CLAIMS

What is claimed is:

1. A fluid distribution system comprising:

a pump, the pump adapted to selectively produce a flow of fluid;

a single use filler manifold, the single use filler manifold including a filler manifold inlet, a plurality of filler manifold outlets, and a filler manifold body conduit, the filler manifold inlet in fluid communication with each one of the plurality of filler manifold outlets via the filler manifold body conduit, the filler manifold inlet arranged with the pump for delivering a supply of fluid to the single use filler manifold, the filler manifold outlets comprising at least one standard fill outlet and an underfill outlet;

a filler valve arrangement, the filler valve arrangement including a plurality of valves arranged with the single use filler manifold such that each of the filler manifold outlets is independently occludable via a respective one of the valves of the filler valve arrangement;

a vent conduit, the vent conduit in fluid communication with the filler manifold body conduit;

a vent valve, the vent valve arranged with the vent conduit to selectively occlude the vent conduit, the vent valve in operable arrangement with the control unit;

a control unit, the control unit including a processor and a non-transitory computer readable medium bearing a fluid distribution program, the processor arranged with the computer readable medium to execute the fluid distribution program, the processor being in electrical communication with the pump and the filler valve arrangement to selectively operate the pump and the valves of the filler valve arrangement based upon instructions from the fluid distribution program, the fluid distribution program having a container filling module configured to discharge a target fill volume of the supply of fluid out of each standard fill outlet of the filler manifold outlets, discharge an underfill volume of the supply of fluid out of the underfill outlet of the filler manifold outlets, and drain a filler manifold volume of the supply of fluid from the filler manifold body conduit out of the underfill outlet of the filler manifold outlets, the underfill volume being less than the target fill volume.

2. The fluid distribution system according to claim 1, further comprising:

a plurality of single use containers, each single use container having an access

port fluidly connected to a respective one of the filler manifold outlets via an aseptic fluid connector;

wherein the container filling module of the fluid distribution program is configured to perform the following steps when executed by the processor:

feed the supply of fluid into the filler manifold inlet of the single use filler manifold,

sequentially discharge the target fill volume of fluid respectively from each standard fill outlet of the single use filler manifold into the single use containers respectively aseptically fluidly connected thereto,

after sequential target fill volume discharging, discharge the underfill volume of fluid from the underfill outlet of the single use filler manifold to the single use container aseptically fluidly connected thereto,

after underfill volume discharging, drain the filler manifold volume of fluid from the filler manifold body conduit out of the underfill outlet into the single use container aseptically fluidly connected thereto.

3. The fluid distribution system according to claim 1, further comprising:

a vent liquid sensor, the vent liquid sensor disposed in the vent conduit, the vent liquid sensor configured to generate a liquid detection signal in response to detecting liquid in the vent conduit, the control unit in electrical communication with the vent liquid sensor to receive the liquid detection signal therefrom;

an air filter, the air filter arranged with the vent conduit, the vent valve interposed between the vent liquid sensor and the air filter;

wherein the control unit is configured to cease operation of the pump and/or close the vent valve in response to receiving the liquid detection signal.

4. The fluid distribution system according to any one of claims 1 to 3, wherein the fluid distribution program includes a filler manifold priming module configured to perform the following steps when executed by the processor:

prime the filler manifold body conduit of the single use filler manifold with the filler manifold volume of the supply of fluid,

displace air in the filler manifold body conduit out of the vent conduit during priming the filler manifold body conduit, the vent valve being in an open position, and

place the vent valve in a closed position to occlude the vent conduit after the filler manifold body is primed.

5. The fluid distribution system according to any one of claim 1 to claim 4, further comprising:

a single use distributor manifold, the single use distributor manifold including a distributor manifold inlet, a plurality of distributor manifold outlets, and a distributor manifold body conduit, the distributor manifold inlet in fluid communication with each one of the plurality of distributor manifold outlets via the distributor manifold body conduit, one of the plurality of distributor manifold outlets in aseptic fluid connection with the filler manifold inlet, and the distributor manifold inlet arranged with the pump for delivering the supply of fluid to the single use filler manifold via the one of the distributor manifold outlets;

a distributor valve arrangement, the distributor valve arrangement including a plurality of valves arranged with the single use distributor manifold such that each of the distributor manifold outlets is independently occludable via a respective one of the valves of the distributor valve arrangement.

