G4M (Gen4 Energy Inc., USA)

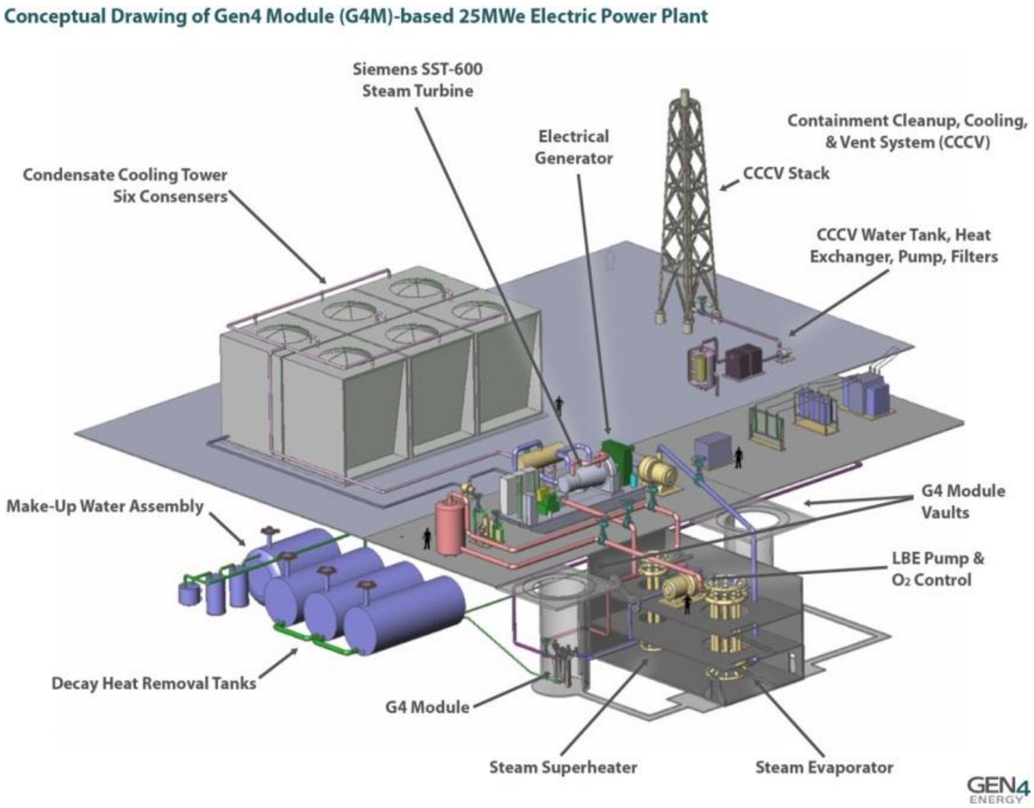

FIG. 25. Depiction of the G4M plant

Reactor type:	*Liquid metal cooled reactor*
Electrical capacity:	*25 MW(e)*
Thermal capacity:	*70 MW(th)*
Coolant:	*Lead–bismuth*
Primary circulation:	*Forced circulation*
System pressure:	*N/A*
Core outlet temperature:	*500°C*
Thermodynamic cycle:	*Indirect Rankine cycle*
Fuel material:	*Uranium nitride*
Fuel enrichment:	*19.75%*
Fuel cycle:	*10 years*
Reactivity control:	*Rod insertion and B_4C ball insertion*
No. of safety trains:	*2*
Emergency safety systems:	*N/A*
Residual heat removal systems:	*Passive*
Design life:	*5–15 (nominal 10) years*
Design status:	*Conceptual design*
Distinguishing features:	*Transportable factory fuelled design*

Introduction

Founded in 2007 as Hyperion Power Generation Inc., Gen4 Energy was formed to develop the Gen4 Module (G4M), first conceived at the Los Alamos National Laboratory (LANL) in New Mexico. Through the commercialization programme at LANL's Technology Transfer Division, Hyperion Power Generation was awarded the exclusive licence to utilize the intellectual property and develop the module.

Description of the nuclear systems

The reactor has been designed to deliver 70 MW of power over a ten year lifetime without refuelling. The materials in the core are uranium nitride fuel, HT-9 as the structural material, lead–bismuth eutectic as the coolant, quartz as the radial reflector, and B_4C rods and pellets for in-core reactivity control. The reactor is approximately 1.5 m in diameter and 2.5 m in height, in which there are 24 subassemblies containing the fuel pins. The pin assembly is filled with liquid LBE to provide a high conductivity thermal bond between the fuel and cladding. The gap in the fuel pins has been sized to preclude fuel clad mechanical interference throughout the core's lifetime. A plenum is located at one end, which serves as both a fission gas plenum and a repository for the LBE inside the pin as the fuel swells with burnup.

The core coolant is LBE, with a mixed mean exit temperature of 500°C. This temperature limits the cladding temperature, so that maximum cladding creep over the 10 year lifetime of the reactor is less than 1%. During operational shutdown, decay heat is removed from the G4M by two methods. The first method transfers heat from the core by natural circulation of coolants in the primary and secondary loops to the steam generators. The second removes heat by passive vaporization of water from the surface of the secondary containment vessel.

Description of the safety concept

There are two independent, safety grade reactivity control systems in the core: a control rod system comprising 18 B_4C control rods and a reserve shutdown system consisting of a central cavity into which B_4C spheres may be inserted into the core. Both the control rods and the spheres are inserted into dry wells in the core, which are hexagonally shaped thimbles. These thimbles penetrate the reactor vessel and are sealed from the primary coolant. Both systems can independently take the core to long term cold shutdown.

The safety concept of the HPM is driven by a set of design criteria that the designers believe are sufficient to ensure protection of the facility and its surroundings. These criteria are a sealed core, operational simplicity, minimal to no in-core movement, mechanical components and separation of power production and conversion operations.

Deployment status

Gen4 Energy announced in April 2012 that they would not be pursuing the US Department of Energy's small modular reactor licensing support programme because they concluded that "use of well-known Light Water Reactor (LWR) technology of 45 to 300 MW intended for deployment in the USA had a much higher probability of success given the [Funding Opportunity Announcement's] stated maximum of two awards" [10].