Nuclear Power Plant and Its Importance in Respect of Fungus

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Abstract

Nuclear power plants are the fourth largest source of electricity in India. The IAEA reports that there are 437 nuclear power reactors in operation, and 69 nuclear power reactors under construction in 31 countries around the world. Electricity was generated by a nuclear reactor for the first time ever on September 3, 1948 at the X-10 Graphite Reactor in Oak Ridge, Tennessee in the United States, and was the first nuclear power plant to power a light bulb. In India Nuclear Power Plants contribute to about 2% of its total power generation. There are & nuclear power plants in India with a sum total of 21 fully functional nuclear reactors. They produce a total of 30,292.91 GWh of electricity.

Keywords: *Nuclear power, Nuclear Reactors, Electricity, Nuclear power Plants*

1. INTRODUCTION

Nuclear power plant is a thermal station in which the heat source is a nuclear reactor. The heat source is used to generate steam which dives a steam turbine collected to an electric generator which produces electricity. Electricity was generated by a nuclear reactor for the first time ever on September 3, 1948 at the X- 10 Graphite Reactor in Oak Ridge, Tennessee in the United States, and was the first nuclear power plant to power a light bulb. The IAEA reports that there are 437 nuclear power reactors in operation, and 69 nuclear power reactors under construction in 31 countries around the world.

2. NUCLEAR POWER PLANT

The conversion to electrical energy takes place indirectly, as in conventional thermal power stations. The fission in a nuclear reactor heats the reactor coolant. The coolant used may be water even liquid metal depending on the type of reactor. The reactor coolant then goes to a steam generator and heats water to produce steam. The pressurized steam is then usually fed to a multi-stage steam turbine. After the steam turbine has expanded and partially condensed the steam, the remaining vapor is condensed in a condenser.

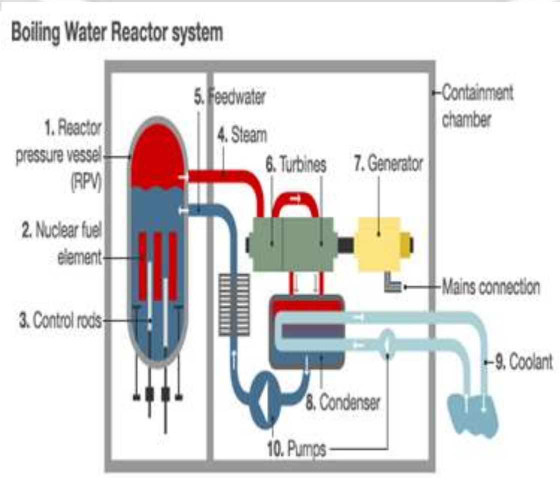


Figure 1.1: Parts of a Nuclear Power Plant

3. LITERATURE REVIEW

Ben Wealer (2018) The perspectives of nuclear power deployment in the long-term depend very much on the development of costs, in relation to other low-carbon options, and the economics of investments into new capacities. While there is a consensus in the literature that nuclear power is not competitive under regular market economy, competitive conditions, at least two issues need to be considered going forward. First, the evolution of future technologies, and second, the treatment of “costs” in other, non-market institutional contexts, The objective of this paper is to provide insights into the economics of nuclear power for electricity generation by considering the perspective of a private (or public) investor.

(Hirschhausen 2017) If Russia and China are able to provide the role of a global supplier needs to be seen, but both countries provide a strong government backed package including financing as a policy tool (“nuclear diplomacy”). Although, it is unclear how long Russia is able to sustain this practice, given the macroeconomic weakness of the country. When comparing the LCOE of nuclear power plants to other renewable and fossil technologies, competitiveness is far from being in sight, even with a CO2-price of 100€/t, there is no profitable investment to be expected where nuclear becomes competitive.

Marshall (2017)The session “Future of Natural gas markets” attracted many academic researchers and professionals interested in perspectives on the role of natural gas in the transition of energy markets After an introduction by Machiel Mulder, Hill Huntington, an Executive director Energy Modeling Forum, Stanford University, provided insights into the US natural gas industry. He pointed out a huge potential of shale natural gas development in the US and highlighted its future trends: with reduced and currently attractive prices, the gas displaces coal for power generation, brings broader fuel competition, and boosts US geopolitical power. However, given its continuing increase, gas will unlikely becomes long-term climate savior since it can endanger groundwater and could cause earthquakes if over-exploitation.

Hirschhausen (2017) Talking about the future of Russian gas exports to the European market, Knut Einar Rosendahl, Professor of Environmental and Resource Economics, Norwegian University of Life Sciences, Norway, presented the future of Russian gas exports to the European market. Prof. Rosedahl concluded that it is unlikely to have a golden age for the gas in Europe and Russia has other options for its gas (Asian markets and LNG). New pipelines from Russia to the Europe would rather have strategic or geopolitical, than economic interest.

Rothwell (2016), to decompose overnight construction costs (OCC) into indirect and direct costs and the latter into different technical components helps identifying cost positions, which have the most impact on total construction cost. The cost breakdown for a Gen III/III+ shows that the reactor equipment has with 40% the highest impact.4 It is therefore instructive to have closer look on the supply chain, especially for reactor pressure vessels ,which is the most constrained.

