Introduction

India at present has 20 operational nuclear power reactors in six states; seven more plants are being constructed and around thirty six projects are kept under consideration.\(^1\) The nuclear deal with the USA in 2008 has also opened new avenues of cooperation and advancement in the field.\(^2\) India is on the verge to operate Kudankulam nuclear power plant but owing to the recent Fukushima disaster, two developed economies, Germany and Japan are all set to shut down their nuclear power plants by 2022 and 2040 respectively.\(^3\)

Nuclear Energy utilizes fuel made from mined and processed uranium in order to generate electricity through the process of fission and fusion.\(^4\) The two reactors of the Kudankulam Power Plant are being expected to generate around 1850 MW of power, with a life expectancy of 20 years.\(^5\) At one side where there is an exigent need for power generation to meet the demands of the growing population, the environment is again at risk. There are people favouring such projects and then, there are people opposing it totally. In the Kudankulam case, the opposers were mainly the farmers who stayed in the locality and were apprehending some natural disaster as a consequence of the plant.

The installation of the plant led to several continued disputes based upon the liability in cases of accidents, quality of equipment used, safety measures etc. These disputes were gradually settled in favour of the power plant and the Supreme Court gave a green signal for power generation to Kudankulam. The project is expected to benefit the nation in achieving its ‘electricity to all’ goal and most importantly in Tamil Nadu. Some of the major nuclear catastrophes which have taken place have been stated in this paper as well to highlight the damage causing capacity of a nuclear plant. The social impact which the Kudankulam Project has caused has also been discussed in this paper. The paper brings out the need for India to generate more power in order to meet its needs and also whether is ready for nuclear energy as a source of power generation. In this paper, the author has also stated the current state of nuclear energy and the position of nuclear power plants from an International perspective and as to how the other countries perceive the idea of nuclear power plant. In the end, the author has given as to what is the perspective of the author, and what is the viability and feasibility of the nuclear power plants on the national and at an international level as well.

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Kudankulam: History & Background

The Kudankulam nuclear project is a result of the MOU (Memorandum of Understanding) signed in 1988 between India and the Soviet, i.e., Russia. 7 After Rajiv Gandhi’s visit to Moscow in 1989,8 it was agreed between the two nations to set up a 2000 MW nuclear power plant in India.9 The breakup of Soviet which led to the fall in trade between the two nations,10 and the US influence on the Indian side reasoned to the holding of up the agreement.11 The deal was signed before the NSG guidelines that came up in 1992,12 thus the deal was not in conformity with the NSG.13 But, in 1996, there was a sudden swing in the foreign policy which paved the way for the construction of two nuclear reactors of 1000 MW each in Kudankulam,14 which is around 650 kilometers away from the city of Chennai.15 The first phase of construction led to the diversion of water from Pechiparai16 irrigation dam in Kanyakumari district calling for the first set of protests from the rural folks.17 Tuticorin port was again a site of dispute and protest beyond the Cold War, see Hagerty, “Are we present at the creation?” in Ganguly, Shoup and Scobell, eds., pp. 16-31; Varun Sahni, “Limited cooperation between limited allies: India’s Strategic Programs and the India-US strategic trade,” in Sumit Ganguly, Brian Shoup and Andrew Scobell, eds., US-Indian Strategic Cooperation: Into The 21st Century (London: Routledge, 2006): pp. 173-91.

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since, the transportation via this port resulted in huge damages to the raw materials.\textsuperscript{18} A small port was then constructed in Kudankulam only in January, 2004 for the transportation purpose.\textsuperscript{19} Four more PWRs were also prescribed to be added to the nuclear power plant as a result of an agreement signed in 2008 between Russia and India;\textsuperscript{20} our of which two have already been added and two are to be added in the second phase.\textsuperscript{21} On the visit of Russia’s Prime Minister, Vladimir Putin to India, a number of important agreements were signed including an Intergovernmental Agreement was signed on the cooperation between the two nations in the construction of nuclear power plants in India, in future; and also, for the expansion for the Kudankulam Project.\textsuperscript{22} An agreement in furthureance was also signed in 2010 to build 18 such more reactors in India.\textsuperscript{23} According to the latest updates, the nuclear plant will begin with the commercial operations in September, 2014 after receiving the green signal from India’s Atomic Energy Regulatory Board.\textsuperscript{24}

