WHAT IS CLAIMED IS:

1. A solid oxide fuel cell (SOFC) stack with a primary enclosure wall assembly (8045) for balancing temperature, the primary enclosure wall assembly comprising:

a combustion region wall (8060) defining a cathode chamber (8055) in which the SOFC stack is disposed, the cathode chamber comprising a combustion region around an outlet end of the SOFC stack for collecting spent fuel flow and spent cathode air flow exiting the SOFC stack, wherein the spent fuel and the spent cathode air mix, combust and generate heat in the combustion region wherein the heat is transferred from the combusted mixture to the combustion region; and

a first sidewall (8065) depending from the combustion region wall along the SOFC stack gas flow axis (z), wherein:

a cathode input manifold (9070) is disposed outside of the primary enclosure wall assembly, at least one wall of the cathode input manifold comprising both of the combustion region wall (8060) and the first sidewall (8065);

the first sidewall (8065) comprising an inner surface that faces and further defines the cathode chamber, an outer surface that faces the cathode input manifold (9070), and has a distal end adjacent an inlet end of the SOFC stack;

the heat absorbed by the combustion region wall (8060) is thermally conducted to the distal end of the first sidewall (8065); and

the heat conducted to the distal end of the first sidewall (8065) radiates from the inner surface of the first sidewall (8065) that extends from combustion region wall (8060), through the cathode chamber, to the inlet end of the SOFC stack to outside surfaces of a cell of the SOFC stack, and is transferred to a cathode air flow within the cathode input manifold by convection and radiation from the outer surface of the first sidewall (8065), to reduce a temperature of the combustion region wall and increase a temperature of surfaces of the first sidewall (8065) that extend from combustion region wall (8060) to the inlet end of the SOFC stack.

2. The SOFC stack of Claim 1 further comprising: a second sidewall depending from the combustion region wall opposing the first sidewall; wherein the first sidewall and the second sidewall face opposing side of the SOFC stack; first and second hot zone enclosure end walls (8080, 8085) coupled to each of the first sidewall, and the second sidewall enclose the SOFC stack inside of a cathode chamber (8055).

3. The SOFC stack of Claim 1 further comprising a fuel input manifold (8015) or a hot zone enclosure base wall or an intermediate chamber enclosure base wall (9010) disposed to provide a bottom boundary of the cathode chamber.

4. The SOFC stack of Claim 1, wherein the combustion region wall and the first sidewall comprise a thermally conductive core having a coefficient of thermal conductivity that is greater than 100 W/m°K at temperatures above 350°C.

5. The SOFC stack of Claim 2, wherein the combustion region wall, the first sidewall and the second sidewall comprise a thermally conductive core having a coefficient of thermal conductivity that is greater than 100 W /m°K at temperatures above 350°C.

6. The SOFC stack of Claim 1, further comprising one or more rows of SOFC cells separated by the first sidewall.

7. The SOFC stack of Claim 6, wherein the one or more rows of SOFC cells comprises at least two rows, and wherein the SOFC stack further comprises: a first outer sidewall depending from the combustion region wall and enclosing a first of the at least two rows with the first sidewall; and a second outer sidewall depending from the combustion region wall and enclosing a second of the at least two rows with the first sidewall, wherein the first and second outer sidewalls receive heat from the combustion region wall by thermal conduction and radiate heat to the inlet end of the SOFC stack.

8. A Solid Oxide Fuel Cell (SOFC) system comprising:

a primary wall assembly (8045) comprising a unitary element comprising a combustion region wall (8060) and one or more sidewalls (8065), the unitary element configured to enclose a cathode chamber (8055) therein and formed to provide one or more thermally conductive pathways extending between different regions of the primary wall assembly; and

a SOFC stack (8005) enclosed by the primary wall assembly, wherein a first portion of the unitary element receives heat from a combustion region enclosed by the primary wall assembly conducts the heat to a second portion of the unitary element, and the second portion radiates heat to a first portion of the SOFC stack within the cathode chamber (8055) and transfers heat to a cathode air flow passing surfaces of the primary wall assembly outside of the cathode chamber (8055) by heat exchange.

