Claims

1. A method of initiating operation of a hydrogen-producing fuel cell system (HPFCS), the method comprising:

detecting an inability of a primary power source to satisfy an applied load;

responsive to the detecting, initiating supply of stored hydrogen gas from a hydrogen storage device of the HPFCS to a fuel cell stack of the HPFCS, consuming the stored hydrogen gas with the fuel cell stack to produce an initial electrical output from the fuel cell stack, and at least partially satisfying the applied load with the initial electrical output;

initiating startup of a fuel processor of the HPFCS; and

subsequent to at least a threshold startup time for the fuel processor, initiating supply of generated hydrogen gas from the fuel processor to the fuel cell stack, consuming the generated hydrogen gas with the fuel cell stack to produce a subsequent electrical output from the fuel cell stack, and at least partially satisfying the applied load with the subsequent electrical output,

wherein the initiating the supply of the generated hydrogen gas includes initiating the supply of the generated hydrogen gas responsive to a generated hydrogen gas supply pressure of the generated hydrogen gas exceeding a stored hydrogen gas supply pressure at which the stored hydrogen gas is provided to the fuel cell stack.

2. The method of claim 1, wherein the detecting includes detecting a decrease in a monitored voltage, and wherein the monitored voltage is at least one of:

(i) a primary voltage of the primary power source configured to provide a primary electric current to the applied load;

(ii) a grid voltage of an electrical grid configured to provide a grid electric current to the applied load; and

(iii) an energy storage device voltage of an electrical energy storage device configured to provide stored electrical current to the applied load.

3. The method of claim 1, wherein the applied load is from one or more of the HPFCS and an energy-consuming device.

4. The method of claim 1, wherein the initiating the startup of the fuel processor is performed at least partially concurrently with the consuming the stored hydrogen gas with the fuel cell stack to produce the initial electrical output.

5. The method of claim 1, wherein the initiating the startup of the fuel processor includes utilizing a portion of the initial electrical output to power one or more components of the fuel processor.

6. The method of claim 1, wherein the at least partially satisfying the applied load with the initial electrical output includes at least partially satisfying the applied load with the initial electrical output during a startup timeframe that includes the threshold startup time and in which the stored hydrogen gas is the only hydrogen gas provided to the fuel cell stack.

7. The method of claim 1, wherein the at least partially satisfying the applied load with the initial electrical output includes satisfying the applied load solely with the initial electrical output.

8. The method of claim 1, wherein the method further includes at least partially satisfying the applied load with the initial electrical output within a threshold initial supply time, wherein the threshold initial supply time is less than a threshold fraction of the threshold startup time for the fuel processor, and wherein the threshold fraction is less than 80% of the threshold startup time for the fuel processor.

9. The method of claim 8, wherein the fuel processor is a thermally primed fuel processor, and wherein the method includes maintaining the fuel processor at a thermally primed temperature prior to the detecting.

10. The method of claim 1, wherein the fuel processor is a thermally primed fuel processor, wherein the method further includes maintaining the fuel processor at a thermally primed temperature prior to the detecting, and wherein the initiating the startup of the fuel processor includes heating a reforming region of the fuel processor from the thermally primed temperature to a hydrogen-producing temperature range.

11. The method of claim 1, wherein the initiating the supply of the generated hydrogen gas includes initiating the supply of the generated hydrogen gas responsive to the fuel processor reaching a hydrogen-producing state in which a generated hydrogen gas flow rate of the generated hydrogen gas is sufficient to satisfy the applied load.

12. The method of claim 1, wherein the method further includes ceasing the supply of the stored hydrogen gas from the hydrogen storage device to the fuel cell stack.

13. The method of claim 12, wherein the ceasing is at least one of:

(i) subsequent to the initiating the supply of the generated hydrogen gas; and

(ii) responsive to the initiating the supply of the generated hydrogen gas.

14. The method of claim 1, wherein the HPFCS further includes an electrical energy storage device configured to selectively provide a stored electrical current to the applied load.

15. The method of claim 14, wherein the HPFCS includes a stored hydrogen gas flow control valve configured to selectively permit or block flow of the stored hydrogen gas to the fuel cell stack, and wherein the initiating the supply of the stored electrical current comprises utilizing a portion of the stored electrical current to open the stored hydrogen gas flow control valve and permit flow of the stored hydrogen gas to the fuel cell stack.

