© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

SIMULATION OF EFFICIENCY OF POWER PRODUCTION IN NUCLEAR ENERGY POWER PLANT

1Naveen, 2Amit Mahal
1Research Scholar, IIET Kinana
2Assistant Professor, IIET Kinana

ISSN : 2278-6848 03
9 772278 684800
© International Journal for Research Publication and Seminar

Abstract: In the research work, the simulation of the power efficiency considering Ein, Eout as variable and Eout, Ein as constant has been proposed. It also provides the simulation of power production with integration of solar, wind and nuclear power plant. This work has focused on the integration of Nuclear power system with hydrolic, solar, wind based power system. The result represents the simulation of energy efficiency in nuclear power plant considering Ein and Eout. The efficiency decreases as the Ein increases. The efficiency increases with the Eout increase. The proposed work is capable to optimize the Ein and Eout for particular efficiency. The proposed work has simulated how much Ein or Eout should be there in order to achieve particular efficiency level. It would increase reliability and consistency of electricity production. According to proposed model there is no need to depend only on wind and sun. Proposed model would be capable to produce electricity in absence of wind and sun.

Keyword: Nuclear Energy, Heat (Thermal) Energy, Wind Energy, Hydroelectricity

[1] INTRODUCTION

It is form of energy which is obtained from a process which is very well known as nuclear fisson. In this particular process uranium atom is divided in to several parts in a reactor Due to this heat formation take place. With the help of this heat steam is produced. With the help of this heat turbine rotates and generate electricity. An excellent level of protection as well as immunity standards is sustained by all the Nuclear power plants. They are always ready to handle any type of casualties. In order to guard plants from any suspect able threats nuclear plants are provided with a solid physical protection system. In almost all nuclear power plants uranium atoms is divided in to several parts in a reactor Due to this heat formation take place. With the help of this heat steam is produced. With the help of this heat turbine rotates and generate electricityspin a turbine to generate electricity.

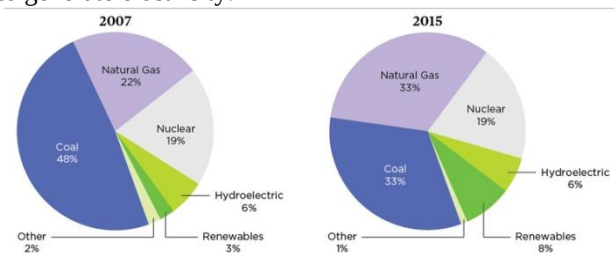


Fig 1 Comparative analysis nuclear energy between 2007 to 2015

Nuclear Fuel

Nuclear fuels are fissile .It is very hard when it puts down into the reactor and remains in the same form when it brings back out of the reactor. It is firstly converted in to gas and then from gas to powder. This powder is then pressed in to pellets and wrapped in to fuel assemblies.

Nuclear Waste

Nuclear waste is a material which is obtained after the process of nuclear fuel in reactor. From front is looks like the fuel which was put down in to the reactor. But as we know that chain reaction take place it is not quite same. Thsee waste materials are so much radioactive and remain radioactive for thousands of years. It was so much toxic that if any one stands near it when it is not shielded gets a radioactive dose.

Safety and Security

An excellent level of protection as well as immunity standards is sustained by all the Nuclear power plants. They are always ready to handle any type of casualties. In order to guard plants from any suspect able threats nuclear plants are provided with a solid physical protection system, excessive safety systems and deeply skilled security officers. By applying latest cyber security methods it is possible to keep away hackers from the layers of security. It is also helpful in continuous monitoring of new threats.

The manufacture and approval of nuclear plants are done by keeping in mind a safety method which is known as “defense-in-depth.” In this method different safety barriers are present which are autonomous. It is necessary that no one completely depend on single safety layer no matter how strong it is. Due to the availability of different safety barriers it is possible to give protection against accidental radiation release such as the rods that encase the

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

uranium fuel and the steel-reinforced concrete building that houses the reactor.