9. A hot zone enclosure assembly (8042) for balancing temperature in a solid oxide fuel cell (SOFC) stack, the hot zone enclosure assembly comprising:

a combustion region wall defining a combustion region around an outlet end of the SOFC stack for collecting anode fuel and cathode air exiting the SOFC stack, wherein the anode fuel and the cathode air, burn and generate heat in the combustion region so that the heat is absorbed by the combustion region wall;

a sidewall depending from the combustion region wall along the SOFC stack; and

a thermally conductive core formed as a unitary element comprising the combustion region wall and the sidewall, a first portion of the unitary element extending along a transverse axis (y) of the SOFC stack and therefrom a second portion of the unitary element along a flow axis (z) of the SOFC stack, wherein:

the combustion region wall and the sidewall define a cathode chamber in which the SOFC stack is disposed, wherein the combustion region wall is disposed in an upper portion of the cathode chamber, above the outlet end of the SOFC stack;

the sidewall has a distal end adjacent an inlet end of the SOFC stack within the cathode chamber; the absorbed heat passes by conduction through the unitary element to the distal end of the sidewall; and

the absorbed heat radiates from the distal end to the inlet end of the SOFC stack to balance temperature along the SOFC stack.

10. The hot zone enclosure assembly (8042) of Claim 9 further comprising:

a second sidewall depending from the combustion region wall opposing the sidewall;

a hot zone enclosure base wall (8075) coupled to the sidewall (8070) and the second sidewall; and

first and second hot zone enclosure end walls (8080, 8085) coupled to the combustion region wall, the sidewall, and the second sidewall to enclose the SOFC stack.

11. The hot zone enclosure assembly (8042) of Claim 9, further comprising a thermally conductive core having a coefficient of thermal conductivity that is greater than 100 W /m°K at temperatures above 350° C.

12. The hot zone enclosure assembly of Claim 9, wherein the SOFC stack is at least two rows of SOFC cells separated by the sidewall.

13. The hot zone enclosure assembly of Claim 12, further comprising: a first outer sidewall depending from the combustion region wall and enclosing a first of the at least two rows with the sidewall; and a second outer sidewall depending from the combustion region wall and enclosing a

second of the at least two rows with the sidewall, wherein the first and second outer sidewalls receive heat from the combustion region wall by thermal conduction and radiate heat to the inlet end of the SOFC stack.

14. A primary enclosure wall assembly (8045) for balancing temperature within a solid oxide fuel cell (SOFC) stack, the primary enclosure wall assembly comprising:

a combustion region wall (8060) defining a combustion region around an outlet end of the SOFC stack for collecting spent fuel flow and spent cathode air flow exiting the SOFC stack, wherein the spent fuel and the spent cathode air mix, combust and generate heat in the combustion region wherein the heat is transferred from the combusted mixture to the combustion region wall by convection; and

a sidewall (8065) depending from the combustion region wall along the SOFC stack gas flow axis (z), wherein:

the sidewall (8065) has a distal end adjacent an inlet end of the SOFC stack;

the heat absorbed by the combustion region wall (8060) is thermally conducted to the distal end of the sidewall (8065); and

the heat conducted to the distal end of the sidewall (8065) radiates from surfaces of the sidewall (8065) that extends from the combustion region wall (8060), to the inlet end of the SOFC stack to outside surfaces of a cell of the SOFC stack, and is transferred to a cathode air flow by convection, to reduce a temperature of the combustion region wall and increase a temperature of surfaces of the sidewall (8065) that extend from combustion region wall (8060) to the inlet end of the SOFC stack; and

the SOFC stack includes one or more rows of SOFC cells separated by the sidewall.

15. The primary enclosure wall assembly of Claim 14, wherein the one or more rows of SOFC cells comprises at least two rows, and wherein the primary enclosure wall assembly further comprises: a first outer sidewall depending from the combustion region wall and enclosing a first of the at least two rows with the sidewall; and a second outer sidewall depending from the combustion region wall and enclosing a second of the at least two rows with the sidewall, wherein the first and second outer sidewalls receive heat from the combustion region wall by thermal conduction and radiate heat to the inlet end of the SOFC stack.