16. The method of claim 15, wherein, prior to the initiating the supply of the stored hydrogen gas, the method further includes determining that the hydrogen storage device includes hydrogen gas sufficient to provide the stored hydrogen gas to the fuel cell stack for at least the threshold startup time for the fuel processor.

17. The method of claim 1, wherein the method further includes regulating a generated hydrogen gas supply pressure at which the generated hydrogen gas is supplied to the fuel cell stack.

18. The method of claim 17, wherein the regulating the generated hydrogen gas supply pressure includes utilizing a generated hydrogen gas pressure regulator of the HPFCS, and wherein the regulating the generated hydrogen gas supply pressure includes ensuring that the generated hydrogen gas supply pressure is at least a threshold pressure differential greater than a stored hydrogen gas supply pressure at which the stored hydrogen gas is provided to the fuel cell stack.

19. A hydrogen-producing fuel cell system (HPFCS), comprising:

a fuel cell stack configured to receive an oxidant and hydrogen gas and to generate an electrical output from the oxidant and hydrogen gas;

a fuel processor configured to receive one or more feed streams and to react the one or more feed streams to produce generated hydrogen gas; and

a hydrogen storage device configured to store a volume of stored hydrogen gas;

wherein the fuel cell stack is configured to at least partially satisfy an applied load with the electrical output when a primary power source that normally is adapted to satisfy the applied load is not providing a primary electrical output to satisfy the applied load, wherein the HPFCS is configured to detect an inability of the primary power source to satisfy the applied load, and wherein responsive to a detection of the inability of the primary power source to satisfy the applied load, the HPFCS is configured to:

initiate a startup of the fuel processor;

supply the stored hydrogen gas to the fuel cell stack to produce an initial electrical output from the stored hydrogen gas during the startup of the fuel processor and at least partially satisfy the applied load with the initial electrical output; and

supply the generated hydrogen gas to the fuel cell stack to produce a subsequent electrical output from the generated hydrogen gas when the fuel processor reaches a hydrogen-producing state from the startup and at least partially satisfy the applied load with the subsequent electrical output;

wherein the HPFCS is configured to restrict flow of the stored hydrogen gas to the fuel cell stack when the fuel processor reaches the hydrogen-producing state,

wherein the HPFCS further comprises a stored hydrogen gas check valve that is configured to permit flow of the stored hydrogen gas to the fuel cell stack when a generated hydrogen gas supply pressure is less than a threshold pressure differential greater than a stored hydrogen gas supply pressure, and wherein the stored hydrogen gas check valve is configured to restrict flow of the stored hydrogen gas to the fuel cell stack when the generated hydrogen gas supply pressure is or exceeds the threshold pressure differential greater than the stored hydrogen gas supply pressure.

20. The HPFCS of claim 19, wherein the fuel processor produces the generated hydrogen gas with the generated hydrogen gas supply pressure, wherein the generated hydrogen gas supply pressure increases during the startup of the fuel processor, and wherein the fuel processor reaches the hydrogen-producing state when the generated hydrogen gas supply pressure is the threshold pressure differential greater than the stored hydrogen gas supply pressure at which the stored hydrogen gas is supplied to the fuel cell stack.

21. The HPFCS of claim 19, further comprising a generated hydrogen gas check valve configured to selectively permit supply of the generated hydrogen gas to the fuel cell stack when the generated hydrogen gas supply pressure is or exceeds the threshold pressure differential greater than the stored hydrogen gas supply pressure and to prevent flow of the generated hydrogen gas to the fuel cell stack when the generated hydrogen gas supply pressure is less than the threshold pressure differential greater than the stored hydrogen gas supply pressure.

22. The HPFCS of claim 19, further comprising an electrical energy storage device configured to supply a stored electrical current to at least partially satisfy the applied load, wherein the HPFCS is configured to produce the initial electrical output from the stored hydrogen gas within a threshold initial supply time from the detection of the inability of the primary power source to satisfy the applied load, wherein the HPFCS is configured to produce the subsequent electrical output from the generated hydrogen gas within at least a threshold startup time from the detection of the inability of the primary power source to satisfy the applied load, wherein an energy storage capacity of the electrical energy storage device is sufficient to satisfy the applied load during the threshold initial supply time, and wherein the energy storage capacity of the electrical energy storage device is less than that sufficient to satisfy the applied load during the threshold startup time.

23. The HPFCS of claim 19, wherein the HPFCS is configured to utilize a portion of the initial electrical output to facilitate the startup of the fuel processor.