APPLICATIONS OF NUCLEAR ENERGY IN FUTURE

Sitek, J., Nečas, V.,
Institute of Nuclear and Physical Engineering , Faculty of Electrical Engineering and Information Technology, Slovak University of Technology, Bratislava

jozef.sitek@stuba.sk, vladimir.necas@stuba.sk

Abstract
Concepts and international frames of generation IV nuclear reactors. A review of use of nuclear energy for non electric applications especially in areas such as seawater desalination, hydrogen production, district heating and other industrial applications

Keywords
Fission reactors types , fast reactors, heat production, hydrogen production

1 INTRODUCTION

Nuclear power is expected to move in future far beyond its historical role as solely a producer of electricity to such non-electric applications which will have tremendous potential. In this century the environmental benefit of nuclear energy can expand and extend to other energy products besides electricity. Nuclear energy can be used to generate hydrogen for use as a transport fuel, and to desalinate water in areas where water is in short supply. Therefore, new system will be needed requiring deployment of nuclear power plant. Nuclear energy have to be also produced more safely and economically with long-term supply and without adverse environmental impacts.

2 GENERATION IV NUCLEAR REACTOR

To enhance the role of nuclear energy systems in future it is necessary to create innovative nuclear systems at present known as Generation IV[1]. This system comprise the nuclear reactor and its energy conversion systems, as well as the necessary facilities for the entire fuel cycle from ore extraction to final waste disposal. To achieve the aims of Generation IV system, four areas must be developed, sustainability, safety and reliability ,proliferation resistance and physical protection and economics. Sustainability includes the extracting the nuclear fuel supply by recycling used fuel, with reduction of residual radioactive waste at the accept impact on the environment. Safety and reliability must be transparent, understood also by non-experts and enhance public confidence of safety of nuclear energy. Proliferation resistance and physical protection will be achieved by improved design features with an aim to be unattractive for diversion .Generation IV systems will have a clear life cycle financial risk comparable to other energy sources and the financial risk will be comparable to other energy projects. The limiting factor facing an essential role for nuclear energy with the once-through cycle is the availability of repository space and in longer term also availability of uranium resources. Closed fuel cycles permit partitioning the nuclear waste and management of each fraction with the best strategy .Advanced waste management strategies include the transmutation technologies, cost effective decay-heat management and flexible waste storage .Motivation for selection of Generation IV systems was to identify systems that make significant advances toward the technology goals and ensure that the important missions. of electricity. generation, hydrogen and heat production and actinide management. .Six designs have been selected [1]for further research and development, and subsequent deployment. Gas-cooled fast reactor (**GFR**) , Lead-cooled reactor (**LFR**), Molten salt reactor (**MSR**), Sodium- cooled fast reactor (**SFR**), Very high temperature reactor (**VHTR**) ,Super critical water-cooled reactor **(SCWR**)[2].

3 NON-ELECTRIC APPLICATIONS

Many innovative designs for nuclear reactors within the small-to-medium size range will be addressed. Such reactors are expected to play a positive role in fulfilment for the need of non-electric applications of nuclear power [3,4]. Non-electric applications of nuclear energy have been considered since the very beginning of nuclear energy development. With the dramatic increase in oil and gas prices in the last few years, and also due to rising concerns of the green house gas emissions and their impact on climate change, there is renewed worldwide interest in considering nuclear energy sources for non- electric applications. It has a still unexploited potential to produce in the combined heat and power (CHP) mode, process heat and steam in a broad temperature range.While considering deployment of nuclear energy into newer possible applications, challenges and difficulties should not be overlooked. Moving from their potential to realities is undoubtedly feasible, but it will need time, investments, and policy measures to address a wide range of techno-economic and socio-political challenges. Public acceptance is a major issue for nuclear energy. Non-electric applications of nuclear energy can play an important role in enhancement of their public acceptance. Nuclear community would have three priorities. First to ensure protection when nuclear energy is used to produce electricity, for district heating,desalination or hydrogen production, that is used safely, securely, and with minimal proliferation risk. Second, to ensure continued technological innovation for improvement of economic viability, enhanced safety, security and proliferation resistance. Third, to ensure that the needs of developing countries are taken into account. However lack of confidence in political stability, nuclear regulatory policies and financial aspects in many countries interested in nuclear technology has been a negative factor. To overcome this, partnership of utilities large industrials will be welcome. The role of governments in recognizing social benefits and in reducing various risks is also desirable.

4 CONCLUSION

Sustainable nuclear energy should be based on fissible material regeneration. Fast neutron system can achieve the goal. Now, design feature on international studies are developed for future nuclear systems. It suppose that Generation IV type reactors would be build before 2030 year.

In considering the deployment of nuclear energy into advanced applications, challenges and difficulties should not be overlooked; in particular, it should be acknowledged that a scientific potential is not a technical reality and that competition will drive the choice of energy sources for each application. Moving from their potential to realities is undoubtedly feasible, but will need time, investments, and policy measures to address a wide range of techno-economic and socio-political challenges. Public acceptance is a major issue for nuclear energy. Advanced applications of nuclear energy can play an important role in enhancing public acceptance.

5 REFERENCES

[1] A Technology Roadmap for Generation IV Nuclear Energy Systems ,Issued by the US DOE Nuclear Energy Research Advisory Committee and Generation IV International Forum, GIF-002-00,2002

[2] Murty K.L., Charit I.,(2008) Structural materials for Gen-IV nuclear reactors: Challenges and opportunities :Journal of Nuclear Materials, Vol.383, 189-

[3] IAEA: Non-electric Applications of Nuclear Power, Proc.Int.Conf., Oarai, Japan,2007

[4] IAEA: Advanced Application of Water Cooled Nuclear Power Plants, IAEA, Vienna, 2008