Previous Nuclear Catastrophes

The Chernobyl Nuclear Disaster

At 1.23 am,\textsuperscript{26} 26\textsuperscript{th} April, 1986\textsuperscript{27} witnessed the occurrence of the worst nuclear disaster which has taken place till now. The accident took place at the Chernobyl Nuclear Power Plant which is situated in Ukraine.\textsuperscript{28} The main reason behind the disaster was that a test was scheduled at the Chernobyl Nuclear Power Plant to test a method of keeping the reactors properly cooled in the event of a power grid failure. Initially there were problems, the intensity of the problems was miscalculated and the test went on in spite of the malfunctions.\textsuperscript{29} Reactor of the fourth unit of the Chernobyl Plant got destroyed, and it started to

\textsuperscript{18} Staff, PF, Renewed agitation at Kudankulam; activists lay siege to Tuticorin Port, Sep 22, 2012 11:08 IST, First Post, Available at http://www.firstpost.com/india/renewed-agitation-at-kudankulam-activists-lay-siege-to-tuticorin-port-464516.html, as Accessed on 16\textsuperscript{th} September, 2014.


\textsuperscript{21} Russia, India discuss agreement on second phase of Kudankulam NPP, Russia, February 26, 22:35, ITAR-TASS News Agency, Available at http://en.itar-tass.com/russia/721096, as Accessed on 16\textsuperscript{th} September, 2014.

\textsuperscript{22} Kudankulam NPP 3, 4 (India), ROSATOM STATE CORPORATION COMPANY, Available at http://www.atomstroyexport.ru/wps/wcm/connect/ase/eng/about/NPP+Projects/Perspective/Kudankulam, as Accessed on 16\textsuperscript{th} September, 2014.

\textsuperscript{23} Nuclear industry developments in India beyond the trade restrictions, Nuclear Power in India, July 2014, World Nuclear Association, Available at http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/India/, as Accessed on 16\textsuperscript{th} September, 2014.

\textsuperscript{24} Investment, OVERVIEW OF INDIA-RUSSIA ECONOMIC COOPERATION, Embassy of India, Moscow, Russia, Available at http://indianembassy.ru/index.php?option=com_content&view=article&id=705&Itemid=705&lang=en, as Accessed on 16\textsuperscript{th} September, 2014.

\textsuperscript{25} Korablinov, Alexander, RIRAugust 28, 2014, Kudankulam-1 to start commercial operations in September, Russia & India Report, Available at http://in.rbth.com/economics/2014/08/28/kudankulam-1_to_start_commercial_operations_in_september_37919.html, as Accessed on 17\textsuperscript{th} September, 2014.

\textsuperscript{26} Rosenberg Jennifer, Chernobyl nuclear Disaster, Available at http://history1900s.about.com/od/horribledisasters/p/Chernobyl.htm as Accessed on 17\textsuperscript{th} September, 2014.


\textsuperscript{28} Lallanilla Marc, Chernobyl: Facts about the Nuclear Disaster, Available at http://www.livescience.com/39961-chernobyl.html as Accessed on 17\textsuperscript{th} September, 2014.

\textsuperscript{29} Introduction, Case Study :Chernobyl, UCDAVIS Chemwiki Available at http://chemwiki.ucdavis.edu/Physical_Chemistry/Nuclear_Chemistry/Case_Studies/Chernobyl as Accessed on 17\textsuperscript{th} September, 2014.
release high amount of radioactive species in the atmosphere\textsuperscript{30} It had been speculated that the amount of radioactive material which had been released was 200 times\textsuperscript{31} more than that what was released at the Hiroshima and Nagasaki bombings in 1945\textsuperscript{32}. The nearest town of Pripyat had to undergo an immediate evacuation, and till date, more than 3,50,000 people have been relocated\textsuperscript{33}. By 14 May, some 116,000\textsuperscript{34} people that had been living within a 30-kilometre radius had been evacuated and were relocated later on.

