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Nuclear Energy for Safe and Less Polluted Power Generation.

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A B S T R A C T

From Today's Problems to Tomorrow's Clean Energy Systems: A Discussion on Nuclear Power and Safe Energy Transitions is a new analysis from the International Energy Agency that examines how nuclear energy could aid in resolving the world's two most pressing crises—energy and climate—at the moment. Governments have had to reevaluate their energy security strategy in light of Russia's invasion of Ukraine and the resulting disruptions in the world's energy supplies, placing a higher emphasis on the creation of more diverse and locally based supplies. Nuclear energy is one of the choices for attaining this for numerous governments. Many governments have also increased their goals and commitments to achieve net zero emissions at this time. The classic IEA report Net Zero by 2050: A Roadmap for the Global Energy Sector is expanded upon in the book Nuclear Power and Safe Energy Transitions. It does this by thoroughly examining nuclear power's potential position as a source of on-demand, low-emission electricity to support the leading role of renewable energy sources like wind and solar in the switch to electricity networks with net-zero emissions. The research looks at the challenges that nuclear investment faces in this setting, especially in advanced nations, in terms of cost, performance, safety, and waste management. It takes into account the added difficulty of achieving net zero goals with less nuclear power than anticipated in the IEA Net Zero Roadmap and what kinds of cost targets would allow nuclear power to play a bigger part in energy transitions. The new analysis highlights potential policy, regulatory, and market changes that may be put into place for nations where nuclear power is thought to be an acceptable component of the future energy mix in order to provide new investment opportunities. It also examines the function of emerging technologies, particularly tiny modular reactors, as well as their prospective growth and use.

Keywords: Nuclear energy generation, Uranium temperature, Radiation time, Alpha and Beta loss, Power production range, Reactor Operation..

Introduction.

Nuclear energy plays a significant role in world electricity supply at the beginning of the 21st century with a share of some 16% in total generation and its role will remain noticeable for decades. However, the contribution of nuclear to total primary energy supply worldwide remains modest with some 6%.The fleet of nuclear power plants and fuel cycle facilities in operation today will continue to be part of the electricity generation landscape for some ten to fifty or more years as the most recently built units have a technical lifetime of more than 50 years. In the countries where those facilities are in operation, the assessment of existing nuclear energy chains is highly relevant to monitor that their performance remains at adequate level and improves over time.

According to most published projections, nuclear energy would not increase its share in total primary energy supply beyond some 10% by the end of the century in any scenario. Depending on the scenario considered, nuclear electricity generation is projected to be multiplied by 4 to 30 during the 21st century, reaching some 12 to 93 000 TWh/year in 2100. It should be noted that those scenarios are "conventional" in many ways and in particular do not consider large-scale industrial production of hydrogen by nuclear power plants as an option. On the other hand, many technology breakthroughs may occur over a period of hundred years that would change dramatically the energy supply and/or demand side.

Designers and developers of advanced nuclear energy systems aim at achieving better performance than those of current nuclear and alternative systems. Evolutionary reactors, already under construction or in operation in some countries, have enhanced economic and safety performance and higher global efficiency, leading to reduced fuel consumption and waste volumes. Generation IV systems expected to reach commercial deployment stage by 2020-2030 have more ambitious goals that should be achieved through innovative technology and processes. Large RD&D programmes are pursued by many countries, mostly in the framework or bilateral of multilateral cooperation, for the development of innovative nuclear systems, reactors and fuel cycles.

International cooperation and private/public partnerships are essential to ensure the success of these ambitious endeavours. The effective management of RD&D programmes requires constant monitoring of the interim results to ensure that the concepts and designs under development respond to the pursued goals. In this context, the approaches and tools described in the report provide a relevant support to decision making on the most promising options.

1.1 Fossil power plant

In geothermal energy heat is absorbed in the form of steam that is continuously coming from the Earth and with the help of that steam turbine main rotate or this team can be used for process industries. But geothermal energy is not available worldwide at every region therefore some selected areas are available in the world to get geothermal energy. In geothermal energy continuous supplies available but sometime unwanted particles are also mixed with this steam so purification ation of steam is also required. Tidal way of energy is also available but this natural source of energy is only used when low and high tides are available at frequent proposation to the site. Tidal energy can be harness at lower rate but it is totally pollution free but initial cost maybe higher.

Nomenclature

NU Nuclear

Ur tem Temperature of Uranium

UW Uranium radiation

RH Heating of reactor

AB time. Radiation Waiting time

Eff T. Reactor efficiency

WA RD Wall radiation

RA Temp Temperature of Reactor .

