteristics, multiple and unexpected interactions of failure are inevitable” (1984/1999:5). According to Perrow, despite strict regulations, these accidents recur because system characteristics of different enterprises are “interactively complex.” Effective regulations in some complex systems including nuclear power plants can decrease the risk of catastrophes, but these systems have the potential for tragedies; therefore, the “normal accident” simply cannot be avoided.

The Fukushima nuclear disaster precipitated the peculiarity of such types of risks. For instance, despite cooperative efforts by nuclear and political authorities in Japan, the massive tsunami that struck the Fukushima Nuclear Power Plant triggered the failure of safety systems which induced the meltdown of three of the six nuclear reactors. Normal accidents theory holds that no matter the integrity among warnings, controls, and regulations, there is still room for catastrophes to occur. Likewise, the consequences of radiation from the Fukushima nuclear meltdowns, like with Chernobyl, will continue to affect people of different territories and future generations. To be specific, the radioactive waste released from the Fukushima meltdown contains highly toxic rudiments which will

According to Beck and Giddens, the consequences of risks are now not confined to any specific time or place, risks are globalized; these risks are also results of our own action. There, methodological tools that scholars used in earlier times should be reframed considering the unprecedented nature of new risks.
cross national boundaries and inevitably pollute the environment and human food chains and also eventually may lead to many diseases including cancer, for generations to come.

*Response to Fukushima and the social shaping of technology*

Due to its catastrophic potential, nuclear energy has long occupied a precarious position in the energy landscape. When a tragedy like Fukushima or Chernobyl transpires, the fear and uncertainty over this energy source intensifies. The Fukushima meltdown has bred further resentment and fear against nuclear energy. It is not difficult to understand that after the Fukushima meltdown, the future of nuclear energy will not remain the same (Hindmarsh, 2014; Ramana 2013). A belief in the safety and cleanliness of nuclear power plants has collapsed “rapidly following the disaster” (Hara 2013:23): the people of Fukushima expressed their critical concerns about nuclear energy in a recent survey (Hara 2013). The same concerns were also revealed across the world. For instance, a research commissioned by BBC news conducted a poll in 23 countries which found that, between July and September 2011, a total of 70 percent of the public was not in favor of the construction of nuclear reactors (*Nuclear Engineering International*, 2011).

Yet, rhetoric and debate over the consequences of nuclear radiation have blurred the real facts and figure surroundings two devastating nuclear meltdowns, Chernobyl and Fukushima. Experts are divided and give contrasting opinions. Nuclear authorities have always categorically denied any devastating consequences of radioactive elements emitted from nuclear operations. Perrow points out that this nuclear denial produces “scientific ambiguity which, as a result, supports the governmental and commercial interests and allows nuclear power to continue expanding worldwide” (2013:57). The
Social Shaping of Technology (SST) perspectives divulge the rhetoric surrounding nuclear energy, demonstrating that the belief of safety in nuclear power plants, like any other high-risk technology, is shaped fundamentally by different actors such as governments, electrical power companies, media, and other involved actors (Hara 2013). In their ethnographic analysis of public perception about environmental suffering, Auyero and Swistun (2009) explained that powerful actors shape the ambiguity and the “Social Production of Uncertainty” surrounding pollution. Often times, nuclear authorities use “articulated discourse” (Allan and Welsh 2000) to displace the debate surrounding nuclear powers.

Despite the repeated association of nuclear energy with fallout risks, countries around the world responded to the Fukushima meltdown in a variety of ways. Although very few countries decided to turn off nuclear power plants, as Germany and Switzerland vowed immediately to abandon all their power plants, there are countries—including Japan—who reiterated their commitment to nuclear energy. India is one of these. India historically considers nuclear energy as a prerequisite for its continuing economic progress (Ramana 2012).

Though scholars, journalists, policymakers, and others have already produced a plethora of writings examining many facets of the post-meltdown situation (Juraku, 2013; Yablokov 2014), little research is presently being conducted underscoring the risk society framework with an analysis of the response to the nuclear catastrophe in general, and the Fukushima catastrophe in particular.

Based on the content analysis of newspaper articles and analysis of organizational documents, this research investigates if the Indian nuclear authority’s response to the
Fukushima meltdown has resulted in a critical assessment of the safety of Indian reactors. Or, has it resulted in authorities’ reiteration of India’s nuclear ambitions? Because, without any careful safety review, former Indian Prime Minister Monmohan Singh stressed that Indian reactors are safe (Ramana and Kumar 2014).

In the first chapter, this paper presents a set of overall statements of the problem that this research investigates and discusses. Additionally, as part of the background information, this opening chapter offers a historical account of Indian nuclear energy which provides the context of selecting India as a case for this research. The introductory chapter also offers a brief analysis on nuclear energy, in an attempt to separate fact from fiction in the rhetoric surrounding this energy source. The second chapter reviews and integrates related literature on the Fukushima meltdown and its consequences, nuclear energy, and the theories discussing ‘risk’ society, as well as the gaps that this research attempts to fill. In the second section of the chapter, this paper moves from reviewing existing scholarship to developing the theoretical framework on which this research draws its analysis of the contemporary world and the consequences of modernity, using the Fukushima nuclear meltdown as a case. This theory section coalesces theories proposed by different scholars (namely Ulrich Beck, Anthony Giddens, Charles Perrow, and Kai Erikson) into one single framework. The third chapter discusses the methods and the materials used in conducting this research. In the concluding chapter, this research moves to actual discussion and findings of this research that discusses and analyzes the authorities’ attitudes toward nuclear energy followed by India’s response to the Fukushima meltdown. This research concludes with a short summary of the research findings and an identification of research limitations and policy suggestions.
Research questions

The Fukushima nuclear meltdown has not only renewed worldwide debate about the immediate and long-term costs and benefits of nuclear energy, but has also brought a multitude of engineering, environmental, and social scientific research questions to the forefront. This research applies risk society as a framework, and it investigates whether countries with rapid development aspiration, such as India, have serious concerns about the risk of nuclear energy, especially in the wake of the Fukushima meltdown.

Particularly, this research considers the following set of questions:

1. What is the overall response of the Indian nuclear authorities to the Fukushima meltdown? In other words, in which of the different policy response categories—Exit or Loyalty—does India fall?

2. What lessons has India learned after Fukushima? Has nuclear safety become a cause for concern in the aftermath of the Fukushima Meltdown? And, what do the responses to Fukushima mean for the future of Indian nuclear energy?

Historical Account of Nuclear Energy in India

After Fukushima, a deep fear and grief among Indian people has created a strong opposition to nuclear energy, evident in the protest movements in different parts of India. However, India, as a country with a growing economy, has an ambitious plan of becoming a world leader in nuclear energy. Since this research investigates the response of India, as a major nuclear power, to the Fukushima catastrophe, this historical account of the Indian nuclear energy demonstrates the significance of selecting India as a case of this research.
India has a total of 21 nuclear reactors operating currently and it aims to supply at least 25% of its electricity from nuclear energy by 2050 (World Nuclear Association 2014/2015). India has high ambition to become a world nuclear power. This ambition goes back to the history of the beginning of the Indian nuclear mission. Homi Bhabha, India’s famous nuclear physicist, is known for one of the pioneers of India’s nuclear ambition. Among three physicists who went abroad for higher studies, Homi Bhabha is the only one who returned to India. He was granted his first fund in 1945 for nuclear research from the Tata Trust having envisioned a bright future of India through using the power of nuclear energy. M.V. Ramana stated that “the timing was propitious—a few months later, in August 1945, the whole world was to learn about the power of the atom from the wholesale destruction of Hiroshima and Nagasaki” (2012:5).

It is therefore not difficult to understand why Homi Bhabha received political attention and importance from Jawaharlal Nehru, India’s first Prime Minister and a firm believer in the power of science. Nehru realized the double-barreled benefits of the atom, as an energy generator and as a weapon. Another first generation, renowned Indian nuclear physicist, Meghnad Saha, became critical of the nuclear mission and vision held by the Indian government and scientific authorities. However, Saha failed to make his voice heard over Bhabha’s more ‘dominant’ approach.

---

2 Jawaharlal Nehru—first Indian Prime Minister—was popular for pacifist attitude and was a supporter of the UN. However, his anti-nuclear stand is not indubitable. Ramana in his book *The Power of Promise* claimed with evidence that Nehru was fascinated by the atomic power, both for its contribution to economic development and as a weapon device. Itty Abraham in his *The Making of the Indian Atomic Bom: Science, Secrecy and the Postcolonial State* focused on Nehru’s Dilemma over nuclear power.
Homi Bhabha proposed the clandestine operation of nuclear energy in India. Professor Ramana relates that Bhabha wrote a note to Nehru and recommended that “the development of atomic energy should be entrusted to a very small and high powered body composed of say, three people with executive power, and answerable directly to the Prime Minister without any intervening link” (2012:8). Nehru with his development visions relied largely on the power of the atom, and his nuclear vision followed Homi Bhabha’s insight, leaving their works shrouded in secrecy. Bhabha eventually became a Secretary to the Government of India. The secrecy and mystery surrounding nuclear activities were tightened when Parliament modified the Atomic Energy Act in 1962. Most of the issues related to nuclear energy in India are still classified.

Though India’s nuclear program has advanced largely without assistance from other countries (WNA, 2014), the AEC looked abroad for help in the earlier development of nuclear power plants in India. Bhabha, in 1948, visited Canada and managed obtain uranium oxide from Canada. France also offered help sharing technical information and in training of scientist. The international political climate played an important role in seeking help from abroad for the development of nuclear powers; therefore, for India to receive help from the US and its allies required tactfulness due to the tensions that stemmed out of the Cold War with Soviet Union. However, Bhabha successfully capitalized on this tension and succeeded in accomplishing the strategic benefits (Perkovich, 1999; Ramana 2012).

In 1974 India did its first nuclear test, named Smiling Buddha, in the State of Rajasthan. The Pak-Bangla post-war popularity might have encouraged the former Indian Prime Minister Indira Gandhi to authorize Bhabha Atomic Research Centre (BARC,
previously named Tata Institute of Fundamental Research) to develop and test the nuclear
device.

India’s role in the liberation war of Bangladesh\(^3\) might have stimulated it’s fascination with nuclear energy. In 1971, Bangladesh fought its liberation war against Pakistan, in which India offered military and diplomatic help. Pakistan, renowned for its brutal military force, despite the United States support, was defeated, giving India a military victory and a belief in its own expanding power. Importantly, both covert and overt regional tensions—mostly among India, Pakistan, and China—play an important role in the development of nuclear power in India.