16. A hot zone enclosure assembly (8042) for balancing temperature in a solid oxide fuel cell (SOFC) stack, the hot zone enclosure assembly comprising:

a combustion region wall defining a combustion region around an outlet end of the SOFC stack for collecting anode fuel and cathode air exiting the SOFC stack, wherein the anode fuel and the cathode air, burn and generate heat in the combustion region so that the heat is absorbed by the combustion region wall; and

a sidewall depending from the combustion region wall along the SOFC stack, wherein:

the sidewall has a distal end adjacent an inlet end of the SOFC stack the absorbed heat passes by conduction to the distal end of the sidewall;

the absorbed heat radiates from the distal end to the inlet end of the SOFC stack to balance temperature along the SOFC stack; and

the SOFC stack is at least two rows of SOFC cells separated by the sidewall.

17. The hot zone enclosure assembly of Claim 16, further comprising: a first outer sidewall depending from the combustion region wall and enclosing a first of the at least two rows with the sidewall; and a second outer sidewall depending from the combustion region wall and enclosing a second of the at least two rows with the sidewall, wherein the first and second outer sidewalls receive heat from the combustion region wall by thermal conduction and radiate heat to the inlet end of the SOFC stack.

18. A solid oxide fuel cell (SOFC) system (7000, 8000, 12000, 14000, 15000) comprising:

an enclosure wall assembly (8045, 12045) disposed inside a first gas tight enclosure (9000);

a cathode manifold (9070) disposed inside the first gas tight enclosure and outside the enclosure wall assembly;

a chamber (8055, 12055) enclosed inside the enclosure wall assembly;

a SOFC stack enclosed inside the chamber, the SOFC stack comprising one or more SOFCs (8010);

a combustion region wall defining a combustion region (8030), the combustion region disposed inside the chamber; and

a first sidewall depending from the combustion region wall along the SOFC stack gas flow axis (z), the sidewall having a distal end adjacent an inlet end of the SOFC stack,

wherein an outlet end (8025) of the SOFC stack (8010) is disposed inside the chamber for collecting, within the combustion region, spent fuel flow and spent cathode air flow exiting the SOFC stack,

the spent fuel and the spent cathode air mix, combust and generate heat in the combustion region,

the heat is absorbed by the combustion region wall and thermally conducted to the distal end of the first sidewall, and

the heat conducted to the distal end of the first sidewall radiates between first surfaces of the first side wall that face the chamber and outside surfaces of a SOFC, and is transferred from second surfaces of the first side wall that face the cathode manifold to a cathode air flow within the cathode manifold, wherein the second surfaces oppose the first surfaces across a thickness of the first sidewall.

19. A solid oxide fuel cell (SOFC) system comprising:

a SOFC stack;

an intermediate enclosure assembly (9000);

a hot zone (12000 or 14000) comprising a cathode chamber (12055), the SOFC stack disposed within the cathode chamber; and

a cathode air manifold (14070) disposed adjacent to the primary enclosure wall assembly and outside of the cathode chamber,

wherein the cathode chamber is enclosed by:

a first wall (9015) of the intermediate enclosure assembly, the first wall being made of stainless steel; and

a primary enclosure wall assembly (12045) comprising at least one material having a coefficient of thermal conductivity of 100 W /m°K or greater at a temperature of 350 ° C.

20. The SOFC system of claim 19, wherein the primary wall enclosure assembly comprises a combustion region wall disposed to enclosure an outlet end of the SOFC stack and a side wall depending from combustion region wall along a length of the SOFC stack, the side wall extending from the outlet end towards an inlet end of the SOFC stack, wherein the combustion region wall is coupled to the first wall of the intermediate enclosure assembly, and is configured

and disposed to absorb thermal energy generated by combustion of gas in the combustion region, and the side wall is configured and disposed to transfer heat from the combustion region wall to other portions of the primary enclosure wall assembly by thermal conduction and to transfer thermal between the primary enclosure wall assembly and the SOFC stack.