Cool-FL = Fuel cooling rate

2. Steam power plant

In a fossil-fuelled power plant, heat, from the burning of coal, oil, or natural gas, converts (boils) water into steam (A), which is piped to the turbine (B). In the turbine, the steam passes through the blades, which spins the electrical generator (C), resulting in a flow of electricity. After leaving the turbine, the steam is converted (condensed) back into water in the condenser (D). The water is then pumped (E) back to the boiler (F) to be reheated and converted back into steam.

In a nuclear power plant, many of the components are similar to those in a fossil-fueled plant, except that the steam boiler is replaced by a Nuclear Steam Supply System (NSSS). The NSSS consists of a nuclear reactor and all of the components necessary to produce high pressure steam, which will be used to turn the turbine for the electrical generator.

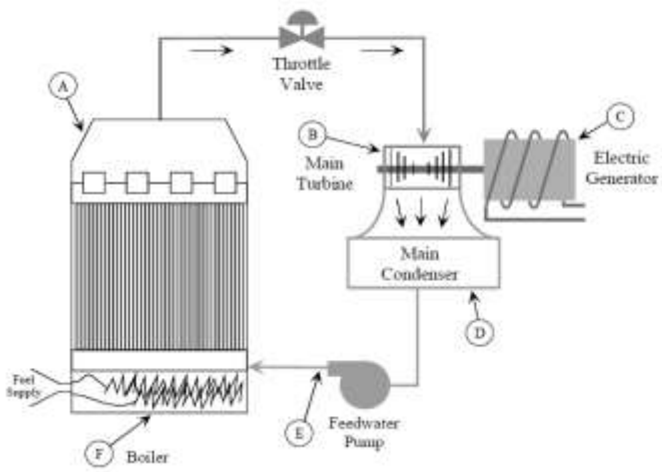

Figure 1 Fossil steam power plant.

2.1 Fuel used in reactor

In Ocean thermal energy conversion system mainly energy can be harnest by temperature difference of water. It is observed that in tropical area temperature of the surface water is higher compare to the temperature of the deep water therefore scientist can use this difference of temperature to harness energy. There are number of techniques to achieve energy from the ocean. Now a days Western countries and other developed countries are trying to achieve energy from the non conventional way because most of the countries in the world are getting energy. Countries are using call as a fuel and their making large amount of pollution to the environment and due to this pollution number of glaciers in the Antarctica are continuously melting and number of low altitude countries are facing issue of floods. In Ocean thermal energy conversion system minimum temperature difference is required 77 Fahrenheit. There are number of elementary components that are used in Ocean thermal energy conversation system

The fuel rods contain the ceramic fuel pellets. The fuel rods are approximately 12 feet long and contain a space at the top for the collection of any gases that are produced by the fission process. These rods are arranged in a square matrix ranging from 17 x 17 for pressurized water reactors to 8 x 8 for boiling water reactors. The spacer grids separate the individual rods with pieces of sprung metal. This provides the rigidity of the assemblies and allows the coolant to flow freely up through the assemblies and around the fuel rods. Some spacer grids may have flow mixing vanes that are used to promote mixing of the coolant as it flows around and though the fuel assembly.

The upper and lower end fittings serve as the upper and lower structural elements of the assemblies. The lower fitting (or bottom nozzle) will direct the coolant flow to the assembly through several small holes machined into the fitting. There are also holes drilled in the upper fitting to allow the coolant flow to exit the fuel assembly. The upper end fitting will also have a connecting point for the refuelling equipment to attach for the moving of the fuel with a crane. For pressurized water reactor fuel, there will also be guide tubes in which the control rods travel. The guide tubes will be welded to the spacer grids and attached to the upper and lower end fittings. The guide tubes provide a channel for the movement of the control rods and provide for support of the rods. The upper end of the control rod will be attached to a drive shaft, which will be used to position the rod during operations.

3. Advances nuclear systems

The main objective pursued by designers and developers of advanced nuclear systems is to obtain better performance than those of current nuclear and alternative energy systems. Designers, operators of nuclear power plants and facilities and researchers work to enhance the capabilities of new nuclear systems essentially in two frameworks: short- and medium-term improvements based on evolutionary approaches; and long-term improvements relying on innovative concepts.

The reactors being built at present such as the ABWR and the EPR are representative of the evolutionary approach. Their characteristics bring\ improvements mainly on safety and economic indicators but their enhanced safety features and fuel performance provide also advantages in terms of

environmental and social indicators, e.g., reduction of fuel consumption and volumes of waste. The next generation of systems, commonly called Generation IV (GEN IV) systems has more ambitious goals requiring innovative technologies and extensive research and development. Their development to commercial and industrial stages will take more than a decade but they could be available on the market by 2020-2030.