Various rules regarding protection and immunity have been imposed by NRC after inspections. If it is found that these rules are not followed in a particular plant then they can either charge fines or order a plant to shut down. In any case two NRC inspectors are appointed in each and every plant. These inspectors can do inspection of plant, at any time.

An excellent security history is noticed in U.S. commercial nuclear plants. There have been lot of things related to their operation all the way through history of their operation.

Electricity Production in India

The utility electricity sector in India has National Grid with installed capacity of three hundred thirty Giga Watt on 31 January 2018. Renewable power plants have thirty two percent of total installed capacity.

Gross electricity produced by utilities in India has been 1236.39 TWh. Total electricity generation in country has been 1433.4 TWh during fiscal year 2016-17.

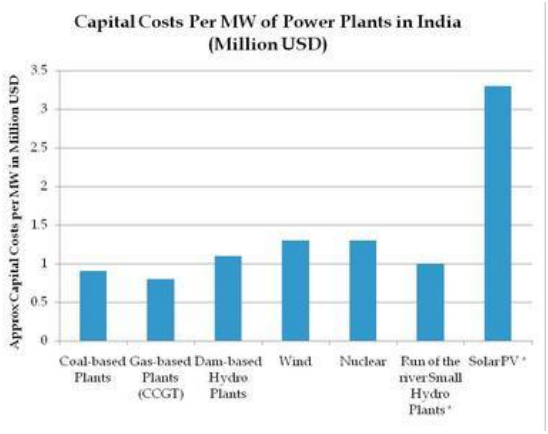


Fig 2 Electricity production in India

[2]PROBLEM FORMULATION

Electricity has been major need for regular activities. It has been found that it is unable to do operation without electricity for domestic and industrial purpose. Power generation, transmission as well as distribution process has been discussed as follow

1. The electricity is generated by power plant
2. Transformer is used to steps up voltage in case of transmission
3. Transmission lines are used to transfer electricity at long distances
4. Neighborhood transformer are used to steps down the voltage
5. The Distribution lines are used to carry electricity for domestic purpose.
6. Transformers on poles are used to step down electricity. It is done before it reaches houses

[3] RESULT AND DISCUSSION

It is known that nucleus of a large atom might split into two in several situations. A certain amount of huge atom's mass has been converted to pure energy in such process. Amount of energy released in nuclear reactions is astounding. Following table presents how long a 100 Watt light bulb might run with help of 1 kilogram of different fuels. Natural uranium undergoes nuclear fission. So it attains very high energy density.

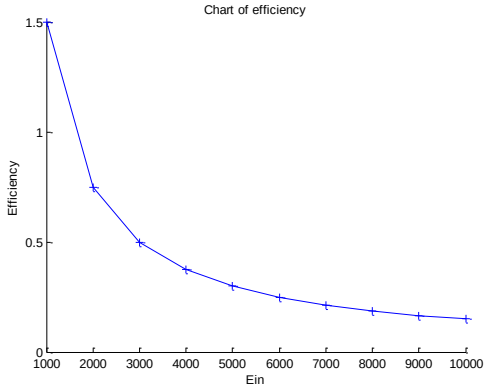


Fig 3 Efficiency Chart (Ein is Variable)

Here in this section the simulation of optimization of efficiency of nuclear power plant has been performed using matlab. In order to perform optimization of simulation a nuclear efficiency a constant efficiency of 0.5 has been considered. Then a matlab based graph representing the influence of Eout on efficiency has been considered.