Nuclear Power in India has developed primarily without technological help from other nuclear powers. India acquired “nuclear weapons capability” in 1974 and was excluded from the Nuclear Non-Proliferation Treaty. Indian nuclear ambition soon has made India one of the seven major nuclear powers in the world. In the year of the Fukushima meltdown, India started constructing Kudankulam Nuclear Power Project (KNNP). Now, India has three other projects under construction (NPCIL website). The following table lists the total number of reactors operating in India now.

3 The conflict between India and Pakistan goes back to the history of the birth of two different countries, India and Pakistan in 1947. In 1947, the British left India and divided it, based on the Hindu and Muslim religions, into two countries, India and Pakistan, respectively. Thus, India’s involvement with Bangladesh’s liberation was also a showdown of Indian power in the sub-continent. The victory of Bangladesh in that war was also a victory of India, politically and militarily.
The above discussion provides the background context for which India is selected as a case to investigate the response to the Fukushima meltdown. India’s nuclear-policy response to the Fukushima nuclear accident is important not only because India was the first country in Asia to start a nuclear program and India is now one of the seven most influential nuclear powers in the world, but because much of the global vision concerning energy sources and its safety management will essentially be determined by India’s next

---

22

steps toward nuclear energy. The following part brings forward the debate concerning the
risks and benefits of nuclear energy and how different actors play significant roles in
creating and nurturing the discourse and myth surrounding nuclear energy.

*Nuclear Energy: Rhetoric and Discourse*

Nuclear energy, though sometimes become uncontrollable, comes out of a very trifling source, the atom. The atom is the most elementary form of matter. The atom retains its identity as element in common physical and chemical interactions (Murray 2009). According to this point, any collection of atoms that form a new gas has a final weight which is the sum of an individual atom’s weight. Two constituents, neutrons and protons, are used to identify the nature of an atom.

The invention and the expansion of nuclear power worldwide are revolutionary. As a source of energy, nuclear power is said to have created a “nuclear renaissance,” a term propagated mainly by strong advocates of nuclear powers. However, after a number of nuclear meltdown accidents such as the Three Mile Island and Chernobyl, the overall growth of nuclear energy appeared to decline worldwide. However, after a concerted campaign by nuclear authorities since 2000, nuclear energy has received profound attention and is growing exponentially in some major countries worldwide (Lowe 2013). Again, the recent deadly nuclear fallout in Fukushima, Japan, has shattered the illusions concerning the “safe, cheap, and clean” image of nuclear energy. The nuclear disaster in Fukushima Japan has again revealed the grave danger of nuclear energy.

Despite this manifestation of dangers associated with nuclear energy, new reactors are still under construction and/or consideration in several countries including Canada, China, Finland, France, India, Japan, Taiwan, U.K., and the United States.
A recent report shows that nuclear energy supplies approximately 25 percent of the electricity consumed in OECD (Organization for Economic Cooperation and Development) countries and its share in the worldwide total electricity supply is nearly 16 percent (OECD 2007).

The important debate, primarily among nuclear experts, political authorities, and scholars from research and academic worlds, has often been clouded by myths that have grown on both sides of this issue. Perrow (2013) argues that the scientific community is divided over the consequences of low level of radiation. The debate also exists about the possibilities and the consequences of nuclear reactors meltdowns. This section is an attempt to separate fact from fiction in the rhetoric surrounding this ‘contestable’ energy source.

*What makes nuclear energy lucrative?*

The major difference between nuclear energy and other energy sources lies to the question of how does nuclear reactors work. The process by which nuclear reactor generates heat distinguishes nuclear energy from all other power-generation technologies (Tabak 2009:1). Heat required for producing energy is a decisive factor for all energy sources. In nuclear energy, this heat can be generated through one of two processes—fission and fusion. In most cases, nuclear energy is produced by fission—a process

---

5 It is not any aim of this research to discuss the complex, technical details of nuclear power plants. This short section is, in fact, an attempt to provide an overview of the operational side of nuclear reactor, which relates the subsequent discussion about the cheap and safety rhetoric of nuclear energy. Additionally, the Nuclear Energy: Rhetoric and Discourse helps to understand the Social Shaping of Technology (SST), because proponents of nuclear energy highlight more about the positive aspects of nuclear energy and use media and other actors to shape the public mind. The SST is theorized by Hara (2013) in his post-Fukushima article, and Irwin, Allan and Welsh (2000) in their risk society analysis.
causes an atom to split. A neutron is immersed into the nucleus of an atom, uranium-235, which in a chain reaction splits into faster and lighter elements and free neutrons. Mara argues that “What made this process even more productive is the phenomenon of the chain reaction—when an atom is split, it produces free neutrons that can split more atoms” (2011:11). However, this fission is the beginning of the complex process to producing electricity. Fission creates a tremendous amount of heat which takes place inside the reactor core. In order to convert water into stream, this heat is used to boil a gigantic amount of water. Accordingly, this stream-pressure moves through turbines and causes the turbines to spin which produces energy.

Therefore, the process of generating heat makes the basic difference among different energy sources. Other energy sources such as coal, oil, and natural gas depend on burning fossil fuels to generate this heat. In a nuclear reactor, splitting atoms—fission process—produces this heat.

Myth: Clean, cheap, and safe

Risks associated with nuclear energy are told to be “acceptable,” and this discourse has been created by articulated rhetoric propagated by nuclear energy authority (Allan and Welsh 2000). Allan and Welsh continues that nuclear authorities oftentimes use the notion of ‘environmental friendliness’ to displace the argument concerning cost and other energy sources. In the complex process of generating energy, nuclear reactor uses mined uranium, uranium 235, as its fuel to make electricity. On the one hand, only a modicum amount of uranium can produce as much energy as 1500 tons of coal (Mara 2011:12); on the other hand, during the fission process, this uranium produces a large amount of radioactive waste, half of which take 700 million years to become harmless
The Fukushima meltdown has released and continues releasing radioactive materials into air and water and that has affected not humans and a variety of organisms. (Lochbaum et al., 2014; Mousseau, 2014; Tanaka et al., 2012; Yoshimura and Yokoduka 2014).

It is true that nuclear reactors have high capacity to produce a vast amount of electricity and are more effective than other types of sources. Another benefit of using nuclear reactor as an energy source is that it releases little CO\textsubscript{2} into atmosphere, a major greenhouse gas responsible for global warming. Yet, even in normal operations, nuclear reactors release many toxic and radioactive materials into biosphere (Ramana 2012). In addition, emissions are also unavoidable in building the nuclear power plants (Giddens 2009). The vast and complex process involved with nuclear energy emits a considerable amount of greenhouse gases into atmosphere. The nuclear fuel cycle is an example in this regard. From mining uranium ore for fuel to enrich uranium to crush and mill the ore to create the concrete and steel for the reactor, and to transport and dispose the nuclear waste require the use of fossil fuels, i.e. coal or oil, which inevitably emit greenhouse gas (Caldicott 2006:6). These aspects of nuclear energy remain mostly underreported like the risks associated with this energy source.

The aforesaid complex process also indicates that nuclear energy is also expensive (Cooper, 2012; Kan, 2014; Hindmarsh, 2013; Ramana 2012). Uranium mining and milling are very complicated process, which requires high expenditure notwithstanding the fact that the energy expenditure is largely dependent on the grade of ore. There is only limited availability of uranium ore containing fair concentration of uranium 235. When this concentration drops to a certain level, the expenses of energy
generation from nuclear reactor shall no longer “cover the costs of extraction of uranium from the earth.” (Caldicott 2006:16). However, a comprehensive analysis of the energetic cost of nuclear power is not available to the mass people. Moreover, the damage that can be done when any nuclear accidents occur is unfathomable. It can cause fatalities instantly and for generations to come with incalculable impacts (Beck 1998, Giddens 1998/2003, Ramana 2013).

In order to forestall the dangers for next generations, it is imperative to understand the social and environmental consequences of nuclear energy (Lowe 2013). The high magnitude of radiation produced in a nuclear reactor has deleterious effects on environment and health. In the reactor core the original uranium fuel becomes terrifyingly radioactive. It is said that a thousand megawatt nuclear power plant can produce radiation more than 1000 Hiroshima-size bomb (Caldecott 2006). Hiroki Koide (2013) estimated that the Fukushima meltdown dispersed almost 500 times cesium-137 than the Hiroshima atomic bomb. In experts’ opinion, a nuclear reactor is thus an atomic bomb factory. Japan’s former prime minister Naoto Kan in a post-Fukushima conference said that “not having nuclear power plants is the safest energy policy” (2014:19).

The nuclear meltdown accident in Fukushima disproved the nuclear authority’s claim of so-called “safe and cheap” energy source. Charles Perrow said that “Fukushima

---

Caldicott cited Jan Willem’s book *Nuclear Power—the Energy Balance* to depict that the rich uranium ores required to achieve for a fairer level of carbon dioxide release is “so limited that if the entire world electricity demand were to be provided by nuclear power, these ores would be exhausted in nine years” (2006:6). Additionally, radioactive fuel rods that must be removed in each year generate radiation and they are thermally hot and should be stored for thirty or sixty years in an adequate building to be cooled. The construction of the containers required to store those rods likely to use as much energy as needed to build a nuclear reactor.
is an eerie replay of the denial and controversy that began with the atomic bombings of Hiroshima and Nagasaki” (2013:56), because respective authorities are likely to deny the catastrophic impact of nuclear disasters on human society. It appears to be evident that the nuclear energy technology was promoted “through the careful nurturing of myth: the myth of safety” (Lochbaum et al. 2014). The health effects of radiation from the Fukushima meltdown have already sparked debate among experts that underpins the Social Shaping of Technology (SST) perspective in framing the public mind. Unfortunately, the people who are most affected by meltdowns have little or no expertise to separate facts from fiction to understand the real consequences nuclear reactors meltdowns.
CHAPTER TWO: LITERATURE AND THEORY

Review of Related Literature

Over the last couple of decades, unprecedented forces are characterizing modernity that leaves far reaching consequences on the people’s lives. Anthony Giddens brings the contour line of these consequences to the forefront by stating that the current world is shifting our prevailing ways of life, and “The world in which we find ourselves today…doesn’t look or feel much like they predicted it would. Rather than being more and more under our control, it seems out of control—a runaway world” (2003:2). The Fukushima meltdown in Japan has succinctly manifested the nature of risks with which people live and risks associated with nuclear fallout.

