

A REVIEW OF NUCLEAR POWER IN ELECTRICITY

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Abstract: A review of nuclear power in electricity has been proposed here. Nuclear power is the conversion of nuclear energy to useable energy, which in this case is electrical energy. Nuclear energy is the energy stored inside of the nucleus of an atom, and it can be released using two methods, nuclear fission or nuclear fusion. In nuclear fission the nucleus of an atom is split into two smaller atoms using neutrons, whereas, in nuclear fusion the nucleus of an atom is forced to combine with another nucleus of a separate atom to form a larger atom. There are several researches in the field of nuclear power in which some researchers have been described here. In order to meet the Administration's goals of energy security and greenhouse gas reductions, nuclear energy must play an important role in the national energy portfolio.

Keywords: Nuclear power, Matlab, Nuclear Reactors, Electricity, Nuclear power Plan

[1] INTRODUCTION

Nuclear power is the conversion of nuclear energy to useable energy, which in this case is electrical energy (EIA, 2015). Nuclear energy is the energy stored inside of the nucleus of an atom, and it can be released using two methods, nuclear fission or nuclear fusion (EIA, 2014). In nuclear fission the nucleus of an atom is split into two smaller atoms using neutrons, whereas, in nuclear fusion the nucleus of an atom is forced to combine with another nucleus of a separate atom to form a larger atom (EIA, 2015). The energy released is then harnessed and used to make electrical power. Although nuclear fusion yields almost four times the energy than that of nuclear fission it is not a method that is utilized. It remains a field of ongoing research because of the difficulty in maintaining a nuclear fusion chain reaction (World Nuclear Association, 2014). In nuclear reactors today, nuclear fission is the only method used, and an example of how nuclear fission works can be seen in Figure 1 (EIA, 2014). In order to generate power, nuclear power plants must successfully convert the energy released from nuclear fission, and they do so in a long tested manner.

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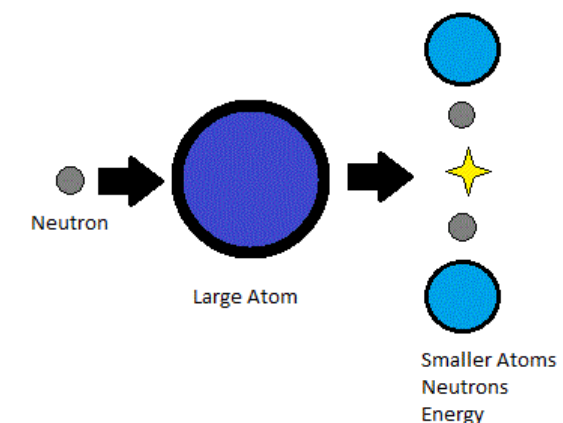


Fig 1 Nuclear Fission

A conventional power plant converts the potential energy of one substance into another form of energy, which is generally mechanical energy or thermal energy. Then this new form of energy is used to produce electrical energy. Through the mechanical energy method, turbines spin using mechanical force produced by the fuel. For thermal energy, water is boiled to produce steam, which is then forced to rotate turbines. The rotation of the turbines produces electricity by changing the magnetic field around the coils it is rotating within. The power grid uses transmission lines to distribute the electrical current produced.

[2] LITERATURE REVIEW

There are several researches in the field of nuclear power. Some of researches have been described here:

In 2003, D. Kanev, et al. [1] proposed the impact of different options for decommissioning of existing nuclear power units to the Bulgarian power sector development. In the paper, a comparative technical and economic analysis of the expansion plans by different cases is made.

In 2018, Hu Dian-Gang, et al. [2] wrote on Joint Planning of Pumped Storage, Nuclear Power, and Wind Power Installed Based on Maximizing Global Efficiency. In this paper, the power structure, the peaking capacity of the power grid and the impact of wind power on the peak shaving capacity are comprehensively studied. At the same time, considering the volatility of load and wind power, a joint planning model of pumped storage-nuclear power-wind power installation is constructed.

In 2004, N.K. Trehan, et al. [3] evaluated the Power uprates in nuclear power generating stations. install advanced excitation control system; install power system stabilizer or control of MVAR by the Independent System Operator/Regional Transmission Organization. This paper

discusses the theory, importance of power uprate and methods of achieving it.

In 2017, Salem M. ElKhodary, et al. [4] wrote on the role of nuclear energy in the future of energy systems in Egypt. This paper presents the contribution of nuclear energy in the development of the of energy sector in Egypt. Finally, safety and environmental considerations which must be applied in the nuclear power plants will be discussed because it is considered the definitive proof which invalidates allegation that nuclear energy is dangerous energy generation type and able to cause fatal radiation accidents.