6. The fluid distribution system according to claim 5, further comprising:

recovery container and an aseptic fluid reserve pathway, the recovery container in fluid communication with the distributor manifold body conduit via the aseptic fluid reserve pathway;

wherein the fluid distribution program includes a distributor manifold draining module configured, when executed by the processor, to drain a distributor manifold volume of the supply of fluid in the distributor manifold body conduit into the aseptic fluid reserve pathway to the recovery container.

7. The fluid distribution system according to claim 6, further comprising:

a vent conduit, the vent conduit in fluid communication with the filler manifold body conduit;

a vent valve, the vent valve arranged with the vent conduit to selectively occlude the vent conduit, the vent valve in operable arrangement with the control unit;

a recovery valve, the recovery valve arranged with the aseptic fluid reserve

pathway such that the aseptic fluid reserve pathway is occludable via the recovery valve, the recovery valve in operable arrangement with the control unit;

wherein the recovery container is disposed below, in the direction gravity acts upon the distributor manifold volume, the vent valve and the single use distributor manifold;

wherein the distributor manifold draining module is configured, when executed by the processor, to open the vent valve to admit air from outside the vent conduit into the distributor manifold body conduit, and to open the recovery valve arranged with the first aseptic fluid fill pathway.

8. The fluid distribution system according to claim 7, further comprising:

a recovery high liquid sensor, the recovery high liquid sensor arranged with the recovery container and configured to generate a high recovery liquid level signal in response to detecting liquid in the recovery container at a predetermined high level, the control unit in electrical communication with the high recovery liquid sensor to receive the high recovery liquid level signal therefrom;

wherein the distributor manifold draining module is configured, when executed by the processor, in response to receiving the high recovery liquid level signal, to close the vent valve, and to close the recovery valve arranged with the first aseptic fluid fill pathway.

9. The fluid distribution system according to any one of claim 5 to claim 8, wherein the single use distributor manifold comprises an intermediary single use distributor manifold, the system further comprising:

an upstream single use distributor manifold, the upstream single use distributor manifold including an upstream distributor manifold inlet, a plurality of upstream distributor manifold outlets, and an upstream distributor manifold body conduit, the upstream distributor manifold inlet in fluid communication with each one of the plurality of upstream distributor manifold outlets via the upstream distributor manifold body conduit, one of the plurality of upstream distributor manifold outlets in aseptic fluid connection with the distributor manifold inlet of the intermediary single use distributor manifold, and the upstream distributor manifold inlet arranged with the pump for delivering the supply of fluid to the single use filler manifold;

an upstream distributor valve arrangement, the upstream distributor valve

arrangement including a plurality of valves arranged with the upstream single use distributor manifold such that each of the upstream distributor manifold outlets is independently occludable via a respective one of the valves of the upstream distributor valve arrangement.

10. A method of aseptically distributing fluid using a fluid distribution system according to any one of claim 1 to claim 9, the method comprising:

feeding a supply of fluid into a filler manifold inlet of a single use filler manifold;

discharging a fill portion of the supply of fluid respectively from all but a reserved one of a plurality of filler manifold outlets of the single use filler manifold to single use containers respectively aseptically fluidly connected thereto;

after fill portion discharging, discharging an underfill portion of the supply of fluid from the reserved one of the filler manifold outlets to a single use container aseptically fluidly connected thereto, the underfill portion being less than the fill portion;

after underfill portion discharging, draining a filler manifold volume of the supply of fluid from a body conduit of the single use filler manifold out of the reserved one of the filler manifold outlets to the single use container aseptically fluidly connected thereto.

11. The method according to claim 10, wherein draining the filler manifold volume of the supply of fluid remaining in the body conduit of the single use filler manifold includes opening a manifold vent in fluid communication with the body conduit and replacing the filler manifold volume with air in the body conduit during draining.