Not only the people, but even the land which came within the ambit of the radiation leak were also affected and got contaminated. Almost all parts of Europe were affected by the radiation. The repercussion caused problems such as Down's syndrome, chromosomal aberrations, mutations, and also could result in birth defects in the long run\textsuperscript{35}. Over 1,25,000 square miles\textsuperscript{36} of land was contaminated. Agricultural land was also damaged making it non fertile. Twenty-eight emergency workers died from acute radiation syndrome, 15 from thyroid cancer, and it is estimated that the total number of deaths from cancers caused by Chernobyl may reach 4,000 among the 6,00,000 people having received the greatest exposures\textsuperscript{37}.

Thyroid diseases, Immune system disorders have greatly affected the children. There is also a possibility that these diseases are hereditary in nature\textsuperscript{38}. However after more than 28 years of the tragedy, it can be said this nuclear disaster also led to the devising of improvements in the field of nuclear safety\textsuperscript{39}. The International Atomic Energy Agency (IAEA) safety review projects for each particular type of Soviet reactor are noteworthy and have also incorporated Western engineers to enhance the safety measures\textsuperscript{40}. Soon after various immediate plans to restore the social condition, steps were taken, and the main priority was agriculture and improving the forest conditions, and also inducting qualified people and rehabilitating them. Initial infrastructure requirements included the containment of gas, availability of potable water and power supply. 21,484 dwellings\textsuperscript{41} are slated for connection to gas networks during 2011-2015. Over 1300 kilometers of road will be laid, new sewerage works will be established including 15 pumping stations\textsuperscript{42}.


\textsuperscript{32} BBC, WW2 People's War, Available at http://www.bbc.co.uk/history/ww2peopleswar/timeline/factfiles/nonflash/a6652262.shtml as Accessed on 17th September, 2014.


\textsuperscript{36} Barbalace C. Roberta, Chernobyl Disaster's Agricultural and Environmental Impact, Available at http://environmentalchemistry.com/yogi/hazmat/articles/chernobyl2.html as Accessed on 18th September, 2014.


\textsuperscript{40} Infra.9.


The Fukushima Daiichi Plant Disaster

On the 11th March, 2011 at 2:46 p.m. (+3.30 IST), the Tohoku earthquake began. At 2:47 p.m., the first of the reactors at Fukushima Daiichi Unit began to power down automatically, after sensors registered the earthquake. Due to the earthquake, access to the ultimate heat sink for cooling failed which caused significant damage to nuclear core. The release of radioactive material was too high, and the Government had ordered an immediate evacuation in a 30 kilometer radius. By 31 December 2011, TEPCO had examined the radiation exposure of 19,594 people who had been employed on the site since 11 March. The officials stated that 159,128 people had been evacuated immediately and had to lose their homes and virtually their entire possessions. Disposal of the contaminated water which was present in the reactor and turbine buildings had become the major contention, along with contaminated water in trenches which held the cabling and pipe work. This was primarily from the leakage from reactors. Run-off from the site into the sea contained radio nuclides which were in excess of allowable levels. As of late August 2014, JPY 4.224 trillion has already been paid in compensation for damages which had resulted because of the accident and all the individuals who suffered from the accident were to be paid 12000 US $ as compensation.

National Scenario

POWER NEEDS OF INDIA : “Powering India: The Road to 2017”, a report by The McKinsey & Company's Electric Power and Natural Gas Practice study released in 2008 depicts the growing needs for power in India. The six month long study suggests that the power demand in India is expected to cross 300 GW in the next ten year span. To satisfy the same, India is likely to require generation capacity of 415 to 440 GW. The electric power consumption last measured in 2011 depicts it to be 684.11 kWh per capita. The Wall Street Journal in 2012 reported it to be 778.71 kilowatt hours per year.

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46 Tokyo Electric Power Company


52 Electric power consumption (kWh per capita) in India, Trading Economics, Available at http://www.tradingeconomics.com/india/electric-power-consumption-kwh-per-capita-wb-data.html, as Accessed on 19th September, 2014.

