World Academy of Science, Engineering and Technology
International Journal of Nuclear and Quantum Engineering
Vol:10, No:12, 2016

Development of Scenarios for Sustainable Next Generation Nuclear System

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Abstract : The Republic of Korea has been facing strong storage crisis from nuclear waste generation as At Reactor (AR) temporary storage sites are about to reach saturation. Since the country is densely populated with a rate of 491.78 persons per square kilometer, Construction of High-level waste repository will not be a feasible option. In order to tackle the storage waste generation problem which is increasing at a rate of 350 tHM/Yr. and 380 tHM/Yr. in case of 20 PWRs and 4 PHWRs respectively, the study strongly focuses on the advancement of current nuclear power plants to GEN-IV sustainable and ecological nuclear systems by burning TRUs (Pu, MAs). First, Calculations has made to estimate the generation of SNF including Pu and MA from PWR and PHWR NPPS by using the IAEA code Nuclear Fuel Cycle Simulation System (NFCSS) for the period of 2016, 2030 (including the saturation period of each site from 2024~2028), 2089 and 2109 as the number of NPPS will increase due to high import cost of non-nuclear energy sources. 2ndly, in order to produce environmentally sustainable nuclear energy systems, 4 scenarios to burnout the Plutonium and MAs are analyzed with the concentration on burning of MA only, MA and Pu together by utilizing SFR, LFR and KALIMER-600 burner reactor after recycling the spent oxide fuel from PWR through pyro processing technology developed by Korea Atomic Energy Research Institute (KAERI) which shows promising and sustainable future benefits by minimizing the HLW generation with regard to waste amount, decay heat, and activity. Finally, With the concentration on front and back end fuel cycles for open and closed fuel cycles of PWR and Pyro-SFR respectively, an overall assessment has been made which evaluates the quantitative as well as economical combativeness of SFR metallic fuel against PWR once through nuclear fuel cycle.

Keywords : GEN IV nuclear fuel cycle, nuclear waste, waste sustainability, transmutation
Conference Title : ICNPPE 2016 : International Conference on Nuclear Power Plants Engineering
Conference Location : Bangkok, Thailand
Conference Dates : December 12-13, 2016