CLAIMS

1. A charging initiation method for a flow battery for allowing charging of the flow battery from an AC power supply with a power converter having a minimum operational DC voltage, the flow battery comprising a positive electrolyte tank containing a positive electrolyte, a negative electrolyte tank containing a negative electrolyte, a cell stack comprising a positive porous electrode and a negative porous electrode, a positive electrolyte pump which when activated pumps the positive electrolyte from the positive electrolyte tank through the positive porous electrode, and a negative electrolyte pump which when activated pumps the negative electrolyte from the negative electrolyte tank through the negative porous electrode,

the charging initiation method comprising:

connecting a DC power supply to the positive porous electrode and the negative porous electrode to charge the cell stack, while the positive electrolyte pump and the negative electrolyte pump are deactivated; and

in response to a pre-charging condition:

disconnecting the DC power supply from the positive porous electrode and the negative porous electrode;

connecting the power converter coupled to the AC power supply to the positive porous electrode and the negative porous electrode to charge the cell stack from the AC power supply; and

activating the positive electrolyte pump and the negative electrolyte pump.

2. The charging initiation method of claim 1, further comprising, prior to connecting the DC power supply to the positive porous electrode and the negative porous electrode,

activating the positive electrolyte pump and the negative electrolyte pump to refresh positive electrolyte located in the positive porous electrode and negative electrolyte located in the negative porous electrode; and

deactivating the positive electrolyte pump and the negative electrolyte pump.

3. The charging initiation method of claim 1, wherein the DC power supply comprises an AC-DC power supply unit or a bidirectional/uni-directional DC- DC converter, the flow battery is a redox flow battery, the positive electrolyte and the negative electrolyte comprise vanadium and the AC power supply is an AC power grid.

4. The charging initiation method of claim 1, wherein the pre-charging condition comprises a voltage between the positive porous electrode and the negative porous electrode exceeding a voltage threshold which is greater than or equal to the minimum operational DC voltage of the power converter.

5. The charging initiation method of claim 4, wherein the voltage threshold is greater than the minimum operational DC voltage by 1 volt, preferably 5 volts and more preferably 10 volts.

6. The charging initiation method of claim 4, wherein the voltage threshold is in the range 20 volts to 1500 volts.

7. The charging initiation method of claim 1, wherein the pre-charging condition comprises a charging current from the DC power supply falling below a current threshold in the range 1A to 1000A.

8. A controller for a flow battery system configured to control the flow battery system to carry out the charging initiation method claim 1.

9. A flow battery system, comprising:

a flow battery comprising:

a positive electrolyte tank containing a positive electrolyte;

a negative electrolyte tank containing a negative electrolyte;

a cell stack comprising a positive porous electrode and a negative porous electrode;

a positive electrolyte pump, which when activated pumps the positive electrolyte from the negative electrolyte tank through the positive porous electrode; and

a negative electrolyte pump, which when activated pumps the negative electrolyte from the negative electrolyte tank through the negative porous electrode;

a DC power supply electrically couplable to the cell stack;

a power converter having a minimum operational DC voltage and being

electrically couplable to the cell stack; and

a controller configured to execute a charging initiation method comprising:

connecting the DC power supply to the positive porous electrode and the negative porous electrode to charge the cell stack, while the positive electrolyte pump and the negative electrolyte pump are deactivated; and

in response to a pre-charging condition:

disconnecting the DC power supply from the positive porous electrode and the negative porous electrode;

connecting the power converter coupled to an AC power supply to the positive porous electrode and the negative porous electrode to charge the cell stack from the AC power supply; and

activating the positive electrolyte pump and the negative electrolyte pump.

10. The flow battery system of claim 10, wherein the charging initiation method further comprises, prior to connecting the DC power supply to the positive porous electrode and the negative porous electrode, activating the positive electrolyte pump and the negative electrolyte pump to refresh positive electrolyte located in the positive porous electrode and negative electrolyte located in the negative porous electrode and then deactivating the positive electrolyte pump and the negative electrolyte pump.

11. The flow battery system of claim 10, wherein the DC power supply comprises an AC-DC power supply unit or a bidirectional/uni-directional DC- DC converter, the flow battery is a redox flow battery and the positive electrolyte and the negative electrolyte comprise vanadium and wherein the AC power supply is an AC power grid.

12. The flow battery system of claim 10, wherein the pre-charging condition comprises a voltage between the positive porous electrode and the negative porous electrode exceeding a voltage threshold which is greater than or equal to the minimum operational DC voltage of the power converter.

13. The flow battery system of claim 12, wherein the voltage threshold is greater than

the minimum operational DC voltage by 1 volt, preferably 5 volts and more preferably 10 volts.

14. The flow battery system of claim 12, wherein the voltage threshold is in the range 20 volts to 1500 volts.

15. The flow battery system of claim 10, wherein the pre-charging condition comprises a charging current from the DC power supply falling below a current threshold, in the range 1A to 1000A.