This literature review section incorporates 1) the consequences of nuclear meltdown in Fukushima 2) sociological literature about the nature of the current world order, and 3) responses to the Fukushima meltdown, followed by the gaps that this research fills up through integrating risk society, nuclear energy and India’s response to the Fukushima meltdown.

The Fukushima meltdown: Consequences and concerns

In March 2011, Japan was struck with an earthquake registered at 9 on the Richter scale. Though Japan is located in one of the most earthquake-prone regions of the world and has a number of tremors each year, the country had never experienced tremor stronger than a magnitude of 7.9. This massive earthquake caused a tsunami that struck and destroyed the Fukushima Daiichi Nuclear Power Plant (FD-NPP). Twenty-four hours after the tsunami, an explosion occurred in Unit one reactor building has blasted off the roof, throwing rubble and debris in surrounding areas. Damage to the cooling system of
the power plant led to several explosions which resulted in the profuse release of nuclear contaminants (Caldicott, 2014; Hui et al., 2012; Star, 2014; Suzuki, 2011; Yoshimura and Yokoduka 2014).

Though incidents of meltdowns have been a perennial problem for decades, the Fukushima Daiichi meltdown is considered to be the worst nuclear disaster in history (Blowers, 2013; Lochbaum et al., 2014; Suzuki 2011). The International Nuclear Event Scale (INES) lists Fukushima at the scale of 7—only Chernobyl was labeled with this same magnitude. Scholars argue that it might even take more than decade to completely understand its true magnitude and consequence (Roberson 2013). It is also no secret that the Japanese authorities knew the risks of those nuclear stations and chose to do nothing about them. For example, “the 1990 study provided the first and most important indication of a high tsunami risk” (Noggerath et al. 2011:41). The Fukushima disaster divulged and challenged the safety assumptions held and propagated by nuclear experts, corporations, and governments of nuclear nations for decades.

The economic cost of the Fukushima meltdown is approximately between $71 billion and $250 billion (Lochbaum 2014). The large amounts of radiation released from the Fukushima meltdown could result in “thousands of cancer deaths and hundreds of billions of dollars in decontamination costs and economic damage” (Lochbaum et al. 2014:84). The toxic contamination will stay in vast areas of Japan for hundreds of thousands of years (Caldicott 2014). Therefore, the consequences of the Fukushima meltdown are confined not just to human health. Fukushima has also impacted a variety of organisms in nature.
The Fukushima meltdown emitted radioactive materials into the environment which infected many fishes in lakes and streams (Yoshimura and Yokoduka 2014). Tanaka et al. (2012) analyzed fresh and dead leaves around the contaminated area of FDNPP. They found that a large amount of radioactive radionuclides were emitted from Fukushima which polluted the environment. The Fukushima meltdown accident caused these two radionuclides to be deposited into the soil of the surrounding areas, and, these radionuclides have managed to stay in the soil. Furthermore, these radionuclides have also been absorbed into foliage that can lead to food contamination.

The Fukushima disaster affected the natural habitat and will do so for decades to come. Timothy Mousseau (2014) compares the effects from radiation in Chernobyl and Fukushima. The researcher discovered much genetic damage within the cells of these organisms that was proportional to the amount of radiation to which they were exposed. Mousseau states that many other organisms “showed increased rates of deformities, developmental abnormalities, eye cataracts, and even tumors and cancer” (2014:93). What was even more disturbing were the more chronic problems, including reduced fertility rates and significantly decreased life spans of the organisms (2014:93-94). Mousseau admits that some parts of the zone are actually clean in terms of radiation, but all in all, the number of original organisms and species in the area were significantly decreased (2014:96-97).

After Fukushima, mothers’ confidence in their ability to take care of their children diminished (Aya Goto 2014). Families were faced with different challenges and problems from losing jobs to having to move away from the radiation infected areas. Aya Goto (2014) collected data during routine checkups where the mothers were asked a series of
questions that pertained to the health and well-being of themselves and their children. The findings indicate that mothers were less confident after the disaster for many reasons, especially due to the released radiation, that, at the time, could have caused several problems from cancer to birth defects.

Disaster exposures are also vivid among nuclear power plant workers. Shigemura et al. (2014) compares peritraumatic distress and posttraumatic stress responses after the severe nuclear disaster at Fukushima. The participants conducted a self-report and 80 percent of 1,411 respondents completed the survey. The researchers created “pathway maps to test…conceptual model of how independent variables associate with PD and/or PTSR.” (2014:6). They compared the Daini and Daiichi workers and they found that Daiichi workers suffered higher disaster exposures than the Daini workers. Daiichi actually suffered tsunami attacks and a nuclear meltdown, which is why the results stated that they had high disaster exposures and that their mechanism path was complex. Infants and children are the worst suffer of nuclear radiation from Fukushima.

There is no threshold radiation in which there is no risk (Sakiyama, 2014; Starr 2014). Fukushima taught a lesson that “nuclear reactors are hazardous” and the popularity of nuclear energy has decreased everywhere (Ramana 2015). The widespread anti-nuclear sentiments came out of two important factors: 1) the possibility of the devastating and long-lasting consequences of the Fukushima meltdown and 2) despite recurrent happenings, nuclear authorities’ continual denial about the catastrophic potential of this energy source. Scholars argue that “social and political fallout following the March 2011 Fukushima-Daiichi nuclear disaster permanently altered the zeitgeist of
global public attitude towards nuclear power and towards energy technology in general” (Hassard et al. 2012:566).

Fukushima therefore renewed the concerns about the safety of nuclear reactors. These concerns are expressed because, “The atmospheric channel is so fast that nuclear material will be diluted and deposited over land and ocean within 3–4 months” (WANG 2012).

Sociological literature and ethical choices after Fukushima

Considering all of the social and environmental effects that a nuclear meltdown can create, researchers have highlighted the social justice and ethical choices arising from the risks associated with nuclear energy. Andrew Blowers (2013) argues that the Fukushima was a catastrophe, “not only for Japan but for the world” (2013:175). The Fukushima disaster event brought global awareness about nuclear issue across the world. In fact, nuclear meltdown is a disaster for reasons beyond human casualties, and there is no end to the trauma, which leaves a mark that may never be erased. Blowers believes that until the adverse events are totally ruled out, nuclear technology “must no longer be used.” Because nuclear poses direct threats to the environment and human health, it is imperative to decide on this social justice issue.

Keith Smith (2013) shows how natural systems are affected by human activities. The society of modern technology has brought a wide range of issues centering on environmental, health and personal risks (Adam et al. eds, 2000). Like Anthony Giddens (2003) and Ulrich Beck (1998), Smith (2013) stated that people are facing new and complex threats well beyond those posed by traditional natural hazards. For instance, technological hazards are man-made accidents triggered by human action rather than by
natural process. Large meltdowns cause many deaths, extreme societal disruption, and
long-lasting pollution. Smith also pointed out that, in many cases, hazardous industrial
sites have built in areas with lower income and minority population groups. Citing Beck
and Giddens, Smith (2013) exemplified that the Chernobyl and the Fukushima nuclear
accidents forced us to see the catastrophic consequences of technology.

It is therefore clear to understand why the issues raised by Ulrich Beck
reverberate widely throughout social theory. Beck’s social theory, which is critical of
modernist projects, consists primarily of two important concepts: reflexive modernization
and the issue of risk (Lash and Wynne1992/2012). Beck stated that “contemporary
society is a risk society precisely because political authority uses the scientific apparatus
to embark on risky policies” (Rossi 20114/2012) that created an unprecedented society
with unavoidable consequences which are beyond our ability to control. According to
Beck and Giddens, risk is distinct from catastrophe. Beck stated that risk is not
necessarily catastrophe; risk is the anticipation of catastrophe; therefore, risk is not real,
but a possibility of being, or what Beck called “becoming real”7 (2014:81). Similarly,
according to Giddens, the notion of risk is inseparably related to “probability and
uncertainty” (Giddens 2003:22). Whilst simple modernity is based on an evolutionism,

7Beck used three concepts that refer future insecurity: threats, risks, and
manufactured uncertainties. In earlier times, society had threats coming from outside and
are attributable to natural or supernatural phenomenon (such as natural disasters). Risk,
on the other hand, human-generated. Many risks against which we make our insurance
(such as car accidents) are the character of earlier modernity. On the contrary, a society
of manufactured risks is produced by human activities and has nothing to do with
insurance. Nuclear meltdown, a human-made disaster, is a burning example of such
manufactured risk. These risks are “collectively imposed thus individually unavoidable,”
and by dint of its very characters, they are different from “experienced risks and
institutionalized routines; they are incalculable, uncontrollable” (Beck 2014:82).
Beck focused more on the negative consequences of scientific and industrial development, especially risks that the late modernity has created. However, Beck is not pessimist—he thinks that modernization is now reflexive. Because of people are being individualized, they tend to free themselves from the constraints of the structure and actively engage in the process of modernization (Lash and Wynne, 1992/2012; Rossi 2014). Likewise, According to Giddens, the modernity of the current world refers to a new form of social arrangement of contemporary society which has supplanted its past.

What Anthony Giddens also shares with Ulrich Beck that the future of the world is in many ways now unknowable, and ‘uncertainty’ is a leading character of human existence now. Therefore, risk has taken a “new and peculiar importance” in modern society (Beck, 1998; Giddens, 2002). Both Giddens and theorized the idea of reflexivity, in which “society where the conditions in which we live are increasingly a product of our own actions and, conversely, our actions are increasingly oriented towards managing or challenging the risks and opportunities that we ourselves have created” (O’Brien 1998:16)

Additionally, these risks and uncertainties are delocalized (not confined to specific boundary) and incalculable (Beck, 1992/2012, 1998; Lash and Wynne, 2012/1992; Ury 2014). Thus, Beck argues that methodological nationalism\(^8\), which use

---

\(^8\) This concept is one of the main methodological concepts used by Beck in his Risk Society theory. Since uncertainty is a basic feature of the current society, older methodological tools are inappropriate to analyze the minute details of risk society. Beck argues that threats, risks, and manufactured uncertainties are the three concepts corresponding to three types of society. Threat, as future uncertainty, was the character of earlier times. Risk is a modern concept that presupposes human action and decision. This modern concept is also distinguishable from manufactured uncertainty, which is a feature of second modernity. The nation-state frame of reference is not adequate to analyze the
nation-state as a frame of reference, of early modernity is not any longer useful to analyze the world risk society (Ury, 2004/2014; Beck, 1998; Franklin 1998). Therefore, there is a fundamental shift from industrial to risk society, modernity to radical modernity. In this world risk society, the risk in which we are exposed to is a result of our own action. As Giddens pointed out, “Our very attempts to control the future tend to rebound upon us, forcing us to look for different ways of relating to uncertainty” (2003/1999:26). Giddens and Beck’s propositions about global risk society are palpable in the recent nuclear meltdowns in Fukushima.

