

is a need for an efficient system to safely convert existing diverter infrastructure into an MPD-capable closed loop system utilizing a more reliable sealing technology than prior arts within the diverter. It is preferred that the inventive system and method has compatibility with common diverter models
5 used offshore. For new build rigs, the configuration described here can be used to replace the existing atmospheric diverter design with this improved system and method.

Embodiments of the system described in this application seek to provide an alternative, possibly more cost effective, diverter system which is capable of
10 operating at the pressures experienced in MPD, which may be simpler to install and which does not require the need to change the rig's riser space out, and therefore may more readily be integrated into existing systems.

According to a first aspect of the invention we provide a drilling system including a riser, a pressure vessel, a source of pressurised gas, a main flow
15 line which extends from the riser to the pressure vessel, the pressure vessel having a liquid inlet port connected to the main flow line, a gas inlet port connected to the source of pressurised gas, a liquid outlet port located in a lowermost portion of the pressure vessel, a gas outlet port located in an uppermost portion of the pressure vessel, a liquid pressure control valve which
20 is operable to control the flow of liquid out of the pressure vessel via the liquid outlet port, a mud gas separator which has a liquid inlet port to which the liquid outlet port of the pressure vessel is connected by means of a liquid flow line, the liquid pressure control valve being provided in the liquid flow line, and a gas pressure control valve which is operable to control the flow of gas out of
25 the pressure vessel via the gas outlet port, wherein the mud gas separator has a gas inlet port to which the gas outlet port of the pressure vessel is connected by means of a vent line, and the gas pressure control valve is provided in the vent line.

The gas inlet port may be provided in an uppermost portion of the pressure
30 vessel.

A valve may be provided in a line connecting the source of pressurised gas to the gas inlet port of the pressure vessel.

A secondary pressure control valve may be provided in the main flow line.

The main flow line may be connected to the riser via a diverter.

- 5 The diverter may include a diverter assembly which is operable to close around a drill string extending down the riser to contain pressure in the annulus of the riser around the drill string. In this case, preferably the diverter closes around the drill string above the connection to the main flow line. The diverter assembly is preferably operable to close around a drill string extending
- 10 down the riser to contain pressure in the annulus of the riser around the drill string whilst allowing the drill string to rotate about its longitudinal axis.

The diverter assembly may be mounted in a diverter support housing which is adapted, in use, to be suspended from a rig floor.

The system may include a drill string extending down the riser.

- 15 A slip joint may be provided in the riser below the connection to the main flow line.

The source of pressurised gas may comprise a bottle of compressed nitrogen.

- The system may further include a pressure sensor which is operable to provide an output indicative of the pressure of the gas in the uppermost region
- 20 of the pressure vessel.

The system may further include a liquid level sensor which is operable to provide an output indicative of the level of the liquid in the pressure vessel.

- According to a second aspect of the invention we provide a method of operating a drilling system including a riser, a pressure vessel, a source of
- 25 pressurised gas, and a main flow line which extends from the riser to the pressure vessel, the pressure vessel having a liquid inlet port connected to the

main flow line, a gas inlet port connected to the source of pressurised gas, a liquid outlet port located in a lowermost portion of the pressure vessel, a liquid pressure control valve which is operable to control the flow of liquid out of the vessel via the liquid outlet port, a gas outlet port located in an uppermost

5 portion of the pressure vessel, a gas pressure control valve which is operable to control the flow of gas out of the vessel via the gas outlet port, and a mud gas separator which has a liquid inlet port to which the liquid outlet port of the pressure vessel is connected by means of a liquid flow line, wherein the mud gas separator has a gas inlet port to which the gas outlet port of the pressure

10 vessel is connected by means of a vent line, and the gas pressure control valve is provided in the vent line, wherein the method includes the steps of operating one or both of the liquid pressure control valve and gas pressure control valve to control the pressure in the riser.

The method may include the steps of opening both the gas pressure control

15 valve and liquid pressure control valve so as to decrease the degree to which the valves restrict flow of fluid out of the vessel in order to decrease the pressure in the riser, or closing both the gas pressure control valve and liquid pressure control valve so as to increase the degree to which the valves restrict flow of fluid out of the vessel in order to increase the pressure in the riser.

20 The system may also include a mud gas separator which has a liquid inlet port to which the liquid outlet port of the pressure vessel is connected by means of a liquid flow line. In this case the liquid pressure control valve may be provided in the liquid flow line.

