CLAIMS

What is claimed is.

1. A system for maneuvering a plug in and out of a tubing hanger that is disposed in a subsea wellhead assembly, the system comprising:

a housing selectively coupled with the subsea wellhead assembly and that comprises an end with an opening;

a chamber in the housing intersecting the opening;

a tractor selectively deployed from within the housing; and

an end effector mounted to the tractor and selectively coupled with the plug, so that when the tractor is deployed from within the housing, the end effector handles the plug in the tubing hanger.

2. The system of claim 1, further comprising a reel mounted on the housing, a control cable spooled on the reel that has an end attached to the tractor and is in selective communication with a remotely operated vehicle deployed subsea

3. The system of claim 2, further comprising at least one hot stab mounted on the housing for connecting to the remotely operated vehicle.

4. The system of claim 1, wherein the chamber registers with a main bore in the subsea wellhead assembly when the housing is coupled with the subsea wellhead assembly.

5. The system of claim 1, wherein the tractor comprises wheel members that project radially outward and into urging contact with an inner surface of the chamber when the tractor is in the

housing and into urging contact with a main bore in the subsea wellhead assembly when the tractor is deployed from within the housing.

6. The system of claim 1, wherein an upper end of the chamber is subsea.

7. The system of claim 1, wherein an upper end of the chamber is enclosed and isolates the internal bore of the housing from the subsea environment.

8. The system of claim 1, wherein a seal is defined along an interface between the housing and the wellhead assembly.

9. A system for plugging a tubing hanger in a subsea wellhead assembly comprising:

a housing comprising an open end, a connector at the open end that is sealingly attachable to the wellhead assembly, a closed end opposite the open end, and a chamber that intersects the open end; and

a plug tooling assembly selectively deployable from within the chamber, the plug tooling assembly comprising a tractor, an end effector mounted on the tractor, and a plug releasably connected to the end effector.

10. The system of claim 9, wherein when the open end of the housing attaches to the wellhead assembly the closed end is disposed subsea.

11. The system of claim 9, wherein when the open end of the housing attaches to the wellhead assembly, the closed end isolates the internal bore of the housing from the subsea environment.

12. The system of claim 9, further comprising a control cable for providing control signals to the plug tooling assembly, the control cable having an end coupled with the plug tooling assembly and being in communication with a remotely operated vehicle disposed subsea.

13. The system of claim 11, wherein the control cable extends along a passage formed through the closed end and wherein packoffs in the passage define a pressure barrier between the cavity and ambient to the housing.

14. The system of claim 9, further comprising proximity sensors in the housing and the plug for determining a location of the plug in the housing.

15. A method of handling a plug in a tubing hanger of a subsea wellhead assembly, the method comprising:

enclosing a tractor with an attached end effector in a housing;

mounting the housing onto the wellhead assembly so that an upper end of the housing is submerged subsea;

deploying the tractor and end effector from the housing into a main bore in the wellhead assembly; and

handling the plug in the tubing hanger with the end effector.

16. The method of claim 15, wherein the step of deploying the tractor comprises engaging wheels on the tractor with an inner surface of the housing and an inner surface of the main bore.

17. The method of claim 15, further comprising deploying a remotely operated vehicle subsea, engaging a connector on the housing with the remotely operated vehicle, and controlling the tractor and end effector from the remotely operated vehicle through the connector.

CLAIMS

What is claimed is:

1. A system for maneuvering a plug in and out of a tubing hanger that is disposed in a vertical bore of the subsea wellhead assembly, the vertical bore having a vertical axis, the system comprising:
a housing selectively lowered subsea and coupled with the subsea wellhead assembly, and that comprises a lower end with an opening;

a chamber in the housing intersecting the opening, the chamber having a vertical wall adapted to be coaxial with the axis when the housing is coupled with the subsea wellhead assembly;

a tractor selectively deployed along the vertical axis from within the chamber of the housing into the vertical bore of the subsea wellhead assembly and that comprises crawler members that extend radially outward from an axis of the tractor and into rolling contact against the vertical wall of the chamber for moving the tractor into and out of the vertical bore of the subsea wellhead assembly, and a motor that drives the crawler members;

a reel mounted on the housing;

a control cable spooled on the reel that has an end attached to the tractor and is in selective communication with a remotely operated vehicle (ROV) deployed subsea via a control hot stab on the reel;

an end effector mounted to the tractor and selectively coupled with the plug, so that when the tractor is deployed from within the housing and located in the vertical bore of the subsea wellhead assembly, the end effector handles deploying the plug into the tubing hanger; and wherein

the control hot stab on the reel enables the ROV to control the tractor and the end effector.

2. The system of claim 1, wherein tractor and the end effector define a plug tooling assembly, and wherein the ROV communicates with the plug tool assembly through the control cable and the control hot stab on the reel.

