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Supercritical water reactor

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INTRODUCTION

Current scenarios predict a global demand for electricity 2-3 times higher in the next 50 years compared to nowadays. Today there are about 440 nuclear power reactors operating in 30 countries, most of which will exhaust their resources by 2050. If nuclear's energy share of the worldwide energy production will remain unchanged at a level of 14%, at least 1,000 nuclear reactors would have to be built.

Thus in 2001, nine countries (Argentina, Republic of Korea, Brazil, Canada, Republic of South Africa, United Kingdom, France, United States and Japan) signed the founding document of Generation IV International Forum (GIF) in order to develop nuclear systems that can fulfill the increasing world electric power needs.

SCWR

Currently, there is a number of Generation IV SCWR concepts under development worldwide. It is a high-temperature, high-pressure water-cooled reactor that operates above the thermodynamic critical point of water (above 374°C, 22.1 MPa). The main advantage of the SCWR is improved economics due to increase in thermal efficiency from 30 – 35% to approximately 45 – 50%. Moreover, the use of a high-temperature, single-phase coolant allows to simplify plant’s operations and lower expenses by decreasing its electrical-energy costs [1].

SCWR DESIGN OPTIONS

The reactor core may have a thermal or a fast-neutron spectrum, depending on the core design. The concept may be based on current pressure vessel or on pressure tube reactors, and thus use light water or heavy water as a moderator. It opens the way for a number of concepts.

LIGHT WATER REACTOR

The SCWR concept was developed at the University of Tokyo in 1989 and became a global concern after being selected by the Generation IV International Forum in 2002. It’s Pressure-vessel, since 1989 (thermal version) and 2005 (fast version) [2].

CANDU-SCWR

Another concept proposed by Canada is generically called CANDU-SCWR, It is a pressured tube type reactor with fuel channels separating the light water coolant from the heavy water moderator [2].

CONCLUSION.

Nuclear energy systems are essential to meet the world’s growing energy demand while providing competitively-priced and reliable energy in a safe and sustainable way.

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Radioactive waste vitrification

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As the world fossil fuel reserves diminish, alternate energy sources will become increasingly important. One of the most commonly discussed forms of alternative energy is nuclear power. Although there are a number of pros and cons to nuclear power generation, one aspect that has received some attention in the news over the past few years is the long-term storage solutions for nuclear waste from both past, current, and future productions.

Nuclear Waste

Nuclear waste currently in storage comes from three principal sources: spent fuel from commercial or research reactors, liquid waste from the reprocessing of spent fuel, and waste from the nuclear weapons and propulsions industry. Most of the storage concerns relate to so-called ‘high level’ nuclear waste, which are highly radioactive, require cooling and containment because their decay gives off heat and radiation, and have an extremely long half-life. In particular, some radioactive isotopes such as Tc-99, Se-79, and I-129 are mobile in water, requiring a storage solution that reduces their ability to move into the groundwater.

In the US, most nuclear waste storage is temporarily done on site. Spent nuclear fuel is kept in pools of recirculated water to keep it cool while the increased radioactivity dies down before it either reprocessed to recover the plutonium or kept in dry storage for eventual deposit into a geological repository. For the nuclear waste resulting from weapons development, the majority of the waste is stored at the Hanford site in southeastern Washington, where the plutonium for the US weapons was produced. Much of the waste there is stored in 177 buried tanks as a combination of both high-level and low-level liquid waste. These tanks were never intended for long-term waste storage and several are known to be leaking.

Vitrification

The desired long-term storage form for nuclear waste is a relatively insoluble, compact solid. As a solid, the waste becomes easier to store and handle; a small volume is desired because there are likely to be few candidates for long-term storage spaces and thus space will be at a premium. Keeping the solubility low reduces the chances of groundwater contamination. The resulting solid is then likely to be packaged, which provides additional barriers to contamination of the environment, but the effects of radiation on the surrounding matrix packaging are not negligible.

Amorphous borosilicate’s have been identified as one option for nuclear waste storage forms. To produce the glass, the waste is dried, heated to convert the nitrates to oxides, and then mixed with glass-forming chemicals and heated again to very high temperatures (approximately 1000 °C) to produce the melt. This is then poured into a containment vessel where it cools to form a glass. The containment vessel can then be sealed, decontaminated,