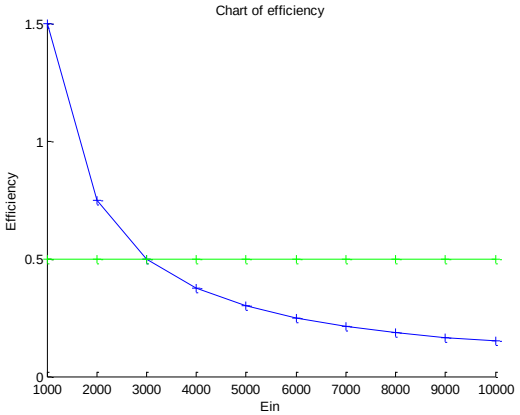


Fig 4 Optimization of Efficiency (Ein is variable)

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

Here the simulation has been made of power efficiency considering Eout as variable and Ein as constant

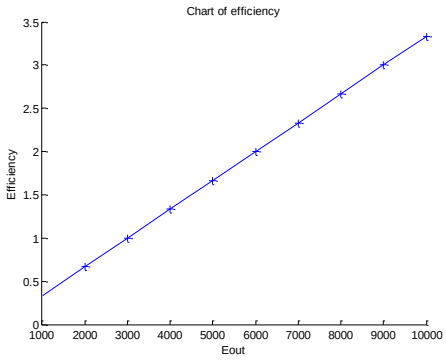


Fig 5 Efficiency Chart (Eout is Variable)

Here the optimization of Energy efficiency has been made in nuclear power plant (Eout is variable)

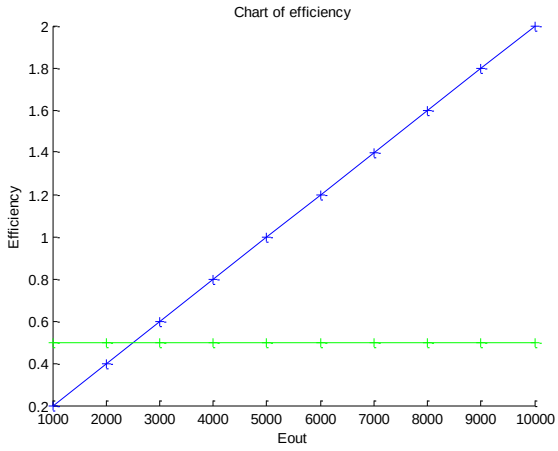
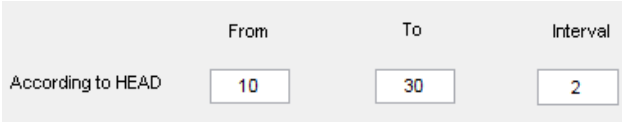


Fig 6 Simulation of power production with integration of solar, wind and nuclear power plant

Case 1: Hydrolic simulation is made on Head of 10 feet to 30 feet with interval of 2. All other variable such as water weight and flow are constant.



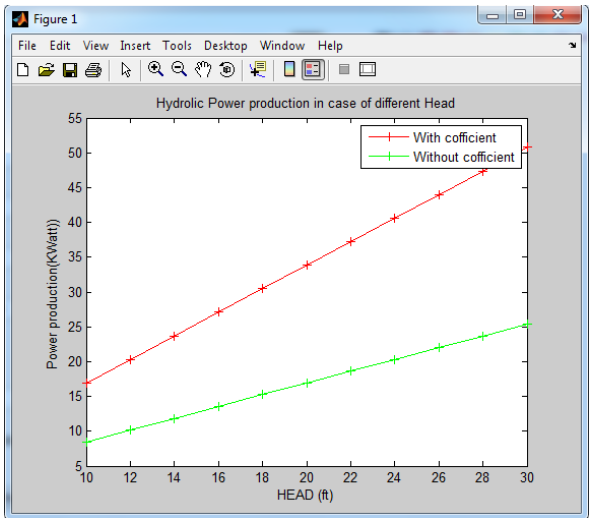


Fig 7 Hydrolic power simulation in case of Head from 10 to 30 feet

Case 2: The simulation is made on Head of 10 feet to 40 feet with interval of 5. All other variable such as water weight and flow are constant.

