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Basic analysis of the thermal-hydraulics of the Advanced Micro Reactor (AMR)

South Africa can achieve safe affordable base load energy using nuclear power integrated with renewable energy sources on a decentralized basis. This suggests the development of a micro modular nuclear reactor, to supply energy to towns, small communities, mines, and processing plants. A High Temperature Advanced Micro Reactor (AMR) is in the process of being developed and the design philosophy is to design for inherent safety, using technology that has been developed and validated in previous HTR programs. The concept is based on existing experience and expertise gained during the Pebble Bed Modular reactor (PBMR) project. The AMR reactors are to be factory built to obtain good quality control and rolled out to various sites. Once the reactor has reached its end of life, it would be returned to a licensed organisation for refuelling. The AMR produces 10MW of thermal power. The reactor configuration uses hexagonal graphite blocks for structural and moderator material, which are arranged to form a cylindrical core layout. The fuel assemblies are silicon carbide tubes that house coated particle fuel, immersed in a lead-bismuth eutectic alloy (LBE). Each fuel assembly is contained in a boring within the graphite moderator that allows an annulus for cooling. There are 420 fuel assemblies in the core using low enriched fuel in the form of UO2 or UCO. The helium coolant enters the core at 320˚C and exits at 750˚C. The mechanical, neutronic and thermal-hydraulic design of the AMR, is being evaluated using the OSCAR-5 code package, together with the Serpent neutronic code to perform the basic neutronic studies. The Flownex package is used to determine the thermal-hydraulic and safety evaluation for the Design Base Accident (DBA) specifically the Depressurized Loss of Forced Cooling (DLOFC) event.

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