The mark set by the National Electricity Policy for 2012 to achieve electrical power for all can be estimated to have missed the mark by almost 60\%.\(^\text{54}\) At present, around 70 percent of Indian power needs are taken care by coal based thermal power plants.\(^\text{55}\) In this light, renewable source of energy like solar energy, wind energy etc. are being introduced to meet up the demands of the population and, also to maintain the environmental balance. Nuclear energy is another taster, though not so environment friendly. A fact in favour of the Kudankulam projects as the savior for all the energy deficiency problems in India, but another argument states that if that the diversion of only two percent of the present generation will be sufficient enough to enlighten the electrified households of India by providing them with sustenance consumption of 30 units per month.\(^\text{56}\)

SAFETY: Local People have endlessly opposed the Kudankulam nuclear power plant placing their safety concerns on the first priority. The Fukushima disaster forms the precedent for the same.\(^\text{57}\) Some oppose had alleged that the plant has neither been granted clearance under the Environment Protection Act, nor has the Environment Impact Assessment been made.\(^\text{58}\) In reply to this, the Atomic Commission formed an expert committee which in its report settled that the Nuclear power plant met all the safety requirements of the time.\(^\text{59}\) In furtherance of this, scientists from scientists from IISc at Bangalore, IIT at Madras and Bombay, IIA, IISER, IACS, NIAS IUCAA etc. had sent a letter to then Prime Minister, Manmohan Singh expressing their concern for the substandard components used in the Kudankulam project. In response to this, a Supreme Court bench comprising Justice Dipak Misra and Justice K S Radhakrishnan specified that there are no such concerns.\(^\text{60}\) The Nuclear Power Corporation of India (NPC) in its report has also mentioned that the Kudankulam Nuclear Power plant has effective supplies to resist cyclones, earthquakes, tsunami, shockwaves, tidal waves etc.\(^\text{61}\)

The fishermen around the coastal area of the plant also criticized it as they feared the mass evacuation around the region. The evacuation is estimated to be around for one lakh citizens within a radius of 30 km. It is also alleged that once the nuclear reactors begins to function, it will release a lot of hot water which consecutively will affect their livelihood in an adverse manner. The marine life would get destroyed.\(^\text{62}\)

\(^{54}\) Ibid.


The Fukushima disaster which is referred time to time in opposition of the project was a result of an earthquake whose intensity was a thousand times more severe than that of the earthquake that occurred in Sikkim, the one regarded as the most precarious in the history of India.53 And, above all, Kudankulam stands far away from such apprehensions. The project is developed to benefit the state of Tamil Nadu. The nuclear power plants at Tarapur and Kaiga sell energy at Re1/kWh and Rs3/kWh respectively. The power generation of around 1000 MW from Kudankulam would be supplied to Tamil Nadu costing less than Rs3/kWh.64 This evidently would solve the power hitches in Tamil Nadu and help develop new industries there.

**Nuclear Energy: International Perspective**

Over the past decades, there have been major nuclear catastrophes which have taken place65 and have caused a lot of damage to the environment and the human population. These nuclear disasters have drastically changed the perspective regarding the nuclear power plants in countries around the Globe. In Italy, the Caorso plant has been permanently shut down66 and its services have discontinued permanently. Also the construction of the Montalo di Castro plants has been stopped67. Nuclear power plant projects have been mothballed in countries such as Finland and Netherlands68. Soon after the Fukushima Daiichi disaster, Germany also soon announced that they shall shut down their entire currently working nuclear power plants by the year 202269. Apart from the closure of various nuclear plants, the improvement in safety standards of the existing nuclear power plants has also been stressed upon. 143 nuclear plants70 in the European Union’s 27 member states have decided to take part in the extensive and transparent nuclear risk and safety assessments which have been termed as “stress tests”. Following the Fukushima nuclear disaster, all nuclear plants have been asked to adhere to the guidelines for Severe Accident Management or Mitigation71. In mid-2011 the IAEA Incident and Emergency Centre brought forward a new secure web-based communications platform which would ensure the exchange and compilation of information during any nuclear emergency72. These conventions not only help in formulation of safety standards, but also place the member nations under an obligation to put forward their initiatives towards the management of their respective nuclear plants. There have been various arguments regarding the maintenance of nuclear plants rather than their shutdown, however, the major

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63Srinivasan, MS, Why Kudankulam plant is safe, and good for us, Friday, 7 October 2011 - 9:00am IST, DNA, Available at http://www.dnaindia.com/analysis/comment-why-kudankulam-plant-is-safe-and-good-for-us-1595817, as Accessed on 22nd September, 2014.