Though more from organizational and system perspectives, these recurring accidents explained well by theory of normal accidents, proposed by Charles Perrow. Perrow argued that in the current world we produced “designs so complicated that we cannot anticipate all the possible interactions of the inevitable failures; we add safety devices that are deceived or avoided or defeated by hidden path of the systems” (1999/1984:11). He continued: these high-risk technologies, such as nuclear reactors are “so tightly coupled, control of operators must be centralized because there is little time to check everything out and be aware of what another part of the system is doing” (1999/1984:10). Perrow states that these systems have potential for catastrophes because these are interactively complex. He argues:

Despite the glaring failures of the nuclear power industry, it is clear that its design, construction, and operating problems do not, in themselves, constitute the cause of system accidents. It is instead the potential for unexpected interactions of small failures in that system that makes it prone to the system accident. (1999:61).

manufactured uncertainties. See Beck’s (2014) “Incalculable Futures: World Risk Society and Its Social and Political Implications” and “We Do Not Live in An Age of Cosmopolitanism and But in An Age of Cosmopolitalization: The ‘Global Other’ in Our Midst.”
Explaining the post-Fukushima situation, Charles Perrow emphasized on the recent Fukushima meltdown and argued that in the case of nuclear power plants and other potentially dangerous industrial systems, enforcement is lax and often too willing to ignore warning signs. In addition, Perrow made his argument clear that “the unanticipated interaction of multiple failures many create an accident that no designer could have anticipated and no operator can understand” (2011:50). Thus, the Fukushima disaster might be the most horrific, but it was not unique, rare occurrence of disaster. Perrow claims that regardless of dedicated efforts to regulating this industry, a lot of systems interact in such complex ways that no one could anticipate what would happen.

Similarly, Kai Erikson (1995) describes the nuclear disaster in Pennsylvania as a product of human hands and a factor of fear among the city’s population. At the Three Mile Island incident, unknown amounts of toxins escaped the power plant. First, Erikson discusses the advisory and evacuation plan of those within the ten-mile radius of the plant. Readers are told that there was a wide imbalance between the scale of advisory, and those who actually evacuated (Erikson 1995:140). This gap can be described as the “evacuation shadow theory,” the gap between what advice was called for, and what those who were at risk actually did. The bare cause of this disaster and reasoning of it, comes from the fact that is a technological disaster rather than a natural. He continues, there is no reported exact amount of toxins that was released into the air, so we tend to be more in fear of the years after the disaster. For example, Erikson uses the Chernobyl disaster because most of the effects on humans were not visible until years after the disaster occurred. People tend to be more in fear of radiation and nuclear toxin disasters because they tear away at human tissue inside the body whereas natural disasters are more violent.
to the outside of the body and last for one generation. Toxins can affect ones whole gene
line, no one knows how far the affected area is, because these toxins are invisible, we
cannot be sure to determine where the ending area of affect may be. Erikson refers to
natural disasters as similar to a plot in a story; there is a beginning, middle and an end
(1995:147). He then compares natural disasters to radioactive disasters as a never-ending
story because no one is sure when or where the toxins will end. Erikson also speaks of
the survivors of these disasters as having “lost a certain immunity or misfortune”

*Responding to nuclear catastrophe*

Scholars argue that the Fukushima meltdown has turned the long-standing
consensus of support for nuclear energy into shambles across the globe. For instance,
Germany’s pronouncement about nuclear phase-out is a major ‘game changer’ for world
nuclear energy. Like the Brokdorf protest in Germany, there have been many anti-nuclear
movements across the world. It seems evident that a belief in the “safety of nuclear power
plants has collapsed…following the disaster” (Hara 2013:23). In a recent survey, two-
thirds of Tokaimura residents expressed their critical concerns about nuclear power
(Lochbaum 2014). A number of survey polls conducted before and after Fukushima
found a huge difference: 74 percent of respondents showed their resentment and preferred
denuclearization after Fukushima; whereas, 60 percent preferred expansion of nuclear
energy before the disaster.

The Fukushima meltdown reignites the debate as to whether nuclear energy is not
only worth it, but if it is even morally right (Blowers 2013). Unfortunately, most of the
times it is not up to the citizens to decide what happens in their country, the nuclear and
political authorities get to decide what happens regardless of public opinion. For instance, it seems that most countries going down the continued loyalty route and it seems these countries do not care about the consequences of nuclear meltdowns. Including India, some of the countries just weeks after Fukushima were rushing to sign agreements with nuclear vendors or were looking to further construction (Ramana 2013). Despite all of these repeated warnings from scholars, such as in Fukushima case, the nuclear authorities could not imagine that “such a cascading failure of safety systems would really occur” (Lochbaum, 2014:13; Noggerath et al. 2011:41).

Even Japan has decided to resume nuclear plant operations after one and half year of the catastrophe. Japanese people are critical of the explosion of nuclear reactors and they demonstrated their resentments over the resumption of nuclear plant operations (Yamashita 2012:697). But, Japanese people are told that another accident could never happen. Rossnagel and Hentschel (2012) argue that Germany has made a long and difficult journey before reaching into firm decision about nuclear phase-out. The authors shows some surprising aspects where different responsible personnel, including Angela Markel, were oscillated regarding Germany’s nuclear phase-out decision which eventually made this journey more difficult. For instance, in 2009 an organizing body led by Chancellor Angela Markel “reversed the country’s previous phase-out decision and declared to continue extending nuclear power in Germany” (Rossnagel and Hentschel 2012:56). Despite this complicated journey, Fukushima meltdown made a major impetus behind Germany’s firmness about nuclear phase-out (Glaser, 2012; Rossnagel and Hentschel, 2012; Schreurs 2012).
The nuclear crisis in Japan precipitated the fear among Indian people and the anti-nuclear movements gained widespread attention in India (Choudhury 2012). However, the Indian nuclear authorities failed to learn the lessons from the Fukushima accidents, because after the meltdown accidents in Japan, “various high-level nuclear officials dismissed the possibility that anything like the Fukushima accidents could occur in India” (Ramana and Kumar 2013:23). Rather, the Indian nuclear and political authorities use nuclear rhetoric exaggerating the benefits of using nuclear energy. Allan and Welsh (2000) argued that nuclear authorities use “articulated discourse” to make the Social Shaping of Technology (Hara 2013) possible. Allan and Welsh continues:

A careful consideration of the competing discourse of nuclear risks being articulated across the public sphere can reveal how definitions of ‘environmental friendliness’, particularly when coupled with those of ‘cost effectiveness’, recurrently displace arguments for alternative, non-nuclear technologies as being both ‘impractical’ and ‘uneconomical’. (Allan and Welsh 2000: 80).

The above discussion shows that the current system characterizes a global pattern—with a set of social, economic, political and cultural conditions—that are increasingly predicated on the “pervasive logic of manufactured uncertainty” (Adam and Loon 2000). Nuclear power plants are the example of manufactured risk; the Fukushima meltdown has made it clear that despite high regulation, nuclear energy cannot be separated from risks.

Though scholars agree that it may take decades for the world to know the complete impact of the Fukushima meltdown, a good number of writings are already available in academia. The scholarships integrated in this review have shown that the radioactive materials that the Fukushima meltdown released, and continues releasing, have affected environment, humans, and other organisms. The total deaths in future from
cancer are still difficult to predict. Sociological, and other social and physical sciences, literature have long been warning the authority that the nature and the extent of disasters at the current world are unprecedented. The theory of risk society and the theory of normal accidents literature are integrated in this review to reveal clearly the catastrophic potential and devastating consequences of nuclear meltdowns.

This research attempts to fill the gap utilizing the theory of risk society and theory of normal accidents framework and investigating the consequences of nuclear meltdown with an analysis of the response of a major nuclear power to Fukushima. The nuclear meltdown in Fukushima is the case that underpins the significance to synthesize a few theories into one framework to investigate the Indian nuclear authority’s response to this meltdown.

Theory: Modernity’s Oxymoron

In order to theorize about Risk society, Nuclear Energy, and India’s response to the Fukushima meltdown, this research has drawn its analysis using a number of significant sociological frameworks provided by Ulrich Beck, Anthony Giddens, Charles Perrow, and others. All of these theorists present different but connected analysis about new risk situations with which we live our lives today. These scholars have all shed light on different “high-risk technologies.” These “high-risk technologies” such as nuclear reactors have brought us as a society in a state of “manufactured uncertainty.”

Risk society and globalization of risks: Ulrich Beck and Anthony Giddens

Ulrich Beck has proposed a new notion explaining the current pattern of social changes in his Risk Society. According to Beck, there is a major change from industrial to risk society, which is centered on the significance of odds and negative results. In Beck’s
words, “In advanced modernity the social production of wealth is systematically accompanied by the social production of risks” (1992:19). Risk society is neither confined to nor constituted by any single territory. Moreover, the risks are uncontrollable and no insurance can be made against these risks (Beck 1980/2014). For example, the consequences of nuclear meltdown extend beyond the border of any specific territory and are not limited to one or two generations, because “the unpredictable consequences of radiation stemming from nuclear energy will last into the unimaginable future” (Ury 2004:vi).