4. ATOMIC NOMENCLATURE

All atoms are made up of three subatomic particles: the proton, neutron and electron. Each determines part of how we see an atom: The number of protons in an atom determines its atomic number. This is the atoms “identity”: all atoms with one proton are hydrogen atoms, all atoms with two protons are helium atoms and so on. The atomic number (Z) is the same as the number of the element in the periodic table. The atomic number is denoted with a leading subscript: 2He refers to a helium atom with two protons.

5. NUCLEAR BINDING ENERGY

Nuclei are made up of protons and neutron, but the mass of a nucleus is always less than the sum of the individual masses of the protons and neutrons which constitute it. The difference is a measure of the nuclear binding energy which holds the nucleus together. The enormity of the nuclear binding energy can perhaps be better appreciated by comparing it to the binding energy of an electron in an atom. The comparison of the alpha particle binding energy with the binding energy of the electron in a hydrogen atom is shown below. The nuclear binding energies are on the order of a million times greater than the electron binding energies of atoms.

6. ATOMS AND MOLECULES

Somewhat more than a hundred elements are known and are thought to be the building blocks of everything in the universe. The atom is the basic unit of structure for each element. An important connection between the microscopic world of the atom and the macroscopic world of experience is given by Avogadro's number. A gram-mole of any element has Avogadro's number (6.023 x 1023) of atoms. The atom may be considered as consisting of a positively charged nucleus at its center and one or more negative charges around the nucleus called electrons that make the atom electrically neutral. The electron is the fundamental unit of negative charge. It may be viewed as a particle which is much smaller than the nucleus and which orbits around the nucleus as a planet orbits the sun, or it may be viewed as a diffuse electron cloud around the nucleus.

7. ADVANCED NUCLEAR REACTORS AND PASSIVE SAFETY

The world demand for energy is growing rapidly, particularly in developing countries that are trying to raise the standard of living for billions of people, many of whom do not have access to electricity or clean water. Climate change and the concern for increased emissions of green house gases have brought into question the future primary reliance of fossil fuels. With the projected worldwide increase in energy demand, concern for the environmental impact of carbon emissions, and the recent price volatility of fossil fuels, nuclear energy is undergoing a rapid resurgence.

Generation I reactors were the first to be developed; many were small.

Generation II reactors include most reactors operating today and will be the predominant type in operation up to 2020 and beyond. With extensions of their operating life to 60 years, many of these reactors will be operating past 2035.

Generation III reactors are what have been built in the last few years in France and Japan. Some reactors of this general type are called Generation III+. More Generation III reactors will be built in the next decade, including several to be built in the United States.

Generation IV reactors are usually referred to as advanced reactors. None have been built and none are close to being under construction

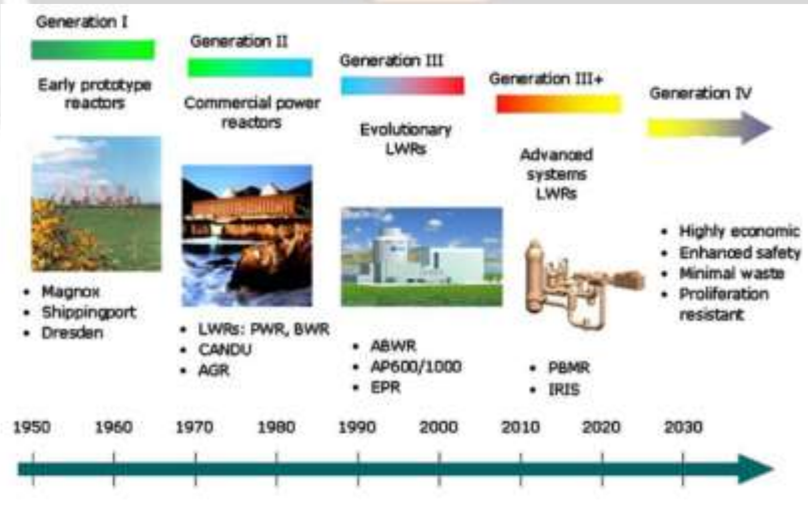
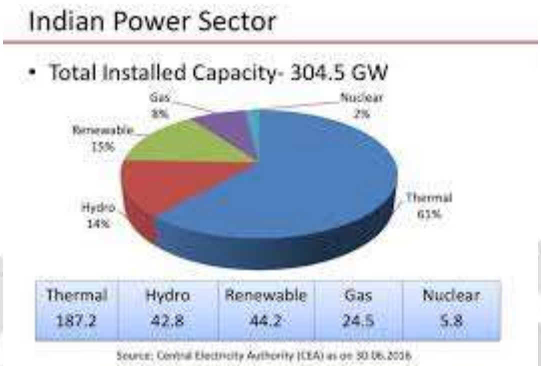


Figure 1.1: Nuclear Reactors Generations

8. NUCLEAR POWER IN INDIA

Nuclear power is the fourth-largest source, of electricity in India after hydroelectric, thermal and renewable sources of electricity. As per the latest reports, India has 21 Nuclear reactors in a total of 7 Nuclear Power Plants. The installed capacity of 5780 MW and producing a total of 30,292.91 GWh of electricity. A total of 6 more reactors are under construction and are expected to generate an additional 4,300 MW. In October 2010, India drew up "an ambitious plan to reach a nuclear power capacity of 63,000 MW in 2032", but, after the 2011 Fukushima nuclear disaster in Japan, "populations around proposed Indian NPP sites have launched protests, raising questions about atomic energy as a clean and safe alternative to fossil fuels".