64Srinivasan, MS, Why Kudankulam plant is safe, and good for us, Friday, 7 October 2011 - 9:00am IST, DNA, Available at http://www.dnaindia.com/analysis/comment-why-kudankulam-plant-is-safe-and-good-for-us-1595817, as Accessed on 22nd September, 2014.


problem is that most of the plants are more than 40 years old, and upgrading them to the currently available safety standards cannot be done. It has also been feared by many countries that nuclear power plants can be targeted by terrorists in order to cause harm to a country, by damaging the plant and releasing radioactive waste in the atmosphere.

Nuclear power plant disasters although have caused catastrophic damages, but they are important for maintaining the energy balance in the world. Nuclear power plants help in the generation of electricity without releasing any greenhouse gases and even help in reducing the level of carbon dioxide. The World Nuclear Association has stated that Nuclear Energy is one the best alternatives towards producing clean energy, and to concede to the happening of a nuclear disaster is a necessary evil. It is obvious that nuclear energy is a very good source for generation of electricity, but the risks which it carries is far too great, and it becomes imperative that the countries which are hinting at establishment of nuclear power plants be capable of maintaining the safety standards of the power plants. In lieu of cry for better safety standards, the developing countries are upgrading their nuclear power plants and channelizing funds to improve the infrastructure as well. At an International level, the risks associated with a nuclear power plant have been realized, and accordingly counter safety standards are being evolved and implemented.

Conclusion

Nuclear plants in India bear a history of opposition. Jaitapur was opposed in Ratnagiri, Kudankulam was opposed in Tamil Nadu and the proposal for a plant in Purba Medinipur was rejected in West Bengal. The opposition is generally formed of the farmers or, the people who are compelled to bestow their lands along with the environmentalists. The proposition usually comprises of business houses that can make profit out of that project. The policy behind the Kudankulam nuclear power plant seems to run on two suppositions, first the power needs of India and secondly, the global competition; and Kudankulam is the most effective answer for the same. It is not the first time that a Nuclear power plant has been built in the country or, in the world. Accidents have occurred; but such plants have become safer with time. The countries who have announced a shutdown for their reactors are Japan, Germany and France. Now these countries as compared to India are much more technologically developed and relatively smaller in area. Hence, shutting down nuclear power plants or, relying less on them won’t harm them much. Moreover, the expectations for prospective accidents are only based upon unsubstantiated anticipations.

The Indian scenario is quite different. India is a developing country. Most of the Indian population resides in rural and suburban areas; and these areas face power crisis interminably. They urgently required infrastructural development and this cannot be condemned by any argument. Even the metro cities face power cuts time to time. Not just this, the nation is catering industries too; big and small, new and old. They invariably require electricity for growth, development and sustainability. This makes nuclear power plants in the country a necessity. Thus, to make India self-sufficient in power generation, it has to rely on...
nuclear power plants instead of adopting the idea of shutting them. The World Nuclear Association in its report has already stated that India needs nuclear power plants to meet at least one fourth of its power needs.

Tamil Nadu as a state undoubtedly holds the capability to nurse various industries and till date, the same has not been achieved due to the long existent power crises. The power generation by two units of the Kudankulam nuclear power plant will end this crises to a great extent and help the state prosper manifold.

Germany after shutting down its nuclear reactors would rely upon wind farms and coal power plants along with carbon sequestration technology. Japan, on the other hand, would have to rely on fossil fuels from abroad. India if turns off the nuclear mode it has stepped into, it will again be operating on the conventional sources of energy which are limited, and other renewable resources like solar energy and wind energy which are undoubtedly way too expensive. In the light of these arguments, India has no way out but to depend upon nuclear power.

The question that still remains is which section of the society this project would prosper. Unarguably, the project demarcates two segments; the poor farmers leaving their land and the corporate sector making out of the project. The Supreme Court has already deliberated in the favour of the project placing the ‘greater’ good as at the topmost priority. The prosperity of the state no doubt is a positive mark but what about the farmers who are losing their land, their profession, their source of income, their living, and most importantly their home. In this context, Kudankulam is a boon to the rich and a bane to the poor. The concept of justice doesn’t find a place here. There lies no equality in the judgment. There is just party winning it all over and the other one losing all its possessions.

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