Furthermore, Beck (1992/1998) argues that these risks resulted mainly from the actions of people from different walks of life such as government officials, corporate officials, and experts in science and technology, who view society as a “laboratory.” Additionally, these risks are difficult to see and sense even though they are external to humans. For instance, even long after the Fukushima disaster, people will continue to be affected by the nuclear fallout such as children will born with various deformities. The changing nature of society is associated with the changing nature of science. Beck further argues that science, which people think has the ability to manage, does not have much authority because “sciences are operating in terms of probabilities, which do not exclude the worst case,” he concludes that nuclear reactors have to be constructed in order for experts to study the functioning and risks of nuclear reactors (1998:13)\(^9\). According to

---

\(^9\) However, the analyses of these crises are not new in social sciences. Jurgen Habermas has also cautioned about the illegitimacy of the current social order. In his chapter “Legitimation Problems in the Modern State” in a book Communication and the Evolution of Society (1979), Habermas argues that due to the potential of the communicative rationality of modern times, the representation of state loses its recognized worthiness, which eventually leads to the legitimation crises. Though Beck
Beck’s theory, it is not an industrial society, instead, it is a risk society in which we are living now. Obviously, no global state or international organizations are capable of controlling this global risk. In addition, risk is now also deterritorialized because it is not confined to any specific country or group of people. The catastrophic Fukushima meltdown in 2011 makes Beck’s theory of risk society more prominent and more popular because of the concrete manifestation of the risks associated with nuclear energy.

Since global transformations have brought enormous social changes, any sociological theory based on a singular evolutionary approach is bound to fail. These changes force us to develop new concepts and tools to replace, again, what Beck calls, “zombie concepts.” Put succinctly, these zombie concepts had been used by earlier sociologists to understand the nature of earlier modernity in the period of methodological nationalism. Contemporary society is a risk society, in which modernity is radicalized. Though Beck criticized modernity because of its dismal failures, he thinks that it is not necessarily a “postmodern” society (1998). Moreover, taken-for-granted notions are not useful to fathom the ontology of this new modern society. In this era of transnationalism, single nation-state has nothing to do with a new, radicalized version of modernity. The strong social structure of early modernity waned because of the widespread process of globalization. Beck (1992, 1998) presents a double-edge situation of the risk society where risks are caused by the very process of modernization which attempts to control and regulate them.

rejected the Habermas’s notion of modernization as Enlightenment project (Lash and Wynne 1992), alike Habermas, Beck argues that in modern industrial society, political and other institutional apparatuses have “followed irrational policies” (Rossi 2012/2014:59), which eventually have aggravated various crises.
In addition to Beck’s theory of risk society, this thesis also draws on Anthony Gidden’s notions of consequences of modernity and “manufactured risk.” Anthony Giddens (1998) states that the contemporary world lives after nature and after tradition. Giddens characterizes this transition as “manufactured uncertainty,” a term also shared by Ulrich Beck to represent the uncontrollability over technology-induced dangers and accidents. Giddens continues that this new epoch propelled us toward a society of manufactured risk for which history provides us with very little to no previous experience because we “don't really know what the risks are, let alone how to calculate them accurately in terms of probability tables” (1998:28). The author puts forward the idea that risk itself neither refers to danger nor hazard, nor is it more dangerous or hazardous than preceding types of “social order.” However, the notion of risk was absent in traditional culture. Life in these cultures were dangerous because dangers were accepted as given, and were taken for granted. Risk is a characteristic of modern society due to the fact that it developed from the peoples’ desire to control and “particularly with the idea of controlling the future” (Giddens 1998).

Giddens (1992) provides an intriguing illustration of institutional transformations and consequences associated with modernity. Modernity as Giddens asserts is a double-edged phenomenon because modernity has both shining and gloomy sides. Climate change is an example of gloomy side of modernity. Giddens states that “the dynamism of modernity derives from the separation of time and space and their recombination, the disembembedding of social systems, and the reflexive ordering and reordering of social relations” (1991:16), in which social contexts now free of specific places, local habits, and practices. Social relations are disembodied and are structured across indefinite spans
of time-space. Importantly, all disembedding mechanisms are contingent upon trust—trust in abstract system—which is a vital aspect of modernity.

According to Giddens, this trust presupposes awareness of the circumstances of risk and human-made globalization of risk even can threaten the survival of humanity. Radiation from nuclear accidents or radioactive waste released from nuclear reactors are such frightening that “no expert system can be wholly expert in terms of the consequences of the adoption of expert principles” (Giddens 1991:125). Moreover, the current climate change politics is completely about this type of risk (Giddens 2009). Beck, however, with much trepidation, is more critical of science than Giddens when it comes to have faith in science.

“Organized irresponsibility” is a representative term used by both Giddens and Beck to characterize the current risk society. In Giddens words, “The idea of risk has always been involved in modernity, but I want to argue that in the current period risk assumes a peculiar importance” (1999:25). Both Giddens and Beck argue that due to the advent of globalization, the traditional characteristics of first modernity are eroded, which is replaced by a new form of modernity, reflexive modernity. However, though Giddens agrees that science is losing its traditional role as an expert adviser (Franklin 1998), Giddens thinks that science has the ability to solve the crises associated with modernity.

Theory of Normal Accidents: Charles Perrow

Charles Perrow has discussed the catastrophic potential of the high-risk technologies. Perrow states that “Most of the risky enterprises have catastrophic potential, the ability to take the lives of hundreds of people in one blow, or to shorten or cripple the lives of thousands of millions more” (1999:3). Since contemporary society is a
society of high-risk technologies, the major argument Perrow makes is that no matter what safety measures are taken to prevent the disaster, accidents are inevitable. There are ingredients of accidents in the system, so accidents in each decade are unavoidable. His prediction is correct, which he discussed recently in his several other writings, including post-Fukushima articles. Due to the “interactive complexity” of the system, risk will never be eliminated. For instance, the probability of meltdown in a nuclear power plant is likely to occur repeatedly. Thus, the risks of a tightly coupled system such as a nuclear reactor will unavoidably produce accidents.

In Perrow’s words, the “normal accident is meant to signal that, given the system characteristics, multiple and unexpected interactions of failure are inevitable” (1999:5). Complexities in the system make these industries more catastrophic. These complexities are sometimes even “incomprehensible for some critical period of time.” According to him, modern society is composed of the technological equipment that are predisposed to “crash, burn, or explode.”

In a recent post-Fukushima article, Perrow (2011) reiterated his notion of “Normal Accidents” more clearly. He states that the Fukushima disaster reveals “Just how commonplace—prosaic…how risky the industrial and financial world really is” (2011:44). The normal accident theory states that though failures of nuclear enterprise have become apparent in accidental meltdowns, it is not the failure of design, construction, and operations in themselves that cause the system accidents; instead, it is the “potential for unexpected interactions of small failures in that system” (Perrow 1999) responsible for the dreadful accidents.
The tsunami-induced massive meltdown in the three reactors at the Fukushima Daichi nuclear power plant is an outcome of the bungled interactions within system inside each reactor. Even though Perrow, unlike Giddens and Beck, seems not concerned about the debate on whether we are heading toward a radical, reflexive, or post modernity, he argues similarly that in the industrial system, oftentimes, the failure of design or system is nothing surprising. However, the nuclear authority continues to deny the catastrophic potential of nuclear power plants. Thus, this research also utilizes the Social Shaping of Technology perspective which helps comprehending how a contestable belief in safety is being shaped by interactions among several actors. For example, in shaping the public mind, the most influential group is “the pronuclear power camp that includes…governments, electrical power companies, plants suppliers…mass media, manufacturers and service industries” (Hara 2013:34).

It is clear from the above analysis that in this society of “new species of trouble,” all these potentials for disasters with human-made systems are the product of human hands (Erikson 1994). All the unavoidable consequences in the current world are taken seriously in all of the above named theories which emphatically state that people have entered into a new form of social arrangement by which past is transformed into a radically different one. Our actions to both manufacturing and managing risks are working in tandem: the very advancements we made over the course of time for the betterment of life have produced multifarious uncertainties with which we live today.

All these notable theories underpin risks in the current social order and thus have provided the theoretical framework of this thesis research. Figure 1 in the next page shows the Theoretical Model of this thesis research. This figure depicts that the
Fukushima meltdown succinctly captured the telltale signs of formidable risks associated with nuclear reactors. This risk is “manufactured” risk fashioned by the very advancement of modern development, “especially by the progression of science and technology” (Giddens 1998:211). These theories show that people today live in a double-edged modernity, in which our actions are largely moving toward “managing or challenging the risk” that we ourselves have engendered. Figure 1 also shows that not all accidents are preventable—normal accidents exist, despite strict regulations—because they are “interactively complex,” which again, propels us in a society of New Species of Deep Trouble. In most cases, risk has been converted into an “inescapable part of our lives and everybody is facing unknown and barely calculable risks.” (Beck 1998:12).

The consequences of this accident are deterritorialized and last for many generations to come.

The Fukushima nuclear fallout has also indicated 1) the “interactive complexity” of such types of technology which lead to inevitable failures and accidents, and 2) how disastrous a system failure may become, because the radioactive materials that the Fukushima meltdown released into air and water are likely to affect many generations to come. Therefore, these theories substantiate the argument of this thesis because each theory, though different in analysis, has focused on many catastrophic consequences of the current system with which we live now.
Figure 1. Theoretical Model
CHAPTER THREE: METHOD AND MATERIALS

Theory-driven Research

When technology-induced, risk-producing episodes unfold, a variety of responses arise from different sectors such as citizens, corporations, media, NGOs, and governments. To investigate the responses made by the Indian nuclear authority to the Fukushima meltdown, this research is carried out under the theoretical framework of risk society and normal accidents. Therefore, this research is primarily theory-driven in which articles and documents have been analyzed using theories proposed and developed mainly by Ulrich Beck, Anthony Giddens, Charles Perrow, and a few other influential sociologists.

Content Analysis of Newspaper Articles and Organizational Documents

To investigate the major variable—the Indian nuclear authority’s response, this study utilized content analysis of print media i.e. major English-language newspapers published in India. The newspapers include The Times of India, Hindustan Times, The Hindu, Deccan Chronicle, Telegraph, and The New Indian Express in the period since the Fukushima meltdown, March 2011 to February 28, 2015. Newspapers were selected based on three factors: circulation copies per day (ranges from highest 2,000,000 to lowest 300,000), reach of the newspaper (national audience rather than regional, and newspapers that are followed by global readers), and newspapers that oriented toward policy-making agents (Ferre 2002). These newspapers are also commonly being used for content analysis (Haneefa and Nellikka 2010).

