CLAIMS

What is claimed is:

1. A computer-implemented method of supplying a fuel gas to a fueling system, wherein a processor is configured to control a number of valves in the fueling system to allow or restrict gas flow to perform operations comprising

pre-fill inerting the fueling system, wherein the processor controls the number of valves to

cause a purge gas to be supplied to a fuel gas supply manifold by selectively fluidically connecting a purge gas supply to the fuel gas supply manifold of the fueling system; and

cause the fuel gas supply manifold to be selectively fluidically connected to a vent manifold;

leak-checking the fueling system, wherein the processor controls the number of valves to cause the fuel gas to be supplied to the fuel gas supply manifold by selectively fluidically connecting a fuel gas supply to the fuel gas supply manifold;

charging a pilot subsystem of the fueling system with the fuel gas, wherein the processor controls the number of valves to cause the fuel gas supply manifold to be selectively fluidically connected to the pilot subsystem;

filling the fueling system with the fuel gas, wherein the processor controls the number of valves to cause the fuel gas supply manifold to be selectively fluidically connected to one or more fuel gas storage vessels to flow the fuel gas from the fuel gas supply to the one or more fuel gas storage vessels via the fueling system; and

post-fill inerting the fueling system, wherein the processor controls the number of valves to cause the purge gas supply to be selectively fluidically connected to the fuel gas supply manifold.

2. The computer-implemented method of claim 1, wherein the pre-fill inerting includes

monitoring a first pressure of the purge gas in the fuel gas supply manifold by a sensor in electrical communication with the processor;

responsive to the first pressure of the purge gas dropping below a first threshold, issuing an alarm;

venting the fueling system by the selective fluidic connection of the fuel gas supply

manifold to the vent manifold;

monitoring, by the sensor, a second pressure of the purge gas in the fuel gas supply manifold; and

responsive to the second pressure dropping below a second threshold, incrementing a counter by the processor.

3. The computer-implemented method of claim 1, wherein the leak-checking includes

monitoring a first pressure of the fuel gas in the fuel gas supply manifold at a first time by a sensor in electrical communication with the processor;

responsive to the first pressure having a time rate of change below a threshold, isolating the fuel gas from the fuel gas supply manifold; and

monitoring, by the sensor, a second pressure of the fuel gas in the fuel gas supply manifold at a second time later than the first time; and

responsive to the second pressure of the fuel gas dropping below a second threshold, issuing an alarm.

4. The computer-implemented method of any of the preceding claims further comprising venting the fueling system by the selective fluidic connection of the fuel gas supply manifold to the vent manifold.

5. The computer-implemented method of any of the preceding claims, further responsive to the second pressure of the fuel gas dropping below a second threshold, inerting the fuel gas supply manifold.

6. The computer-implemented method of claim 1, wherein

the fueling system includes a fuel gas storage vessel;

the pilot subsystem includes

a pilot subsystem shutoff valve in fluid communication with the fuel gas supply,

a shuttle valve operative to contain the fuel gas within the fuel gas storage vessel responsive to a pressure of the fuel gas in the pilot subsystem, and

a temperature-pressure relief device operative to vent the pressure of the fuel gas in the pilot subsystem responsive to a detection of an elevated temperature in the fuel gas storage vessel, wherein the shuttle valve is configured to vent the fuel gas from the fuel gas storage vessel responsive to the venting of the pressure of the fuel gas in the pilot subsystem

via the temperature-pressure relief device; wherein charging the pilot subsystem includes

opening, by the processor, the pilot subsystem shutoff valve,

monitoring a first pressure of the fuel gas in the pilot subsystem by a sensor in electrical communication with the processor, and

responsive to the first pressure having a time rate of change below a threshold, closing, by the processor, the pilot subsystem shutoff valve.

7. The computer-implemented method of any of claims 1–3 or 6, wherein the pilot subsystem further includes a pilot gas throttle in fluid communication with the pilot subsystem shutoff valve and operative to throttle flow of the fuel gas into the pilot subsystem.

8. The computer-implemented method of claim 1, wherein

the fueling system includes a fuel gas storage vessel and the processor controls the number of valves to cause the fuel gas storage vessel to be selectively fluidically connected with the fuel gas supply manifold, and the

filling the fueling system with the fuel gas includes

determining, by the processor, a fill pressure set point;

supplying the fuel gas to the fuel gas storage vessel via the fuel gas supply manifold by the selective fluidic connection of the fuel gas supply to the fuel gas supply manifold;

monitoring a temperature of the fuel gas storage vessel by a temperature sensor in electrical communication with the processor;

responsive to the monitoring of the temperature, issuing an alarm;

monitoring a pressure of the fuel gas in the fuel gas storage vessel by a pressure sensor in electrical communication with the processor; and

responsive to the pressure of the fuel gas in the fuel gas storage vessel reaching the fill pressure set point, isolating, by the processor, the fuel gas from the fuel gas supply manifold.