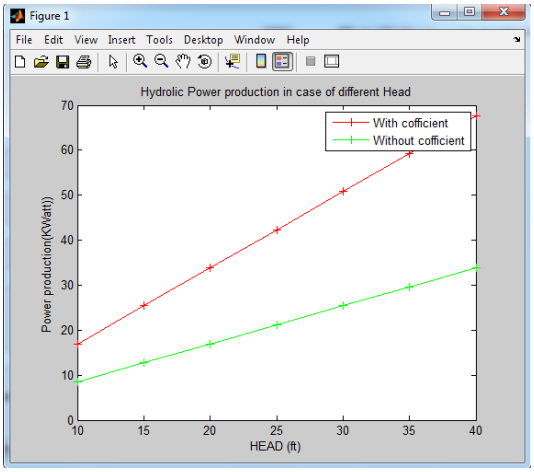


Fig 8 Hydrolic power simulation in case of Head from 10 to 40 feet

Case 3: The simulation is made on flow of 15 to 25cubic feet per second with interval of 2. All other variable such as water weight and Head are constant.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

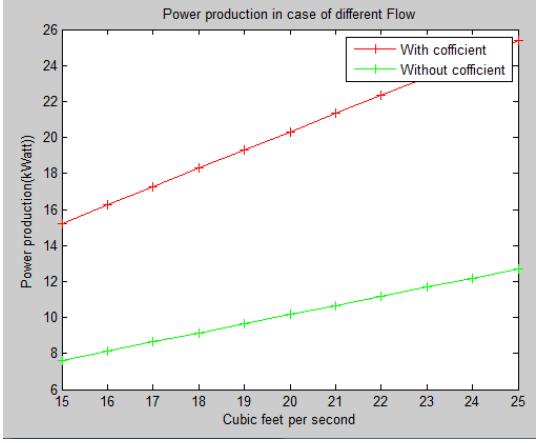


Fig 9 Hydrolic power simulation in case of flow of 15 to 25cubic feet per second with interval of 2
Simulation for Solar energy(kWh) according to solar panel area

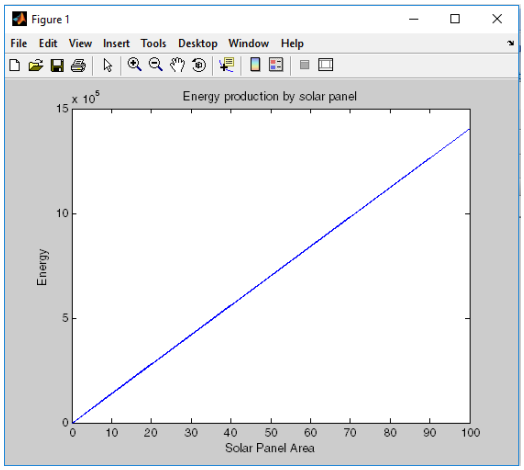


Fig 10 Simulation for Solar energy (kWh) according to solar panel area

[4] OPTIMIZATION FOR TRADITIONAL POWER SYSTEM FOR THE PRODUCTION OF MORE THAN 10000 KW POWER

INPUT PARAMETERS

Solar power parameter

PANEL_AREA=20
SOLAR_PANEL_YIELD=15
ANNUAL_AVERAGE_IRRADIATION=1250
PERFORMANCE_RATIO=0.75

Hydrolic power parameter

HEAD=50;
FLOW=20;
W=62.4;
kw=0.746;
fls=550;
POWER_COFFICIENT=0.5;

WIND POWER power parameter

Blade_length=32;
Wind_Speed=12;
AIR_DENSITY=1.67;
POWER_COFFICIENT=1;
SWEPT_AREA=3.14*Blade_length*Blade_length;

Output

SOLAR_POWER = 2813 KW
HYDROLIC_POWER = 42 KW
WIND_POWER = 4639 KW
TOTAL _POWER= 7494 KW

This configuration is not yielding required power from integrated system. Here we have to reduce the cost and increase the power production.