3. The system of claim 2, further comprising:
at least one signal hot stab mounted on the housing for connecting to the remotely operated vehicle;

a proximity sensor mounted in the housing adjacent the chamber and connected to the signal hot stab via a signal line; and

wherein the proximity sensor provides a signal through the signal line and the signal hot stab to the remotely operated vehicle indicating a position of the tractor within the chamber.

4. The system of claim 1, wherein the crawler members comprise wheels.

5. The system of claim 1, wherein the crawler members extend from opposite sides of the tractor in urging contact with opposite sides of the vertical wall of the chamber when the tractor is in the housing and are adapted to be in urging contact with opposite sides of the vertical bore in the subsea

wellhead assembly when the tractor is deployed into the vertical bore of the subsea wellhead assembly.

6. The system of claim 1, wherein the housing is adapted to be deployed from above the sea surface on a cable.

7. The system of claim 1, wherein an upper end of the chamber is enclosed and isolates the chamber from a subsea environment.

8. A system for plugging a tubing hanger in a subsea wellhead assembly having a vertical bore with a vertical axis, comprising:
a housing comprising an open end, a connector at the open end that is sealingly attachable to the subsea wellhead assembly, a closed end opposite the open end, and a chamber that intersects the open end, the chamber adapted to be coaxial with the vertical bore when the housing is attached to the subsea wellhead assembly;

a reel assembly mounted on the closed end of the housing;

a plug tooling assembly selectively deployable from within the chamber into the vertical bore, the plug tooling assembly comprising;

a tractor having a motor and wheels driven by the motor and on opposite sides of the tractor, the tractor being vertically oriented with the wheels in frictional engagement with opposite sides of a wall of the chamber while the tractor is in an upper position, the wheels adapted to be in frictional engagement with the vertical bore while the tractor is within the subsea wellhead;

an end effector mounted on the tractor; and

a plug releasably connected to the end effector;

a control cable mounted on the reel assembly and extending sealingly through a passage in the closed end of the housing into engagement with the plug tooling assembly for providing control signals to the plug tooling assembly;

a control hot stab on the reel assembly for engagement by a remote operated vehicle (ROV) deployed subsea, the control hot stab being in communication with the control cable to allow the ROV to control the plug tooling assembly;

wherein providing power to the tractor causes the wheels to move the plug tooling assembly from the chamber into and out of the vertical bore of the subsea wellhead assembly; and

the end effector is controllable by the ROV via the hot stab to deploy the plug while the end effector is located in the vertical bore of the subsea wellhead assembly.

9. The system of claim 8, further comprising a packoff in the passage that defines a pressure barrier.

10. The system of claim 8, further comprising:
at least one signal hot stab mounted on the housing for connecting to the ROV;

a proximity sensor mounted in the housing adjacent the chamber and connected to the signal hot stab via a signal line; and

wherein the proximity sensor is adapted to provide a signal through the signal line and signal hot stab to the ROV indicating a position of the plug.

11. A method of handling a plug in a tubing hanger in a vertical bore of a subsea wellhead assembly, the method comprising:
providing a tractor having a motor, crawler members driven by the motor, and an end effector;

enclosing the tractor in a chamber in a housing having a reel mounted to the housing, and a control line spooled on the reel, the crawler members of the tractor being in engagement with a wall of the chamber;

providing a control hot stab on the reel that is connected to the control line;

coupling an end of the control line with the tractor;

mounting the housing onto the subsea wellhead assembly so that an upper end of the housing is submerged subsea and the chamber is oriented vertically above the bore in the subsea wellhead assembly;

engaging the control hot stab with a remote operated vehicle (ROV); then

deploying the tractor and end effector downward from the chamber in the housing into the vertical bore in the subsea wellhead assembly by communicating signals from the ROV to the tractor via the control line that in turn activates the motor to drive the crawler members in a first direction, which roll along the wall of the chamber and along a wall of the vertical bore of the subsea wellhead assembly;

while the end effector is located in the vertical bore of the subsea wellhead assembly, deploying the plug into the tubing hanger with the end effector by communicating signals from the ROV to the end effector via the control line; then

deploying the tractor and end effector upward from the bore of the subsea wellhead assembly into the chamber by activating the motor with the ROV to drive the wheels in a second direction, which roll along the wall of the vertical bore of the subsea wellhead assembly and lift the tractor and end effector upward into the chamber.

12. The method of claim 11, further comprising:
mounting a proximity sensor in the housing adjacent the chamber and connecting the proximity sensor to a signal line that has a signal hot stab;

engaging the ROV with the signal hot stab; and

providing a signal from the proximity sensor through the signal line and signal hot stab to the ROV indicating a position of the plug while the tractor and end effector are within the chamber.