9. The computer-implemented method of any of claims 1–3, 6, or 8, wherein determining the fill pressure set point is based on at least one of an initial pressure or an initial temperature of the fuel gas in the fuel gas storage vessel measured by the respective pressure sensor or temperature sensor.

10. The computer-implemented method of claim 8, wherein the fill pressure set point is determined from an initial pressure in the fuel gas storage vessel and an initial ambient temperature.

11. The computer-implemented method of claim 1, wherein the post-fill inerting includes

isolating the fuel gas from the fuel gas supply manifold by the selective fluidic connection of the purge gas supply to the fuel gas supply manifold;

venting the fuel gas supply manifold by the selective fluidic connection of the fuel gas supply manifold to the vent manifold;

monitoring a first pressure of the fuel gas in the fuel gas supply manifold by a sensor in electrical communication with the processor;

responsive to the first pressure of the fuel gas dropping below a first pressure threshold, supplying the purge gas to the fuel gas supply manifold,

monitoring the first pressure of the purge gas in the fuel gas supply manifold by the sensor;

responsive to the first pressure of the purge gas having a time rate of change below a rate of change threshold, venting the fuel gas supply manifold by the selective fluidic connection of the fuel gas supply manifold to the vent manifold;

monitoring a second pressure of the purge gas in the fuel gas supply manifold by the sensor; and

responsive to the second pressure falling below a second pressure threshold, incrementing a counter by the processor.

12. The computer-implemented method of claim 3, wherein

the fuel gas supply manifold includes a first pressure zone and a second pressure zone, wherein the first pressure zone is at a first zone pressure that is greater than or equal to a second zone pressure of the second pressure zone; one of the first zone pressure or the second zone pressure includes a pressure of the fuel gas in the first pressure zone or the second pressure zone, respectively.

13. The computer-implemented method of claim 12, wherein the sensor comprises

a first sensor in fluid communication with the first pressure zone and a second sensor in fluid communication with the second pressure zone; and

the leak-checking includes

monitoring one of the first or second pressure by the first sensor; and

monitoring one of the first or second pressure by the second sensor.

14. The computer-implemented method of claim 12, wherein the sensor comprises

a first sensor in fluid communication with the first pressure zone and a second sensor in fluid communication with the second pressure zone; and

the leak-checking includes

flowing the fuel gas to the first pressure zone;

flowing the fuel gas to the second pressure zone;

arresting the flow of the fuel gas to a portion of the second pressure zone by a fuel gas shutoff valve;

monitoring a third pressure of the fuel gas in the portion of the second pressure zone downstream of the fuel gas shutoff valve; and

responsive to the third pressure of the fuel gas rising above a third threshold, issuing an alarm.

15. The computer-implemented method of any of claims 1–3, 6, or 8, wherein

the fuel gas supply manifold includes a first pressure zone and a second pressure zone;

a first zone pressure of the fuel gas in the first pressure zone is greater than or equal to a second zone pressure of the fuel gas in the second pressure zone; and

filling the fueling system with the fuel gas includes

supplying the fuel gas to the first pressure zone at the first zone pressure;

reducing the pressure of the fuel gas in the first pressure zone from the first zone pressure to the second zone pressure;

supplying the fuel gas to the second pressure zone at the second zone pressure; and

supplying the fuel gas to the fuel gas storage vessel via the second pressure zone at the second zone pressure.

16. The computer-implemented method of claim 9, wherein

the fuel gas supply manifold includes a first pressure zone and a second pressure zone;

a first zone pressure of the fuel gas in the first pressure zone is greater than or equal to a second zone pressure of the fuel gas in the second pressure zone;

the selective fluidic connection of the fuel gas supply manifold to the vent manifold

includes a selective fluidic connection of the first pressure zone to the vent manifold and a selective fluidic connection of the second pressure zone to the vent manifold; and

the post-fill inerting includes venting the respective first and second pressure zones to the vent manifold by the respective selective fluidic connections of the first and second pressure zones to the vent manifold.

17. The computer-implemented method of any of claims 1–3, 6, 8, or 11 wherein the fuel gas is hydrogen.

18. The computer-implemented method of any of claims 1–3, 6, 8, or 11, wherein the fueling system includes a fuel gas storage vessel.

19. The computer-implemented method of claim 1, wherein the fuel gas is supplied to the fueling system by a fuel gas source, and the fuel gas source comprises a pressurized vessel operative to be selectively coupled to the fueling system by a fuel gas supply conduit.

20. The computer-implemented method of any of claims 1–3, 6, 8, or 11, further comprising purifying the fueling system, wherein the purifying includes

monitoring a first pressure of the fuel gas in the fuel gas supply manifold by a sensor in electrical communication with the processor;

responsive to the first pressure of the fuel gas dropping below a first threshold, issuing an alarm;

venting the fueling system by the selective fluidic connection of the fuel gas supply manifold to the vent manifold;

monitoring, by the sensor, a second pressure of the fuel gas in the fuel gas supply manifold; and

responsive to the second pressure dropping below a second threshold, incrementing a counter by the processor.