[5] OPTIMIZATION FOR PROPOSED POWER SYSTEM FOR THE PRODUCTION OF MORE THAN 10000 KW POWER

INPUT PARAMETERS

Solar power parameter

PANEL_AREA=20
SOLAR_PANEL_YIELD=15
ANNUAL_AVERAGE_IRRADIATION=1250
PERFORMANCE_RATIO=0.75

Hydrolic power parameter

HEAD=50;
FLOW=20;
W=62.4;
kw=0.746;
fls=550;
POWER_COFFICIENT=0.5;

WIND POWER power parameter

Blade_length=32;
Wind_Speed=12;
AIR_DENSITY=1.67;
POWER_COFFICIENT=1;
SWEPT_AREA=3.14*Blade_length*Blade_length;

Output

NEUCLEAR POWER=3000KW
SOLAR_POWER = 2813 KW
HYDROLIC_POWER = 42 KW
WIND_POWER = 4639 KW
TOTAL _POWER= 10494 KW

The above configuration is optimum as it is yielding more the a10000KW power supply. The presence of Nuclear power, Hydraulic allows system to provide power even if wind power and solar power is not working. However the maximum energy would be

taken solar power and wind power. But in absence of these the input to Nuclear power system is modified.

[6] CONCLUSION

This work has focused on the integration of Nuclear power system with hydrolic, solar, wind based power system. The result represents the simulation of energy efficiency in nuclear power plant considering Ein and Eout. The efficiency decreases as the Ein increases. The efficiency increases with the Eout increase. The proposed work is capable to optimize the Ein and Eout for particular efficiency. The proposed work has simulated how much Ein or Eout should be there in order to achieve particular efficiency level. This system would provide the clear picture for the energy production according to input.Considering the limitation of exiting work proposed work is integration of Nuclear power, hydro electricity power, solar system, and wind energy.

[7] SCOPE OF RESEARCH

It would increase reliability and consistency of electricity production. According to proposed model there is no need to depend only on wind and sun. Proposed model would be capable to produce electricity in absence of wind and sun. This system would reduce consumption of fossil fuels and production of greenhouse gases. System is good for remote application: satellites, rural hospital equipment in developing counties, telecommunication equipments, etc. It would reduce the loss of electricity due to power line resistance because it can be sited where the electricity is used. System reduces water consumed in electrical generation processes by displacing electrical demand.

References

1. L. Chao, T. Ke, C. Wei-hua, P. Jia-lin, and X. Hong-yun, “Study on Visual Monitoring System of Nuclear Power Operating Safety Status Evaluation Base on Real-time Data,” no. 1, pp. 1–12.
2. Z. Hao et al., “Modeling and simulation of loss of power in nuclear power plant,” no. 201804270000214, pp. 4708–4714, 2018.
3. Y. Da-hai et al., “Study on Nuclear Island Modeling and Parameter Measurement of Medium Pressure in Power Grid Stability Calculation,” no. 1, pp. 1–9.
4. Y. Da-hai, Y. Xiu-yue, C. Feng, and C. Chang-jian, “Modeling and parameter measurement research pressurized water reactor nuclear power generator ’ s prime mover and governor,” no. Powercon 2014, pp. 20–22, 2014.
5. S. Butterfield, S. Sheng, & F. Oyague within (Sep 2009) wrote Wind Energy’s New Role in Supplying World’s Energy: What Role could Structural Health Monitoring Play?
6. Eric H. (2010) “Investigating Hydroelectric Generator: Clean, Powerful Alternative Energy”,
7. Joseph K., Médard F., Oumarou H., (2011) “Promoting re latest able power & power efficiency in Central Africa: Cameroon case study”,
8. Parson Brinckerhoff (2011) wrote Electricity Generation Cost Model
9. Naveen Kumar Sharma (2012) “Solar energy in India: Strategies, policies, perspectives & future potential”
10. Chiyembekezo S. K., Cuthbert Z. K., & Torbjorn K. N. (2012) “Potential of Small-Scale Hydropower for Electricity Generation in Sub-Saharan Africa”,
11. Dennis Woodford, P.Eng. Ieee Life Fellow (Sep 2012) Presented Power Electronics For Wind Energy Application
12. J.Godson, M.Karthick, T.Muthukrishnan, (2013) has made research on “SOLAR PV-WIND HYBRID POWER GENERATION SYSTEM”
13. G.K. Singh (2013) “Solar power generation by PV (photovoltaic) technology: A review”,
14. Xiaobo y., chengyan y., (2013) “Hydro Power Integration with direct current Power Plant Technology”,
15. YOGESH MURTHY.N (NOV 2013) A REVIEW ON POWER ELECTRONICS APPLICATION ON WIND TURBINES
16. Subhash Chander Swami, Anurag Pandey in 2014 has wrote research on Power Generation from Waste Sources of Thermal Plant
17. Shahrouz A., Almas H. (2014) “A Review of Re latest able power Supply & power Efficiency Technologies”,
18. Belqasem A. (2016) “Recent Trends in Hydroelectric Power Technology
19. Bhushan D. Agarkar & B. Barve (2016) “A Review on Hybrid solar/wind/ hydro power generation system”,
20. Deepak K., Katochb S.S (2016) "Environmental sustainability of run of river hydropower projects: A study from western Himalayan region of India",