There have been mass protests against the French-backed 9900 MW Jaitapur Nuclear Power Project in Maharashtra and the Russian-backed 2000 MW Kudankulam Nuclear Power Plant in Tamil Nadu. The state government of West Bengal state has also refused permission to a proposed 6000 MW facility near the town of Haripur that intended to host six Russian reactors. A Public Interest Litigation (PIL) has also been filed against the government's civil nuclear programme at the Supreme Court.



A. Fully Operational Plants

Currently, twenty-one nuclear power reactors have a total install capacity of 5,780 MW (3.5% of total installed base). The exact production of each plant is described in detail in the following table.

B. Plants under Construction the projects under construction in India will produce a total of 4300 MW of power once they are up and functional. The details are described below

C. Proposed Plants The proposed plants in India will be place in different states. If these plants are sanctioned the total capacity of produced power will be 33564 MW. The details are as follows:

9. IMPORTANCE IN INDIAN ECONOMY

The consumption of electricity in India has seen an exponential growth in the past few years. The per capita consumption in 2012-13 was 914.41 kWh. It increased to 957 kWh in 2013-14, with a difference of nearly 44 kWh compared to the previous year. The country's per capita electricity consumption has reached 1010 kilowatt-hour (kWh) in 2014-15, with a huge difference of more than 50 kWh. With such increase in the power consumption, nuclear power plants contribute to about 2% of the produced electricity.

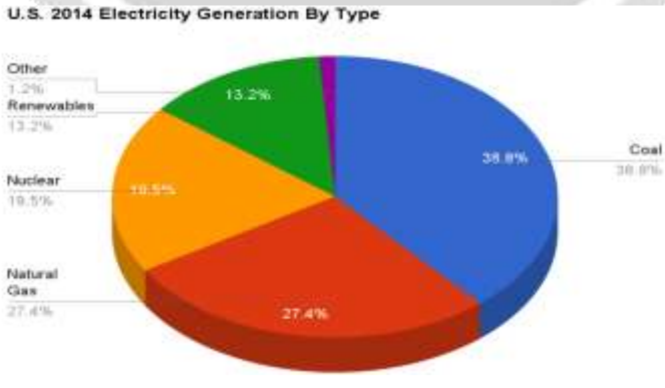


Figure 1.3: Electricity sources

As of 2013, India had 5.78 GW of installed electricity generation capacity using nuclear fuels. India's nuclear plants generated 32455 million units or 3.75% of total electricity produced in India. India's nuclear power generation effort satisfies many safeguards and oversights, such as getting ISO-14001 accreditation for environment management system and peer review by World Association of Nuclear Operators including a prestart up peer review. Nuclear

Power Corporation of India Limited admits, in its annual report for 2011 that its biggest challenge is to address the public and policy maker perceptions about the safety of nuclear power, particularly after the Fukushima incident in Japan.

10. CONCLUSION

With an increasing appetite for the consumption of electricity in India, it is very important to implement Nuclear Power Plants for the generation of electricity. All the other sources of generation of electricity are contributing in a huge percentage but nuclear power plants contribute a mere 2%. Also India has to increase its contribution through Nuclear energy in the international level. The total costs of the power production can be hugely affected with the implementation of Nuclear Power Plants.

11. REFERENCES

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5. The recent Data Documentation 93 by the DIW Berlin analyzed the worldwide diffusion of NPPs and concluded that none of the 674 reactors analysed in the text, has been developed based on what is generally considered “economic” grounds, i.e. the decision of private investors in the context of a market-based, competitive economic system. See Wealer, et al. (2018).
6. See Thomas, Steve. 2017. “Corporate Policies of the World’s Reactor Vendors.” presented at the 21st REFORM Group Meeting, Salzburg.
7. Cost breakdown: structures & improvements (20%), reactor equipment (40%), turbine generator equipment (25%), cooling system and miscellaneous equipment system (15%), and electrical equipment (10%) (Rothwell 2016).
8. The basis for the cost estimation can be found in the DIW Data Documentation 68. See Schröder et al. (2013) “Current and Prospective Costs of Electricity Generation until 2050” DIW Berlin, Data Documentation 68.
9. See Warth & Klein Grant Thornton AG Wirtschaftsprüfungsgesellschaft. 2015. Gutachtliche Stellungnahme Zur Bewertung Der Rückstellungen Im Kernenergiebereich. Berlin.
10. The current cost estimates for the European and US construction projects are drawn from the World Nuclear Status Report 2017 (See Schneider et al. 2017).
11. See Schneider, et al. (2017). Rothwell, Geoffrey. 2016. Economics of Nuclear Power. London, UK: Routledge.