In 2015, Moon-Young Kim et al. [5] did improvement for electrical transients of safety bus using high speed power transfer scheme in nuclear power plants. Therefore, high speed power transfer scheme as an advanced power transfer design is presented so as to enable to shorten transfer time. This study perform that the improvement for electrical transients of safety bus and essential motor loads using high speed power transfer scheme is simulated and analyzed.

In 2015, Karel Kuchta et al. [6] increased the safety of nuclear power plants - the installation of diverse electricity sources. The power generator is fitted with the starting system with multiple redundancy which provides high assurance of the power generator start during exceptional event. Currently, 4 pieces are installed in nuclear power plants Temelín and Dukovany owned by the Czech Power Group ČEZ.

In 2015, Indrakanti Abhinay et al [7] analyzed the nuclear power-a potential source to meet future electricity demands in India. So, there is an urgent need to use the sources that are reliable, benign to environment and that can provide long term security. Solar and Nuclear tops the list. As solar is hurdle to urbanisation, nuclear based power generation is the best

possible alternative to bridge the gap between supply and demand.

In 2014, Md. Asif Ahamed, et al. [8] provided the nuclear power as a tool for sustainable development in energy sector in Bangladesh. Bangladesh is a fast developing country and it is one of the densely populated nations not in Asia but all around the globe. This study also tries to find ways for increasing efficiency and reducing electricity generation cost in Bangladesh.

In 2013, N. Power, et al. [9] stated 765-2012 - IEEE Standard for Preferred Power Supply (PPS) for Nuclear Power Generating Stations (NPGS). This standard provides PPS requirements for nuclear power plants and guidance in the areas of AAC power source interfaces with PPS, physical independence of the PPS power and control circuits, and expanded PPS criteria for multi-unit stations.

In 2012, Hugo Altomonte et al. [10] wrote on Japan's Nuclear Disaster: Its Impact on Electric Power Generation Worldwide [In My View]. The disaster mobilized the geopolitical world, non-government organizations (NGOs) in general, and environmentalists in particular, as well as national nuclear energy regulatory commissions. The disaster required the ultimate international authority, the International Atomic Energy Agency (IAEA), to respond rapidly and straightforwardly to the Japanese public and the entire world about the impacts of the nuclear disaster.

In 2012, Kenneth Bruninx, et al. [11] discussed the impact of the German nuclear phase-out on Europe's electricity generation. However, the situation on the northern part of the transmission grid stays critical. In 2022, the assumed extension of the generation capacity will not suffice. Keeping the NPPs due to shut down after 2017 on line would mitigate these contingencies.

In 2012, Gil-Su Lee, et al. [12] explained the Voltage stability enhancement of Class 1E bus in NPPs using voltage-reactive power controls. In a recent power grid system, the voltage of off-site power system becomes unstable as the increase of renewable energy such as wind generation. In this study, the cooperation of voltage-reactive power controller is suggested to enhance the voltage stability of Class 1E buses.

In 2012, Heng Luo, et al. [13] studied on nuclear power plant dynamic response characteristics and impact of power quality problems. The analysis results show that, NPP has the characteristics of self-stabilization and self-regulation, and NPP will be affected by power system disturbances. If the disturbances can be cleared quickly, the NPP and power system can remain stable. NPP requires higher operating conditions on power system such as voltage and frequency. The amplitude and rate of NPP power regulation are limited. The grid and NPPS should take effective measures to ensure safe and stable operation.

In 2012, Qiuyun Shi, et al. [14] studied the faults of nuclear power plant and effects on transient stability of power system. The nuclear power plant will impact load rejection of the power grid transient stability and suggest measures to improve the power grid frequency and voltage.

In 2011, Lin Yu-fan, et al. [15] provided a simple Analysis about the Environment Protection and Design of Nuclear Power Plant.

In 1996, A. Reisman, et al. [16] probes the Economic and technical analysis of the Russian nuclear power sector. The JEPAS identified the strategic directions for the power sector's development, investment requirements and opportunities for energy efficiency over the next 15 years. The results presented in the JEPAS confirm the

importance of the continued use and development of nuclear power in Russia's electric power sector.

In 2009, Yang Guang , et al. [17] provided an Analysis of China's Nuclear Power Plant Programme Supply Chain from the Perspective of Life Cycle. Nuclear power development requires completing and vast supply chain as a support. In line with the elements of supply chain, the paper analyzes Chinapsilas nuclear power industry and gives some useful proposals.