12. The method according to claim 11, wherein feeding the supply of fluid into the filler manifold inlet includes priming the body conduit of the single use filler manifold with the filler manifold volume, displacing air in the body conduit out of the manifold vent in fluid communication with the body conduit during priming, and closing the manifold vent after priming.

13. The method according to any one of claim 10 to claim 12, wherein discharging the fill portion comprises sequentially discharging each fill portion.

14. The method according to any one of claim 10 to claim 13, wherein the underfill portion and the filler manifold volume are together in combination substantially the same as the fill portion.

15. The method according to any one of claim 10 to claim 14, further comprising:

feeding the supply of fluid into a distributor manifold inlet of a single use distributor manifold;

discharging the supply of fluid from a first one of a plurality of distributor manifold outlets of the single use distributor manifold to the filler manifold inlet of the single use filler manifold via a first aseptic fluid fill pathway;

after draining the filler manifold volume of the supply of fluid remaining in the single use filler manifold, disconnecting the single use containers from the single use filler manifold;

draining a distributor manifold volume of the supply of fluid from the single use distributor manifold into an aseptic fluid reserve pathway to a recovery container aseptically fluidly connected thereto.

16. The method according to claim 15, wherein feeding the supply of fluid into the distributor manifold inlet of the single use distributor manifold includes introducing recovery fluid from the recovery container into the distributor manifold inlet via the aseptic fluid reserve pathway such that at least a portion of the supply of fluid comprises recovery fluid from the recovery container.

17. The method according to claim 15 or 16, wherein draining the distributor manifold volume of the supply of fluid remaining in the body conduit of the single use distributor manifold includes opening a manifold vent in fluid communication with the body conduit of the single use distributor manifold, and opening at least one recovery valve arranged with the first aseptic fluid fill pathway.

18. The method according to any one of claim 15 to claim 17, wherein the single use distributor manifold comprises an intermediary single use distributor manifold, and the method further comprising:

feeding the supply of fluid into a distributor manifold inlet of an upstream single

use distributor manifold;

discharging the supply of fluid from a first one of a plurality of distributor manifold outlets of the upstream single use distributor manifold to the distributor manifold inlet of the intermediary single use distributor manifold via an aseptic distributor fluid pathway;

wherein draining the distributor manifold volume of the supply of fluid includes draining fluid remaining in the single use distributor manifold and the upstream single use distributor manifold, and wherein the recovery container is disposed below the single use distributor manifold and the upstream single use distributor manifold in the direction gravity acts upon the distributor manifold volume.

19. The method according to any one of claim 15 to claim 18, wherein the single use filler manifold comprises a first single use filler manifold, and the supply of fluid comprises a first supply of fluid, the method further comprising:

after fill portion discharging and underfill portion discharging of the first supply of fluid, disconnecting the first single use filler manifold from the single use distributor manifold;

connecting a filler manifold inlet of a second single use filler manifold to a second one of the plurality of distributor manifold outlets of the single use distributor manifold via a second aseptic fluid fill pathway;

feeding a second supply of fluid into the distributor manifold inlet of the single use distributor manifold, wherein feeding the second supply of fluid includes introducing recovery fluid from the recovery container into the distributor manifold inlet via the aseptic fluid reserve pathway such that at least a portion of the second supply of fluid comprises recovery fluid from the recovery container;

discharging the second supply of the fluid from the second one of the plurality of distributor manifold outlets of the single use distributor manifold to the filler manifold inlet of the second single use filler manifold via the second aseptic fluid fill pathway;

discharging a fill portion of the second supply of fluid respectively from all but a reserved one of a plurality of filler manifold outlets of the second single use filler manifold to single use containers respectively aseptically fluidly connected thereto;

after fill portion discharging, discharging an underfill portion of the second supply of fluid from the reserved one of the filler manifold outlets of the second single use filler manifold to a single use container aseptically fluidly connected thereto;

after underfill portion discharging, draining a filler manifold volume of the second supply of fluid remaining in a body conduit of the second single use filler manifold out of the reserved one of the filler manifold outlets of the second single use filler manifold to the single use container aseptically fluidly connected thereto.