Since many of the issues related to nuclear energy are clandestine, newspaper documents are probably the most reliable source through which to investigate and
analyze the immediate and long-term response of the Indian nuclear authority to the Fukushima meltdown. Despite some notable ideological differences among these newspapers, this research found no general differences about publishing important national and international news. Moreover, the differences among those newspapers are not of any concern to this research since they all publish nationally important news. One of the important reasons to rely on five different newspapers is to overcome idiosyncrasies or biases, if any, which may exist within the selected publications. However, these newspapers are a sample of the diversified mass media in India; therefore, this might be a limitation of the research sample when this paper refers to India’s response to the Fukushima meltdown. Additionally, another rational behind analyzing newspaper articles fit with Social Shaping of Technology perspective’s argument, because the role of news media in forming public opinion is very important. To understand the policy response. History, and commitment of the Indian nuclear enterprise, this research used documents published from different relevant organizations which include Department of Atomic Energy in India, International Atomic Energy Agency, World Nuclear Association, Indian National Reports, Nuclear Power Corporations of India Ltd, and several books and journal articles. With the caveat concerning governmental secrecy under consideration, this research analyzes selective parts of those documents useful to comprehending the stance of the Indian nuclear authority with regard to the nuclear energy policy. Along with the websites of the selected newspaper, this research used LexisNexis for online search in order to access electronic journalistic documents. As India’s response to the Fukushima meltdown is the key objective, this research qualified the search using
key words such as Indian Nuclear Energy, Fukushima Meltdown, and India’s Response to the Fukushima Meltdown. To corroborate the search, this research used Factiva, another search tool that provides access to newspapers documents published worldwide. A combined search helped this research to calculate the total number of articles published during the stipulated timeframe. Table 2 summarizes newspapers articles used in this research.

Table 2. Total Number of Articles and Articles Related to Indian Response (March 11 2011 to February 28, 2015)

<table>
<thead>
<tr>
<th>Newspapers</th>
<th>Total Articles</th>
<th>Articles Related to Indian Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Times of India</td>
<td>160</td>
<td>28</td>
</tr>
<tr>
<td>The Hindu</td>
<td>111</td>
<td>47</td>
</tr>
<tr>
<td>The Indian Express</td>
<td>67</td>
<td>37</td>
</tr>
<tr>
<td>Deccan Chronicle</td>
<td>60</td>
<td>22</td>
</tr>
<tr>
<td>The Telegraph</td>
<td>145</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 2 shows the total number of articles published and the number of articles pertinent to the research questions of this paper. This research did not do any sampling on the pertinent articles that are randomly shown during the online search. However, there were a number of criteria used to screen the articles included in the list. Some articles
were rejected because of little relevance to this research. For instance, articles consisting of fewer than two paragraphs, letters, book reviews, and short news reports were excluded, whereas op-ed columns, news analysis were included. The details from the search results are tabulated in Appendix (see Table 3 and Table 4).

This research used a codebook and a data entry program for coding purposes. The research coded data about the general information of article such as publication date, type of article (e.g. news, op-ed columns) the author of the article, and the focus of the article. Each utterance was coded mentioning the speaker/organization who made it and ideas implicit or explicit in the article. Coding procedure had also been given several revisions because in a few cases some coding ideas have been developed during/after going through the whole article. For instance, the idea of bold loyalty to nuclear energy and outright rejection of any of the potentiality of catastrophe had not been in consideration until it was found in an utterance. Additionally, despite small differences, a few articles were placed into one category because of their similar directions (response categories are discussed in the following section). For example “currently we don’t have any plan for nuclear phase-out” is placed into “loyalty to nuclear energy” category.

Response Categories and Critical Discourse Analysis

This research analyzed the data about the response of India’s nuclear authority to the Fukushima meltdown by looking at units smaller than the entire article because an article shows the ideas, organizations, and speakers involved with the report. To be specific, this research looked at smaller units such as utterance, speaker, and the idea element in the articles (Ferre 2002). These elements are helpful to critically analyze the language that nuclear authority used in support of their position regarding nuclear energy.
In order to measure the Indian nuclear authorities’ response, this research used two broad categories: Exit and Loyalty, following Hirschman’s (1970) model Exit, Voice, and Loyalty. For the content analysis of newspaper articles, this research used two main categories, from Hirschman’s model, to understand the Indian nuclear authority’s response to the Fukushima meltdown: Exit and Loyalty. Exit refers to the determination and decision by the nuclear authority to not expand nuclear power, but instead withdraw gradually from this energy source in light of the risks manifested in the recent Fukushima meltdown. Loyalty refers to the continued, renewed commitment to pursue nuclear power as the best energy source, defying the concerns raised by experts and the public after the Fukushima accident. This Loyalty was split up into other subdivisions such as unswerving loyalty and divided loyalty. But, finally, in this paper, all these subdivisions were consolidated into the Loyalty category. Since these categories are not inclusive enough to measure the Indian nuclear authorities’ response, this research also focused on the safety concerns, if any, the Fukushima meltdown gave rise to about nuclear risks.

In analyzing the findings from the newspaper contents, a critical analysis is also organized around representative phrases that reflect the nuclear authorities’ rhetoric surrounding nuclear energy. To elaborate, though this research primarily focused on what authority said about policy change, or, in other words, what language the responsible

---

10 Albert O. Hirschman’s wrote a classic book by the same name. According to Hirschman, individuals dissatisfied with the organizations may follow these three ways to improve their conditions. This simple model can be applied to a wide spectrum of areas. This paper found the categories Exit and Loyalty partly useful because the determination and decision by the nuclear authority to not expand nuclear power can be categorized as Exit, whereas continued commitment to pursue nuclear power is categorized as Loyalty. Additionally, this paper uses another new category discussing safety concern in response to the Fukushima meltdown.
personnel used when they spoke about the prospect and predicament, after Fukushima, of nuclear energy in India, this research attempted to follow a critical method on how linguistic patterns are intertwined with societal power relations. This critical approach is primarily “an analytical framework for studying connections between language, power and, ideology” (Fairclough 1995/2013). This framework is known as Critical Discourse Analysis (CDA) in this research. In most cases, the ideals are implicit in speech or written text which tends to represent and practice discourse and strives to inculcate these ideas into the social mind, because nuclear authorities use language to frame public mind in favor of nuclear energy.

The Critical Discourse Analysis approach is used to analyze the discourse along with policy response to the Fukushima meltdown. Following the CDA approach, instead of just focusing on theoretical problems, this research starts from prevailing social problems, such as health and the environmental impact of nuclear meltdown, and thereby chooses the perspective of those who suffer most, “critically analy[zing] those in power, those who are responsible, and those who have the means and the opportunity to solve such problems” (Wodak & Meyer 2009). Therefore, this research critically analyzes discourse or, specifically, language as a tool used by nuclear authority personnel in India to address issues related to nuclear energy, considering language used in the statements, verbal and written, official and unofficial.
CHAPTER FOUR: DISCUSSION OF FINDINGS

Introduction

Four years have passed since the Fukushima nuclear disaster in Japan. Yet, the overall policy response from major nuclear powers to this ‘worst’ nuclear disaster is unclear. Though the Fukushima meltdown is said to have shattered the long-lasting attitude toward the safety and cleanliness of nuclear energy, major nuclear countries around the world have responded to this catastrophe in a variety of ways. India, since the inception of its nuclear journey, deemed nuclear energy as a conduit for its economic development.

This chapter argues that the Indian nuclear and political authorities have little to no concern about any possibilities of nuclear accidents in India. The content analysis of newspapers articles finds that a nuclear phase-out in India is not only a far cry away, but also that nuclear accidents are not even a cause for concern. Table 4(appendix) shows that 100% of the articles published discussing the Indian nuclear authority’s response to Fukushima show that India has no plan for nuclear exit. Also, in 95% of articles, nuclear authority personnel think that Indian reactors are safe.

Though there were important lessons to be learnt from Japan’s nuclear catastrophe and nuclear accidents in the other countries, India shows minimal concern about the risks linked with a nuclear reactor meltdown. Instead, in response to the Fukushima meltdown, the Indian nuclear authorities propagate the rhetoric and discourses of safety and cleanliness to make the public mind favorable toward nuclear energy. The findings from critical discourse analysis reveal how nuclear and political authorities and experts in India use language as a tool to shape public perceptions of
nuclear energy. Specifically, along with discussing the findings from newspaper articles and organizational reports, the following sections integrate the rhetoric and discourse presented in newspaper articles through which the Indian nuclear authorities seek to shape the public opinion.

*Indian Nuclear Authority’s Response to the Fukushima Meltdown*

Though anti-nuclear or pro-nuclear sentiment held in the public mind may well be explored and understood by asking people’s opinions, exploring the nuclear authority’s response is somewhat difficult, given the veil of secrecy and mere rhetoric associated with nuclear energy. Initially, this research uses two main categories to understand the Indian nuclear authority’s response to the Fukushima meltdown: Exit and Loyalty. Since these categories do not separate factors beyond the authority’s decision to exit or commitment to stay loyal to the nuclear energy, this research finds it significant to analyze, in a separate section, the safety concerns raised after the Fukushima meltdown. The following sections also arranged around representative phrases that reflect the nuclear authorities’ rhetoric surrounding nuclear energy. This critical approach helps to decipher the social and political dynamics and manufactured uncertainty (Beck 2014) of the current society in which people live today.

*Exit or loyalty?*

To further the country’s economic growth, the Indian nuclear and political authorities are determined to accelerate its nuclear mission. In the discussion of the development of nuclear energy in India in Chapter One, it is clearly revealed that India has higher ambitions to become a regional and global nuclear power. The former Prime Minister Monmohan Singh in his inaugural speech at the International Conference on
Peaceful Uses of Nuclear Energy stated that “If we can manage our program well, our three stage strategy could yield potentially 470,000 MW of power by the year 2050” (Press Information Bureau, Government of India 2009). This projected production is almost 100 times more than what India is currently generating, 4780 MW in its sixty years of nuclear operation.

“One in infinity”

All the statements from the Indian nuclear and political authorities in response to the Fukushima meltdown have reaffirmed that India is committed to continue with its ambitious target to generate power from nuclear energy. The former Indian President and scientist Kalam and Electrical Expert Singh in an article in The Hindu (2011) stated boldly that there is no alternative to nuclear energy for economic prosperity.

