CLAIMS:

What is claimed is:

1. A conduit for cooling a hydrocarbon gas-containing stream, comprising:

(i) a first inner wall having a first inner surface defining a first bore therethrough, a second inner wall having a second inner surface defining a second bore therethrough, and an outer wall disposed about the first inner wall and the second inner wall;

(ii) an annular support wall having a first end connected to an inner surface of the outer wall and a second end that is proximate to an outer surface of the first inner wall such that an annular gap is formed between the second end of the annular support wall and the outer surface of the first inner wall, wherein a first end of the second inner wall and the second end of the annular support wall define a perimeter opening in fluid communication with the second bore;

(iii) an annular flexible ring having an outer perimeter, an inner perimeter, and a continuous ring wall between the outer perimeter and the inner perimeter, wherein the outer perimeter is bonded to the second end of the annular support wall, wherein the inner perimeter flexibly contacts the outer surface of the first inner wall without forming a permanent mechanical bond with the first inner wall, thereby permitting the first inner wall to thermally change dimensions both radially and axially with respect to a longitudinal axis of the first bore, and wherein an end of the first inner wall extends past the inner perimeter of the annular flexible ring;

(iv) a substantially annular cavity disposed between the second inner wall and the outer wall, wherein the annular cavity is in fluid communication with the perimeter opening via a peripheral channel; and

(v) at least one quench fluid introduction port configured to introduce a quench fluid into the annular cavity.

2. The conduit of claim 1, wherein the end of the first inner wall extends past the perimeter opening and into the second bore.

3. The conduit of any of claims 1 to 2, wherein the annular flexible ring and a portion of the outer surface of the first inner wall are configured to distribute the quench fluid onto the inner surface of the second inner wall.

4. The conduit of any of claims 1 to 3, wherein a cross-section of the ring wall of the annular flexible ring is angled relative to a longitudinal axis of the second bore.

5. The conduit of any of claims 1 to 3, wherein a cross-section of the ring wall of the annular flexible ring is angled with respect to the longitudinal axis of the second bore such that the inner perimeter of the annular flexible ring is located closer to the second wall than the outer perimeter of the annular flexible ring.

6. The conduit of any of claims 1 to 5, wherein the at least one quench fluid introduction port is configured to introduce the quench fluid tangentially into the annular cavity.

7. The conduit of any of claims 1 to 6, wherein the conduit comprises at least two annular flexible rings, wherein the outer perimeters of the at least two annular flexible rings are bonded to the second end of the annular support wall, and wherein the inner perimeters of the at least two annular flexible rings flexibly contact the outer surface of the first inner wall without forming a permanent mechanical bond with the first inner wall.

8. The conduit of any of claims 1 to 7, wherein a cross-sectional area of the first bore in a plane perpendicular to the longitudinal axis of the first bore is less than a cross-sectional area of the second bore in a plane perpendicular to the longitudinal axis of the second bore.

9. The conduit of any of claims 1 to 8, wherein the conduit comprises at least two quench fluid introduction ports each configured to introduce the quench fluid into the annular cavity.

10. The conduit of claim 9, wherein the at least two quench fluid introduction ports are spaced substantially evenly about a circumference of the outer wall with respect to one another.

11. The conduit of any of claims 1 to 10, wherein the outer perimeter of the annular flexible ring is welded to the second end of the annular support wall.

12. The conduit of any of claims 1 to 11, further comprising (vi) at least one spacer pin disposed within the peripheral channel, wherein a first end the spacer pin is bonded to the first end of the second inner wall, and wherein a second end of the spacer pin is proximate or in

contact with the annular support wall such that the annular support wall and spacer pin are free to move with respect to one another.

13. The conduit of any of claims 1 to 12, wherein the annular flexible ring is composed of an austenitic stainless steel.

14. The conduit of any of claims 1 to 13, further comprising (vii) at least one annular expansion gasket disposed between the annular flexible ring and the outer surface of the first inner wall.

13. The conduit of claim 14, wherein the annular expansion gasket comprises a braided silica rope covered in a sleeve formed from ceramic fibers.

16. A process for quenching a hydrocarbon gas-containing stream, comprising:

(I) introducing the hydrocarbon gas-containing stream into a first bore of a cooling conduit, wherein the cooling conduit comprises:

(i) a first inner wall having a first inner surface defining the first bore therethrough, a second inner wall having a second inner surface defining a second bore therethrough, and an outer wall disposed about the first inner wall and the second inner wall;

(ii) an annular support wall having a first end connected to an inner surface of the outer wall and a second end that is proximate to an outer surface of the first inner wall such that an annular gap is formed between the second end of the annular support wall and the outer surface of the first inner wall, wherein a first end of the second inner wall and the second end of the annular support wall define a perimeter opening in fluid communication with the second bore;

(iii) an annular flexible ring having an outer perimeter and an inner perimeter and a continuous ring wall between the outer perimeter and the inner perimeter, wherein the outer perimeter is bonded to the second end of the annular support wall, wherein the inner perimeter flexibly contacts the outer surface of the first inner wall without forming a permanent mechanical bond with the first inner wall, thereby permitting the first inner wall to thermally change dimensions both radially and axially with respect

to a longitudinal axis of the first bore, and wherein an end of the first inner wall extends past the inner perimeter of the annular flexible ring;

(iv) a substantially annular cavity disposed between the second inner wall and the outer wall, wherein the annular cavity is in fluid communication with the perimeter opening via a peripheral channel; and

(v) at least one quench fluid introduction port configured to introduce a quench fluid into the annular cavity;

(II) introducing a quench fluid into the substantially annular cavity via the at least one quench fluid introduction port;

(III) flowing the quench fluid through the peripheral channel to the perimeter opening;

(IV) distributing the quench fluid from the perimeter opening onto the second inner surface of the second inner wall;

(V) flowing the hydrocarbon gas-containing stream from the first bore into the second bore; and

(VI) contacting the hydrocarbon gas-containing stream with the quench fluid within the second bore to produce a cooled effluent.