CLAIMS

1. A drilling system including:
 - a riser, a pressure vessel;
 - a source of pressurised gas;
 - 5 a main flow line which extends from the riser to the pressure vessel, the pressure vessel having a liquid inlet port connected to the main flow line;
 - a gas inlet port connected to the source of pressurised gas;
 - a liquid outlet port located in a lowermost portion of the pressure vessel;
 - a gas outlet port located in an uppermost portion of the pressure vessel;
 - 10 a liquid pressure control valve which is operable to control the flow of liquid out of the pressure vessel via the liquid outlet port;
 - a mud gas separator which has a liquid inlet port to which the liquid outlet port of the pressure vessel is connected by means of a liquid flow line, the liquid pressure control valve being provided in the liquid flow line; and
 - 15 a gas pressure control valve which is operable to control the flow of gas out of the pressure vessel via the gas outlet port,
 - wherein,
 - the mud gas separator has a gas inlet port to which the gas outlet port of the pressure vessel is connected by means of a vent line, and
 - 20 the gas pressure control valve is provided in the vent line.
2. The drilling system according to claim 1, wherein a valve is provided in a line connecting the source of pressurised gas to the gas inlet port of the pressure vessel.

3. The drilling system according to claim 1, wherein a secondary pressure control valve is provided in the main flow line, and the main flow line is connected to the riser via a diverter.
4. The drilling system according to claim 3, wherein the diverter includes a diverter assembly which is operable to close around a drill string extending down the riser to contain pressure in the annulus of the riser around the drill string.
5. The drilling system according to claim 4, wherein the diverter assembly is operable to close around the drill string extending down the riser to contain pressure in the annulus of the riser around the drill string whilst allowing the drill string to rotate about its longitudinal axis.
6. The drilling system according to claim 4, wherein the diverter assembly is mounted in a diverter support housing which is adapted, in use, to be suspended from a rig floor.
7. The drilling system according to claim 1, further comprising a drill string extending down the riser.
8. A method of operating a drilling system including a riser, a pressure vessel, a source of pressurised gas, and a main flow line which extends from the riser to the pressure vessel, the pressure vessel having a liquid inlet port connected to the main flow line, a gas inlet port connected to the source of pressurised gas, a liquid outlet port located in a lowermost portion of the pressure vessel, a liquid pressure control valve which is operable to control the flow of liquid out of the vessel via the liquid outlet port, a gas outlet port located in an uppermost portion of the pressure vessel, a gas pressure control valve which is operable to control the flow of gas out of the vessel via the gas outlet port, and a mud gas separator which has a liquid inlet port to which the liquid outlet port of the pressure vessel is connected by means of a liquid flow line, wherein the mud gas separator has a gas inlet port to which the gas outlet port of the pressure

vessel is connected by means of a vent line, and the gas pressure control valve is provided in the vent line, wherein the method includes the steps of operating one or both of the liquid pressure control valve and gas pressure control valve to control the pressure in the riser.

- 5 9. The method according to claim 8, further including the steps of opening both the gas pressure control valve and liquid pressure control valve so as to decrease the degree to which the valves restrict flow of fluid out of the pressure vessel in order to decrease the pressure in the riser, or closing both the gas pressure control valve and liquid pressure control valve so as to
10 increase the degree to which the valves restrict flow of fluid out of the pressure vessel in order to increase the pressure in the riser.

10. The method according to claim 8, wherein the liquid pressure control valve is provided in the liquid flow line.

11. The method according to claim 8, wherein a secondary pressure control
15 valve is provided in the main flow line, and the method includes the steps of operating the secondary pressure control valve to control the gas pressure in the riser and operating the liquid pressure control valve and/or the gas pressure control valve to bring the pressure in the pressure vessel to a desired level, and then opening the secondary pressure control valve to decrease the
20 extent to which it restricts the flow of fluid along the main flow line, before operating the liquid pressure control valve and/or gas pressure control valve to control the pressure in the riser.

12. The method according to claim 11, wherein the system includes a gas
supply valve which controls the flow of gas from the source of pressurised gas
25 into the pressure vessel, and method includes the step of opening the gas supply valve after closing the gas pressure control valve and the secondary pressure control valve.

13. The method according to claim 8, wherein the main flow line is connected to the riser via a diverter, and the diverter includes a diverter assembly, and the method includes operating the diverter assembly to close around a drill string extending down the riser to contain pressure in the annulus of the riser around the drill string.

14. The method according to claim 13, wherein the diverter assembly is closed prior to operating the gas pressure control valve and liquid pressure control valve.

15. The method according to claim 8, wherein the system further includes a pressure sensor which is operable to provide an output indicative of the pressure of the gas in the uppermost region of the pressure vessel, and the method includes using the output of the pressure sensor to determine how to operate the gas pressure control valve and/or the liquid pressure control valve.

16. The method according to claim 15, wherein the system further includes a liquid level sensor which is operable to provide an output indicative of the level of the liquid in the pressure vessel, and the method includes using the output of the pressure sensor to determine how to operate the liquid control valve.

17. The method according to claim 8, wherein the drilling system includes a drill string extending down the riser.