Table 4 shows that there have been a total of 97 articles published in the country’s five major newspapers, all of which represent India’s firm commitment to pursue nuclear power as a main energy source. Furthermore, like most other nuclear powers, India responded to Fukushima by rejecting any possibilities of similar occurrences to those in Chernobyl and Fukushima. For instance, content analysis of newspaper articles reveals that months after the Fukushima meltdown in Japan, the AEC’s former chairmen Srikumar Banerjee announced that the probability of a nuclear accident is “one in infinity” in India (The Hindu 2011). The former chairman was adamant in his speech. He continued that the Fukushima meltdown “was not a nuclear accident…the spread of radiation was not as high as it was projected” (The Hindu 2011). Even only one year past the Fukushima meltdown, the consequences of which have gripped scholars’ sincere attention, Banerjee denied the report and stated that the “fate of nuclear projects in the
country is hanging in balance as a result of the Fukushima incident” (*Times of India* 2012).

*“Essential option” and an unfair comparison*

In the year of the Fukushima meltdown 2011, following the reiteration of commitment to nuclear energy, the government has begun constructing its 25th nuclear power plant, Koodankulam Nuclear Power Plant (KKNPP), which was projected to produce electricity in 2015 (*The Hindu*, 2011; *The New Indian Express*, 2011; *Times of India* 2011). Safety concerns expressed by people and experts were rejected by the nuclear authority, and the Indian nuclear authority has failed to implement the recommendations for this new power plant (Ramana and Kumar 2013). Gopalakrishnan (2013), the former head of AERB, expressed his concerns about KKNPP’s failure to meet safety standards, including its installation of substandard parts and lack of quality control.

The former Prime Minister Monmohan Singh, using the rhetoric of climate change, recapitulated that nuclear energy is bound to remain one of the “essential options” (*The Hindu* 2011) for all of the countries around the world. The aforesaid statement reveals the firm commitment that the Indian nuclear authority holds despite the fact that India already had some wake-up calls. In 1993, there was an accident at the Narora Atomic Power Plant (NAPP), located closer to Delhi, India’s capital. A fire broke out in the reactor that almost resulted in meltdown. In 2011, Gopalakrishnan said in an interview with *National Public Radio* (NPR) that the actions taken by few engineers luckily saved the reactor from meltdown. He also added that the Fukushima meltdown gives the primary lesson to be learned about the dangers of nuclear energy.
Conversely, not everyone seems to have learned this message. Banerjee, the AEC chief, flippantly declared in interview with the Indian Express that “You should worry less for nuclear energy than walking on the streets or driving in Delhi.” (The Indian Express 2011). This culture of not learning from the “worst” disaster allows room for future catastrophes. Ethically speaking, the potential devastation wrought by nuclear meltdown should be cause for concern, even if the odds of disasters like Fukushima are, as the Indian nuclear authority thinks, very low. Additionally, the Indian nuclear authorities are not likely to understand the “the fundamental questions related to the impact of radiation on wildlife, and by extension, human beings” (Mousseau 2014:99).

The Indian nuclear authority is continuing with the nuclear ambitions that they promised almost six decades ago. India, therefore, by all means, falls into the loyalty category. The nuclear authorities of India don’t have any intention yet to reverse their attitude toward and policy on nuclear energy. Moreover, the Fukushima meltdown did not raise any considerable concerns to the Indian nuclear authority. The Indian nuclear authority also failed to realize that a nuclear meltdown is not comparable with frequent car accidents, because radioactive materials from nuclear meltdown affect the health and environment endures over many places, species, and years. Radiations from nuclear meltdown tear away at human tissue inside the body whereas natural or other external disasters are more violent to the outside of the body and last for only one generation (Erikson, 1994; Giddens 1998, 2003).

Safety concerns

The Fukushima meltdown stirred up angst and resentment among the Indian public which spiraled upward in anti-nuclear movements in the country. “Fukushima” has
turned into a “buzzword” for the anti-nuclear experts and activists (The Telegraph 2013). People from many walks of life protested the construction of the recent Kudankulam plant in India. In response to this public sentiment after Fukushima, the Indian government formed several review committees in order to review the safety of existing nuclear plants.

“Zero-risk” confidence

There have been a variety of both official and unofficial statements from administrative personnel regarding the safety of the power plants; some of them rejected any possibilities of nuclear accidents in India, epitomizing the safety myth of nuclear reactors that has been propagated worldwide for decades. However, before going on to discuss any specific findings from the review committees, it is important to explore and analyze what responses about nuclear safety were made by the Indian authority personnel after the Fukushima meltdown.

Table 4 summarizes the safety concerns raised among Indian nuclear authorities after the Fukushima meltdown. Out of a total of 62 articles, only in 3 articles contain statements from the Indian nuclear authority suggesting that nuclear energy is not completely safe. The content analysis categorized the safety concern into three ranked-order categories which include: Concern raised, little concern, and no concern. In spite of the ambiguities in responses, this research finds that of 107 articles, 87 articles demonstrate that the Fukushima catastrophe appears to raise “no concern” in the Indian nuclear authority. The telltale signs of authority’s “zero-risks” attitudes toward nuclear reactors are revealed in this content analysis.
The former AEC chief Banerjee in a response to the Fukushima disaster stated that reactors explosions in Japan “was not a nuclear accident” and there were no (“zero”) causalities due to this accident (The Hindu 2011). Likewise, S K Jain, the Chairman and Managing Director of the NPCIL (the organization responsible for ensuring the health and environmental safety of nuclear operation in India) stated:

There is no nuclear accident or incident in Japan's Fukushima plants. It is a well-planned emergency preparedness programme which the nuclear operators of the Tokyo Electric Power Company are carrying out to contain the residual heat after the plants had an automatic shutdown following a major earthquake. (The Times of India 2011).

These untenable statements from nuclear authorities reveal the paradoxical attitudes; if there is no nuclear accident in Fukushima and the causalities are zero, it is clearly understandable that India has nothing to worry about such types of reactors meltdown. However, Kumar Banerjee, speaking at an Indian national summit, confirmed to the Indian public that Indian nuclear reactors are designed with an in-built passive cooling system, as he stated “If something like Fukushima happens here, I don’t think we will face the same fate, because the government’s disaster management team can handle such situations” (The Hindustan Times 2011). Such attitudes also demonstrate nuclear authority’s effort to shape the public opinion toward nuclear safety.

“Nuclear denials”

The statements denying the possibilities of nuclear accidents, though in a different tone, came out of the former prime minister’s speech in the parliament immediately following the disaster. Following the disaster in Fukushima, India’s former Prime Minister Monmohan Singh asserted that the safety systems of Indian nuclear power plants will undergo a required safety review by the respective nuclear organization,
NPCIL. However, with a surprising tone—in the same statement—he added, without having done any safety review, that the Indian nuclear reactors are safe.

These “nuclear denials” are neither uncommon nor unprecedented surrounding the safety and cleanliness of nuclear energy. The Japanese authorities, prior to the Fukushima meltdown, assumed that the possibility of any high magnitude meltdown was very unlikely, and they refused to consider any situations that would falsify their assumptions (Lochbaum et al., 2014, Suzuki 2011). Importantly, in this age of double-edged modernity (Beck 1998, Giddens 2003), these nuclear denials comes from “not a tiny minority but rather are respected members of the scientific community who specialize in radiation effects” (Perrow 2013:57). For instance, the former Indian president, who is also an eminent nuclear scientist, used an oft-repeated nuclear doctrine to reiterate the safety and importance of India’s nuclear reactors:

…there was no direct loss of life due to the accident or during the operation in its aftermath to contain it…the way the accident was handled…showed how much progress we have achieved in nuclear emergency management over a period of two and half decades…with better emergency management learnt over the years, the maximum radiation was less than 0.4 per cent of that released during the Chernobyl disaster. So…one must also acknowledge the advancement of national and international capabilities to manage nuclear emergencies now. (Kalam and Singh 2011).

A number of Indian anti-nuclear activists and experts urge repeatedly to the authority that “the Government of India should have a re-look at its nuclear policy” (The Hindu 2015) considering Germany and Switzerland’s phase-out decision in a response to Fukushima. Yet, within the Indian nuclear authority, nuclear energy seems to have garnered popularity. Another former DAE and AEC chairman, Srinivasan, who was also the Founder chairman of NPCIL, wrote that “The world gets more energy out of each
pound of fuel, and will have far less, and far less dangerous, nuclear waste to deal with at
the end of the fuel cycle” (Deccan Chronicle 2013).

However, in March, 2011, the chairman of NPCIL formed four task forces\textsuperscript{11} to
review the consequences of nuclear accidents in a similar situation to Fukushima.

Similarly, a committee was formed by AERB and reviewed the safety of Nuclear Power
and came up with somewhat similar findings. This Interim Report concludes that similar
occurrence of earthquake and Tsunami flooding is not expected in India, and considering
a situation of complete loss of offsite and onsite power, the Indian NPPs have adequate
design provisions to cope up with such events, or to withstand site specific seismic
conditions. The report also states that the Indian Nuclear Power Plants are better placed
to handle off-normal situations in the plant compared to their counterparts in several
other countries. The Committee, however, recommends emergency water storage and
related facilities, allowing the fact that Fukushima meltdown caused by the lack of
cooling facilities.

AERB reports also raised some concerns about a few particular reactors (Ramana
and Kumar 2013) and proposed a number of recommendations. This research does not
have the scope to cover the technical sides of the current nuclear reactors in India.

However, concerned nuclear experts in India think that NPCIL didn’t follow all of the
recommendations proposed by AERB review committee in installing new nuclear plants,
KKNPP, which eventually led to a widespread anti-nuclear movement in India. The
Government responded to the movement by arresting thousands of activists (The Hindu,

\textsuperscript{11} This interim report titled “Safety Evaluation of Indian NPPs Post Fukushima Incident”
is available on NPCIL website. The final report was never published officially.
2012; *The Telegraph* 2012). The above findings and discussion about India’s safety and policy responses to the Fukushima meltdown appear to have shown its apathy toward nuclear tragedy.

**India Learned Nothing**

The above findings and discussion shows that the Indian nuclear and political authorities denied the possibility of accidents similar to Fukushima happening in India. In the process of denial, nuclear authorities argue that nuclear energy is the key to economic success in India. Nuclear experts and authorities also use the rhetoric of environmental benefits for promoting nuclear powers in the country. In many instances, it has been proven that the biased reviews and manipulated data have been made public in the hope of shaping the population’s belief (Bowlers 2013). The Indian nuclear authorities and its proponents use language that appears to demonstrate the beneficial sides of using nuclear power. The Indian nuclear authorities do it by rejecting the scholarship of social, economic, and environmental consequences of nuclear accidents. In other words, The Indian nuclear authorities use “articulated discourse” to displace the debate surrounding “cost effectiveness” and “safety and cleanliness” of nuclear energy.