In 2010, Apisit Patchimpattapong et al.[18] proposed the development of thailand's first nuclear power plant. Strengthening energy security, mitigating global warming and being competitive in global markets are among reasons According to the Nuclear Power Infrastructure Establishment Plan, a roadmap for launching nuclear power program in Thailand, nuclear power project will be implemented during 2011-2013, construction will start in 2014, and Thailand's first nuclear power plant will be complete for commercial operation in 2020.

In 2004, N.K. Trehan, et al. [19] analyzed the electric utility deregulation: failure or success. Circumstances like the August 14th, 2003 blackout in the northeast of the United States (not caused by deregulation) brought industry uncertainty to investors and consumers.

In 2004, G. Robert, et al. [20] stated the Conformity evaluation method of power plants performance for grid stability. For In order to support its official appraisal on the impact of drifted IPR, EDF R&D has developed a tool named DEPISTE which compares, through simulations, the stability performance with reference IPR and drifted IPR parameters.

In 2015, Andreas Holzer, et al. [21] discussed the effects of nuclear power phase-out in Germany on the Austrian power system. The results from the case study show that the nuclear power phase-

out in Germany would lead to an increase in electricity exports from Germany to Austria and an increased usage of coal power between 26 % and 39 % in 2022, whereas the total costs for power generation depend stronger on wind power conditions in the future.

In 2015, R. Khan, et al. [22] discussed the Nuclear education and training for nuclear power program. the availability of adequately qualified manpower is essential.

In 1991, W.C. Gangloff , et al. [23] proposed a new US nuclear plants: one scenario. It is pointed out that the obstacles to new nuclear power plants in the US are many and well-known, but that there are some signs pointing toward at least a partial removal of the obstacles.

[3] TOOLS AND TECHNOLOGY MATLAB

MATLAB-The full form of MATLAB is matrix laboratory. It is a high tech programming language. It is mainly used for the purpose of technical computing. It integrates calculation, visualization, and encoding in such a manner that it can be easily understood by an individual. Therefore it is considered as a user friendly software .In this software all the questions and their answers are presented in a well-known numerical form. Thousands of functions are incorporated in Mat lab. It is possible to draw 2Dimension and 3Dimension graph in MATLAB. It also provide a facility to user due to which any user can write down its own function. It is feasible due to the presence of huge quantity of apparatus. It can be used for various purposes which is illustrated below

1 Math and calculation

2 For the growth of algorithm

3 It can be used for the purpose of modelling, simulation, and prototyping

4 Data analysis, exploration, and visualization

5 Scientific and engineering graphics

6 For the growth of application and Graphical User Interface

The MATLAB working environment

It is the combination of equipment and services which is provided by MATLAB to his users or programmer. It contains the services due to which one can manage the variables in his workspace. It also provides the facility of records importing and exporting. The equipments which are required for the purpose of growth, controlling, debugging, and profiling M-files, MATLAB's applications are also incorporated in this.

[4] PROBLEM STATEMENT

The challenges with both domestic and foreign reactors mean that India must adopt a two-pronged strategy: It should push for the smaller indigenous reactors, and commit domestic resources and finances to that. This will ensure India becomes an established international player in nuclear power technology and allow it to scale up civil nuclear capacity. Successful demonstration of this technology will allow India to build PHWRs in other countries, earning it valuable capital for further expanding the fleet of PHWRs at home.

Second, while the political will and commitment to nuclear power remains strong, the government has spent most of its diplomatic ammunition in recent months attempting to secure membership in the NSG, an effort that was ultimately unsuccessful. It is crucial to remember that India does not need NSG membership to import nuclear technology 53—that was already cleared through the exemption given in 2008. India's diplomatic and political capital may be better spent in securing a bilateral civil nuclear deal with

Japan, which is the hurdle yet to be crossed for the construction of EPRs and AP 1000s in India.

[5] CONCLUSION

In order for nuclear power to continue to be a viable energy option in any country, including the United States, nuclear safety, security, and safeguards must be maintained at the highest levels on a global scale. DOE will help to achieve consensus criteria for safe reactor operation through international organizations, such as the World Association of Nuclear Operators, and seek to enhance safety standards for nuclear power, promote appropriate infrastructure at the national and international levels, and minimize proliferation risks from the expansion of nuclear power through its participation with the IAEA and related organizations.

[6] FUTURE SCOPE

This document presents an integrated strategy and R&D framework for the DOE Office of Nuclear Energy. In order to meet the Administration's goals of energy security and greenhouse gas reductions, nuclear energy must play an important role in the national energy portfolio. NE's derived missions in support of these national goals are to enable the development and deployment of fission power systems for the production of electricity and process heat. Four research and development objectives have been identified, which will guide NE's program and strategic planning. Progress in these areas will help ensure that nuclear energy continues to be among the suite of available U.S. energy options throughout the 21st century

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