This chapter reviews the characteristics of evolutionary and innovative systems and provides insights on how they address challenges raised by economic competitiveness, enhanced safety and reliability, improved global efficiency, i.e., reduced fuel consumption and waste, and better proliferation resistance and physical protection.

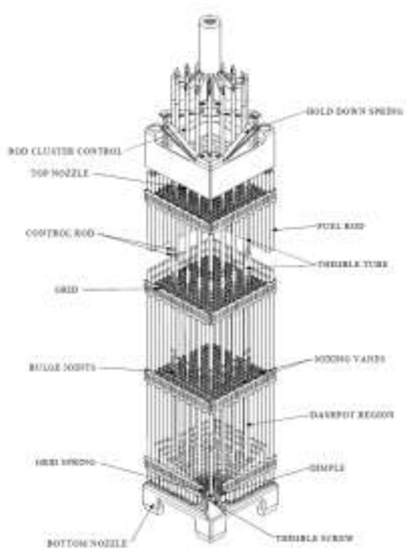

Figure 2 Boiling water reactor

3. Third Generation NU system

The probability of core melt and the probability of a related release of radioactivity into the environment are significantly reduced, 10-6/Reactor*yr and 10-7/Reactor*yr respectively in the new generation of reactors. Multiple containments and barriers ensure a minimal imposition on the environment. The reliability of GEN III/III+ systems is increased through redundancy, diversity and spatial separation of the safety systems. Generation III/III+ systems achieve better economic performance through feedback from experience. Reduction of construction costs, the most important parameter for nuclear energy competitiveness, is pursued by standardisation and improved construction methods, including modularity and factory building. These measures contribute to shorter construction times which reduce interest during construction. Simpler designs reduce operation and maintenance costs. Higher fuel use efficiency improves economics and resource management.

The goals in terms of reduction of fuel consumption and waste volume and radio toxicity are pursued through higher thermal efficiency of the plant, higher burn-up and modifications of the fuel cycle characteristics. Technological progress and improvement of industrial processes in fuel cycle

facilities contribute to reducing the amounts of waste generated at each step of the cycle. Some Generation III plants incorporating evolutionary features are already in operation (in East Asia) while others are under construction (also in Europe).

The latest representative of this generation of LWR reactors is the European pressurised reactor (EPR) that is currently being built in Finland. The EPR is a further development of the proven, standardised French and German reactors.

Conclusion

Continuing technology progress is achieved in nuclear energy systems through evolutionary approaches. They have led to the design and implementation of GEN III/III+ systems responding better to society and market requirements. Additional performance improvements are required to meet fully the goals of sustainable development and respond to social and environmental expectations in the 21st century. For thispurpose, comprehensive R&D programmes are ongoing in the world. International cooperation and joint efforts from governments and the industry should facilitate the design and ultimately market deployment of advanced nuclear systems adapted to the needs of society.

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References

[1] Pioro IL, Duffey RB (2007) Heat transfer and hydraulic resistance at supercritical pressures in power engineering applications. ASME Press

[2] Kaneda J, Kasahara S, Kano F, Saito N, Shikama T, Matsui H (2011) Material development for supercritical water-cooled reactor. Proc. ISSCWR-5, Vancouver, Canada, March 13–16

[3] R, Garnier JC, Guedeney P, Mikityuk K, Mizuno T, Poette C, Pouchon M, Rini M, Somers J, Touron E (2011) The Generation IV gas-cooled fast reactor. Paper 11321, Proc. ICAPP 2011 Nice, France, 2–5 May 2011

[4] Stainsby R, Peers K, Mitchell C, Poette C, Mikityuk K, Somers J (2011) Gas cooled fast reactor research in Europe. Nucl Eng Des 241:3481–3489

[5] Smith RR, Cissei DW (1978) Fast reactor operation in the United States. International symposium on design, construction, and operating experience of demonstration LMFBRs, Bologna, Italy, April 10–14, 1978.

[6] De Bruyn D, Maes D, Mansani L, Giraud B (2007) From MYRRHA to XT-ADS: the design evolution of an experimental ADS system, AccApp'07, Pocatello, Idaho, July 29–Aug 2, 2007

[7] Augusto Di Gianfrancesco 2016 Materials for Ultra-Supercritical and Advanced Ultra-Supercritical Power Plants Woodhead Publishing

[8] "Ocean Energy Technology Assessment, " Meridian Corporation, Falls Church, VA, July 1983.

[9] Alemberti et al (2012) The European lead fast reactor: design, safety approach and safety characteristics, IAEA Technical meeting on impact of Fukushima event on current and future FR designs, Dresden, Germany

[10] Ofer, s. , "An Experimental Study of Evaporation from Round Turbulent Water Jets, " prepared for DOE/ SERI under Grant No . DE-FG02-80CS-89501, February 1983 .