CLAIMS:

1. A steam generation system comprising a steam generator, a gas supply system for the generator, a water supply system for the generator, and a controller for the steam generation system, wherein:

the steam generator comprises:

inputs for hydrogen gas, oxygen gas, a purge gas and water;

an igniter arranged to ignite hydrogen and oxygen within the generator; and

an output for pressurised steam generated by the ignition of hydrogen and oxygen within the generator:

the gas supply system comprises a first, high-pressure stage and a second, low-pressure stage, in which:

the first, high-pressure stage is arranged to receive hydrogen, oxygen and purge gas under pressure and to supply those gases to the second, low-pressure stage under reduced pressure;

the second, low-pressure stage is arranged to receive the gases from the first, high-pressure stage under reduced pressure and to supply those gases to the steam generator:

the water supply system is arranged to supply water under pressure to the steam generator: and

the controller is arranged to control operation of the steam generation system in Prime, Run and Shutdown phases, in which:

in the Prime phase, hydrogen gas and oxygen gas are introduced separately into the first, high-pressure stage and pressure of the hydrogen and oxygen is allowed to build up in the first, high-pressure stage;

in the Run phase, hydrogen gas and oxygen gas are introduced separately into the second, low-pressure stage at a lower pressure than that prevailing in the first, high-pressure stage; the hydrogen and oxygen gases are then supplied separately into the

steam generator where they mix and are ignited by the igniter; and water is supplied into the steam generator to be mixed with the ignited gases at a point downstream of the igniter; and

in the Shutdown phase, the supply of hydrogen and oxygen gases to the steam generator is ceased, the supply of water to the steam generator is ceased, and a purge gas is supplied to the gas supply system and the steam generator to purge the gas supply system and the steam generator of hydrogen and oxygen gases.

2. A steam generation system according to claim 1 wherein, in the Prime phase, respective low-flow valves are initially opened to allow the pressure of the hydrogen and oxygen to build up gradually; and subsequently, respective high-flow valves are opened to allow the pressure of the hydrogen and oxygen to build up more quickly.

3. A steam generation system according to claim 1 or 2 wherein, in the Run phase, the controller calculates, from measurements of temperature, pressure and mass flow of hydrogen and oxygen, a stoichiometric mass ratio of oxygen to hydrogen; and controls valves in the system to maintain said stoichiometric mass ratio at a desired level.

4. A steam generation system according to claim 3 wherein, in the Run phase, the controller monitors water mass flow and either hydrogen or oxygen mass flow; and adjusts those mass flows to achieve a desired overall mass flow through the steam generator.

5. A steam generation system according to any of claims 1 to 4, wherein operation of the steam generation system is controlled by user actuation of a Start Button and a Shutdown Button.

6. A steam generation system according to claim 5 wherein, in use, the Prime phase is started by a first actuation of the Start Button.

7. A steam generation system according to claim 5 or 6 wherein, in use, the Run phase is started by actuation of the Start Button after completion of the Prime phase.

8. A steam generation system according to claim 5, 6 or 7 wherein, in use, the steam generation system enters a Standby condition upon actuation of the Start Button during the Run phase.

9. A steam generation system according to any of claims 1 to 8, comprising at least one indicator to indicate at least one of successful completion of the Prime phase; successful activation of the Run phase; and a Fault condition.

10. A steam generation system according to any of claims 1 to 9, wherein the controller is operative to detect fault conditions comprising one or more of the following at or within a predetermined time:

pressure within the system falling outside a predetermined limit;

flow rate within the system falling outside a predetermined limit;

temperature within the system falling outside a predetermined limit; and

electrical ignition current supplied to the steam generator falling outside a predetermined limit.

11. A steam generation system according to any claims 1 to 10, wherein the controller is operative to initiate the Shutdown phase upon a fault condition being detected.

12. A steam generation system according to any of claims 1 to 11, wherein the steam generator comprises:

- a pressure vessel;
- a water jacket in the pressure vessel;
- a water inlet arranged to receive water under pressure and feed it to said water jacket; and,

- a water outlet positioned within the pressure vessel between the gas inlet and the steam outlet,

wherein, in use: water received at the water inlet passes along said water jacket to provide cooling of the pressure vessel and is output at said water outlet to provide a water spray and/or film that mixes with the ignited hydrogen and oxygen to vaporize the water spray and/or film, the water outlet comprising a body around which gas flows, when flowing from the gas inlet to the steam outlet.

13. A steam generation system according to claim 12, wherein the pressure vessel comprises a double-walled construction, forming the water jacket between the walls.

14. A steam generation system according to claim 12 or 13, wherein the pressure vessel comprises a combustion zone within which the igniter is mounted, the combustion zone being configured to receive hydrogen and oxygen from the gas inlet, and to mix said gases together during the combustion process.

15. A steam generation system according to any of claims 12 to 14, wherein the pressure vessel comprises a water outlet zone within which the water outlet is mounted.

16. A steam generation system according to claims 14 and 15, wherein the water outlet is arranged at a tip of a bullet-shaped portion, the bullet-shaped portion being mounted concentrically within the pressure vessel, along a central axis of the pressure vessel, with the tip facing the combustion zone.

17. A steam generation system according to any of claims 12 to 16, wherein the water outlet comprises a nozzle.

18. A steam generation system according to claim 17, wherein the water outlet comprises a plurality of channels for creating an array of water.

19. A steam generation system according to claim 18, wherein the array is a radial fan, extending generally radially of a principal axis of the pressure vessel.

20. A steam generation system according to any of claims 12 to 19, wherein the water outlet comprises molybdenum.

21. A steam generation system according to any of claims 12 to 20, wherein the igniter comprises a glow plug.

22. A steam generation system according to any of claims 12 to 21, wherein the steam outlet is at an opposite end of the pressure vessel to the gas inlet.

23. A steam generation system according to any of claims 12 to 22, wherein the steam outlet incorporates a valve control means.

24. A steam generation system according to claim 23, wherein the valve control means is a De Laval nozzle.

25. A steam generation system according to any of claims 12 to 24, wherein the pressure vessel is substantially cylindrical.

26. A steam generation system according to any of claims 12 to 25, wherein the pressure vessel incorporates a mixing zone that provides a space within which gases in the vessel are mixed, in use.

27. A steam generation system according to claims 14, 15 and 26, wherein the water outlet zone is positioned between the combustion zone and the mixing zone.

28. A turbine generator incorporating at least one steam generation system according to any of the preceding claims.