17. The process of claim 16, wherein the quench fluid comprises a liquid hydrocarbon.

18. The process of claim 16 or claim 17, wherein the cooling conduit is substantially vertical with respect to a ground surface such that the hydrocarbon gas-containing stream flows downward through the first and second bores and the quench fluid flows downward through the second bore.

19. The process of any of claims 16 to 18, further comprising (VII) controlling a flow rate of the quench fluid introduced into the substantially annular cavity based, at least in part, on a temperature of the cooled effluent.

20. The process of any of claims 16 to 19, further comprising (VIII) introducing a hydrocarbon feed into a pyrolysis furnace operating under pyrolysis conditions to produce the hydrocarbon gas-containing stream.

21. The process of claim 20, wherein a weight ratio of the quench fluid introduced into the substantially annular cavity to the hydrocarbon feed introduced into the pyrolysis furnace is in a range of from 0.1 to 4, 0.8 to 2.5, or 2.5 to 4.

22. The process of claim 20 or claim 21, further comprising (IX) controlling a flow rate of the quench fluid introduced into the substantially annular cavity based, at least in part, on a flow rate the hydrocarbon feed is introduced into the pyrolysis furnace.

23. The process of any of claims 16 to 22, wherein the quench fluid comprises an aromatic hydrocarbon having a final boiling point that is ≥ 400°C.

24. The process of any of claims 16 to 23, wherein the quench fluid comprises an aromatic distillate separated from the cooled effluent.

25. The process of any of claims 16 to 24, wherein: the first inner surface of the first inner wall is at a temperature of ≥ 500°C, ≥ 650°C, or ≥ 800°C, an inner surface of the annular cavity and an inner surface of the peripheral channel are at a temperature of ≤ 300°C, ≤ 250°C, or ≤ 200°C, the second inner surface of the second inner wall is at a temperature in a range of from 200°C to 400°C, and the temperature of the second inner surface of the second inner wall is greater than the temperature of the inner surface of the annular cavity and the inner surface of the peripheral channel.

26. The process of any of claims 16 to 25, wherein the end of the first inner wall extends past the perimeter opening and into the second bore such that the annular flexible ring and a portion of the outer surface of the first inner wall form a wet slip-joint that distributes the quench fluid onto the inner surface of the second inner wall.

27. The process of any of claims 16 to 26, wherein the outer surface of the first inner wall thermally expands radially with respect to a longitudinal axis of the first bore such that the outer surface of the first inner wall deforms the inner perimeter of the annular flexible ring to form a liquid seal therebetween.

28. The conduit of claim 1, wherein a surface of the annular support wall opposed to the first end of the second inner wall is flat.

29. A conduit for cooling a hydrocarbon gas-containing stream, comprising:

(i) a first inner wall having a first inner surface defining a first bore therethrough, a second inner wall having a second inner surface defining a second bore therethrough, and an outer wall disposed about the first inner wall and the second inner wall;

(ii) an annular support wall having a first end connected to an inner surface of the outer wall and a second end that is proximate to an outer surface of the first inner wall such that an annular gap is formed between the second end of the annular support wall and the outer surface of the first inner wall, wherein a first end of the second inner wall and the second end of the annular support wall define a perimeter opening in fluid communication with the second bore;

(iii) an annular flexible ring having an outer perimeter, an inner perimeter, and a continuous ring wall between the outer perimeter and the inner perimeter, wherein the outer perimeter is bonded to the second end of the annular support wall, wherein the inner perimeter flexibly contacts the outer surface of the first inner wall without forming a permanent mechanical bond with the first inner wall, thereby permitting the first inner wall to thermally change dimensions both radially and axially with respect to a longitudinal axis of the first bore, and wherein the annular flexible ring and a portion of the outer surface of the first inner wall are configured to distribute the quench fluid onto the inner surface of the second inner wall;

(iv) a substantially annular cavity disposed between the second inner wall and the outer wall, wherein the annular cavity is in fluid communication with the perimeter opening via a peripheral channel; and

(v) at least one quench fluid introduction port configured to introduce a quench fluid into the annular cavity.

30. The conduit of claim 29, wherein an end of the first inner wall extends past the perimeter opening and into the second bore.

31. The conduit of claim 29, further comprising at least one spacer pin disposed within the peripheral channel, wherein a first end the spacer pin is bonded to the first end of the second inner wall, and wherein a second end of the spacer pin is proximate or in contact with the

annular support wall such that the annular support wall and spacer pin are free to move with respect to one another.

32. The conduit of claim 29, wherein a surface of the annular support wall opposed to the first end of the second inner wall is flat.

33. The conduit of claim 29, further comprising at least one annular expansion gasket disposed between the annular flexible ring and the outer surface of the first inner wall.

34. The conduit of claim 33, wherein the annular expansion gasket comprises a braided silica rope covered in a sleeve formed from ceramic fibers.