21. Kasongo Hyacinthe Kapumpa (2016) “A Review Paper on Solar Photovoltaic Systems”,
22. Deepak Purohit, Goverdhan Singh (2017) “ A Review Paper on Solar Energy System”,
23. Duane C., Eric C., Morgan W., (2003) "A Study of Hydroelectric Power: From a Global Perspective to a Local Application",
24. M.RAVIKUMAR, DR. PSS. SRINIVASAN (2005) “PHASE CHANGE MATERIAL AS A THERMAL ENERGY STORAGE MATERIAL FOR COOLING OF BUILDING”,
25. R. Thresher M. Robinson (March 2008) Wind Energy Technology: Current Status & R&D Future Conference Paper NREL/CP-500-43374 August 2008
26. European Wind Energy Association (March 2009) presented “The economics of Wind energy”
27. Soares S, and C.T. Salmazo, Minimum loss predispatch model for hydroelectric power system. *IEEE Transactions on Power Systems, 12*, 1997, 1220-1228.
28. J P S Catalão, S.J.P.S. Mariano, V.M. F. Mendes, and L.A.F.M. Ferreira, Scheduling of head-Sensitive cascaded hydro systems: A nonlinear approach. *IEEE Transactions on Power Systems, 24*, 2009, 337-346.
29. A Mahor, and S. Rangnekar, Short term optimal generation scheduling of Narmada cascaded hydro electric system. *Hydro Nepal, 7*, 2010a, 71-80.
30. C Li, E. Hsu, A.J. Svoboda, and Chung-li Tseng, Johnson R B, Hydro unit commitment in hydro-thermal optimization *IEEE Transactions on Power Systems, 12(2)*, 1997, 764-769.
31. O Nilsson, and D. Sjelvgren, Variable splitting applied to modeling of start-up costs in short term hydro generation scheduling. *IEEE Transactions on Power Systems, 12*, 1997, 770-775.
32. O Nilsson, and D. Sjelvgren, Hydro unit start-up costs and their impact on the short term scheduling strategies of Swedish Power Producers. *IEEE Transactions Power Systems, 12*, 1997, 38-44.
33. A L DinizL, P.P.I. Esteves, and C. Sagastizábal, *IEEE PES General Meeting*, Tampa, FL, A Mathematical Model for the Efficiency Curves of Hydroelectric units. 2007, 1-7.
34. E C Finardi, and E.L. daSilva, Unit commitment of single hydroelectric plant. Electric Power Systems Research, *75*, 2005, 116-123.
35. J C Galvis, A. Padilha-Feltrin A, and J.Y.M. Loyo, Cost assessment of efficiency losses in hydroelectric plants. *Electric Power Systems Research, 81*, 2011, 1866-1873.
36. A Mahor A, and S. Rangnekar, Short term generation scheduling of cascaded hydro electric system using time varying acceleration coefficients PSO. *International Journal of Energy and Environment, 1*, 2010, 769-782. A Arce, T.