The safety concerns that this chapter discusses have a number of common elements. The summary of the findings about the Indian nuclear authority’s response to the Fukushima meltdown include: India has ambitions of becoming a world nuclear power, and nuclear establishment in India sets goals for energy generation which has never been fulfilled. According to the Indian nuclear authority, the radiation that Fukushima released are less than expected, which contradicts the research findings about the consequences of nuclear meltdown in Fukushima. Though there are safety concerns
raised among the Indian public and among a number of nuclear scientists and nuclear experts in India, these concerns have not received enough attention from the Indian nuclear authorities. If, however, Fukushima has provided any safety concern among the Indian nuclear authorities, it appears vague.

In order to understand the risks and social and environmental implications of “high-risk” nuclear reactors, it is not required to understand the technical sides of this enterprise. From Perrow’s (1984/1999) theory, it can be stated that nuclear meltdowns like Fukushima reveal the interconnectedness of the system that sometimes become “uncontrollable,” which may or may not be caused by external factors. In addition, the risks and dangers of such meltdown are not confined to any specific territory, nor are these limited to any specific time (Beck, 1989, Giddens 1998). For instance, the radioactive materials released in the ocean and air from the Fukushima meltdown have affected humans health, environment, and many natural habitats—which, research predicts, may lead to a global contamination and will cause many cancer deaths for both current and future generations. More than four years after Fukushima, crises are still unfolding. 250,000 Japanese are still displaced and are still not certain if they would be able to go back to their own place (New York Times 2015, USA TODAY 2015).

Scholars from social science theorized that the reality of the nuclear reactors is that a trivial failure can interact and can turn the whole tightly secured system into a most catastrophic one. The Indian Nuclear authority’s claims denoting the “zero-risk” probability is a mere propaganda. Perrow stated that “the potential for unexpected interactions of small failure” made the system of nuclear reactors predisposed to meltdown accidents. At least a culture of learning from nuclear accidents—such as the
Fukushima meltdowns—shall make responsible nuclear authorities more circumspect prior to making statements ignoring all of the risks associated with nuclear fallout.
CONCLUSION

Several studies confirmed that the Fukushima meltdown which released a massive amount of radiation into the air and water appears to be the worst meltdown in the history of nuclear accidents (Juraku, 2013; Lochbaum et al. 2014; Roberson 2013). The Fukushima meltdown has raised serious concerns among the public and scholars from different disciplines, not only about the safety of operating nuclear power plants for energy, but also about the nature of the world in which we live now. According to sociological scholarship, the modern system manufactured many uncertainties (Beck 1998, Giddens 2002) and created a “new species of Deep trouble” (Erikson 1994) that characterizes human existence today. Therefore, it is indeed the reality of risk society in which “A system capable of going out of control over a span of two thousand miles may sound like science fiction” (Chiles 2001:8), yet it would be there in each decade (Perrow 1984/1999). Additionally, though there have been many anti-nuclear movements across world in response to the recent nuclear meltdown in Fukushima, the overall responses made by the Indian authority are not satisfactory.

After Fukushima, India’s former AEC chairman Banerjee, alluding to a comparatively safe energy source, stated that nuclear accidents do not occur as frequently as automobile accidents. Despite the literal truth of this observation, it is bitterly disappointing that this faculty comparison was made by the chairmen of the supreme nuclear organization in India. A nuclear meltdown has the potential to cause millions of deaths in a single blow, leaving many ‘incalculable’ radiation-related consequences for many places, for many generations. This statement unfortunately epitomizes the Indian nuclear authority’s response to the Fukushima meltdown.
According to the findings of this research, it appears that the Indian nuclear and political authorities seem to have no plan for nuclear phase-out, nor does India have any concern about the ‘catastrophic potential’ of nuclear reactors. Denying the risks associated with nuclear reactors, the Indian nuclear authorities reiterated their continuous loyalty to nuclear power, mostly because the Indian nuclear and political authorities firmly consider nuclear energy as the best energy option for furthering its economic growth. India’s absolute loyalty toward nuclear energy has also made the Indian nuclear authority consistently deny any potential accidents that may happen in the Indian nuclear reactors. Nuclear authority personnel in India invariably argue that the Indian nuclear reactors are completely safe. India appears to have failed to learn from the Fukushima accidents despite the fact that the safety of the future world is predicated upon what nuclear powers have learned from these recurrent meltdown accidents.

The Fukushima meltdown gives nuclear powers an opportunity to learn about the ‘catastrophic potential’ of this complex system. Along with the safety factors, the Fukushima disaster also exemplified the importance of looking for and shifting to other alternative, renewable energy sources. Nuclear authorities should take the concerns, that Fukushima gave rise among the public and scholars, into serious attention. The world cannot wait for another disaster.

Despite the difficulties of generalizing the overall response to the Fukushima meltdown, it is indeed true that the nuclear fallout in Japan has changed the public attitudes toward nuclear energy, leading to the development of many antinuclear movements around the world, including India. However, the policy response to Fukushima does not follow any general line— on the one hand, Germany’s decision
about nuclear phase-out is said to change the game of nuclear energy, on the other hand, many nuclear powers expressed their commitment to pursue policies that will expand nuclear power. India, as this research shows, belongs to the latter group.

The major policy implication of this research is for the developing countries and countries which are relying mostly on nuclear powers for its development. The Fukushima meltdown has provided the opportunity to learn about the risks associated with nuclear energy. Considering the long-term effects of nuclear meltdown, countries should be more concerned about the costs and benefits of nuclear energy. In addition, India’s learning from Fukushima about the nuclear risks provide the ground for further research, a cross-national comparison is important to understand the overall response to the Fukushima meltdown.

Despite fears and uncertainties prevalent among the Indian public, 1) nuclear authority in India is determined to pursue nuclear energy 2) Indian nuclear authority claims that there is no possibility for Fukushima to occur in India, and 3) in case of such occurrences, India is well-prepared to tackle any disaster of an equivalent magnitude. India nuclear authority’s such undivided belief about nuclear safety puts forward analyzes that the theories of normal accidents and risk Society argue. Based on the Indian nuclear authority’s statements presented in newspaper articles and organizational documents, this research finds that the Indian nuclear authorities use rhetoric and “articulated discourse” to shape the public opinion in favor of nuclear energy. It is merely shocking that the Indian nuclear authority learns nothing from the recent Fukushima meltdown. How many accidents are required in order for nuclear authorities to develop a culture of learning?
REFERENCES


Nuclear Development. 2007. “Risks and Benefits of Nuclear Energy.” NEA, OECD.


Tanaka, Kazuya, Hokuto Iwatani, Aya Sakaguchi, Yoshio Takahashi, and Yuichi Onda.
2013. "Local Distribution of Radioactivity in Tree Leaves Contaminated by
Fallout of the Radionuclides emitted from the Fukushima Daiichi Nuclear Power

November 10.
The Hindu. 2011. “All Safety Steps Taken in Our Nuclear Plants: AEC Chairman.”
November 16.

Thomas, Steve. 2012. “What will the Fukushima Disaster Change?” Energy policy
45:12-17.


Touraine, Alain et al.. 1983. Anti-nuclear Protest: The Opposition to Nuclear Energy in
France. Cambridge: Cambridge University Press.

Society.” New York: Springer.

USA TODAY. 2015. “250,000 Japanese Still Displaced 4 Years after Quake.” March 11,
2015.

"Numerical Study and Prediction of Nuclear Contaminant Transport from


## APPENDIX A: SUPPLEMENTAL TABLES

### Table 3. Total Articles on Nuclear Authorities Response to Fukushima

<table>
<thead>
<tr>
<th>All Sources (Via LexisNexis, Factiva)</th>
<th>No. of Results</th>
<th>Total articles in the selected newspaper</th>
<th>Articles related to Indian Nuclear Authority’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newpaper</td>
<td>683</td>
<td>543</td>
<td>Times of India</td>
</tr>
<tr>
<td>Web-based Publication</td>
<td>296</td>
<td>X</td>
<td>The Hindu</td>
</tr>
<tr>
<td>Newswire and Press-release</td>
<td>13</td>
<td>X</td>
<td>The Indian Express</td>
</tr>
<tr>
<td>News Transcript</td>
<td>24</td>
<td>X</td>
<td>Deccan Chronicle</td>
</tr>
<tr>
<td>News</td>
<td>4</td>
<td>X</td>
<td>The Telegraph</td>
</tr>
<tr>
<td>Magazines and Journals</td>
<td>2</td>
<td>X</td>
<td>Total= 168</td>
</tr>
<tr>
<td>Industry Trade Press</td>
<td>1</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4: Nuclear Authorities Response to the Fukushima Meltdown

<table>
<thead>
<tr>
<th>Exit</th>
<th>Loyalty</th>
<th>Possibility of Nuclear Accident</th>
<th>Completely Safe?</th>
<th>Safety concern raised after Fukushima?</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>97</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td>59</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
The parent nuclear organization in India is Atomic Energy Commission (AEC). The role of AEC is to create or formulate policies. This organization is directly responsible to the Prime Minister. The Department of Atomic energy (DAE) carries out the policy designed by AEC. However, DAE is not able to apply any policy, including the finance, until it receives clearance from AEC. The DAE runs approximately 15 subordinate organizations assisting primarily in research, development, and industrial sides. The Research and Develop(R & D) centers include the Bhabha Atomic Research Centre (BARC), the Indira Gandhi Center for Atomic Research (IGCFAR). In 2014, Global Centre for Nuclear Energy Partnership (GCNEP) was established. It is DAE’s sixth and the latest R&D organization.

NPCIL is responsible for designing and constructing the thermal nuclear reactors, UCIL performs mining and milling of uranium. Also, the Atomic Minerals Directorate for Exploration and Research (AMD) caries out uranium exploration, the Heavy Water Board (HBW) produces heavy water for plants and the Nuclear Fuel Complex (NFC) produces fuel i.e. refining and conversion of uranium, for nuclear reactors. BARC reprocesses used fuel. The Atomic Energy Regulatory Board (AERB) is responsible for ensuring the safety of using ionizing radiation and overseeing the risks to health and the environment. The AERB comes under the AEC, but independent of DAE. After Fukushima, a Council of Nuclear Safety (CNS), chaired by the Prime Minister, was established to oversee the radiation safety.