PIPELINE ISOLATION TOOL AND METHOD

FIELD OF THE INVENTION

This invention relates to pipeline isolation and, in particular, but not exclusively, to isolation of a section of a pipeline having a restriction or reduced inner diameter.

BACKGROUND TO THE INVENTION

Transporting substances, in particular fluids, over distance is required in many industries, this typically being achieved via a system of pipes, tubes, pipe modules, pipelines and the like. In the oil and gas exploration and production industry, for example, pipelines are used in many surface, subsurface and subsea environments to transport oil and/or gas, often over large distances.

In some instances, it may be necessary to isolate a section of a pipeline for repair or replacement. However, isolation of a section of pipe with piggable tools can be limited or prevented where a section of the pipe bore has a restriction or section of reduced inner diameter. This may be the case, for example, where a section of pipe is dented or otherwise damaged, thereby hindering or preventing deployment of isolation tooling through the pipe bore.

A number of solutions have been proposed for isolating sections of pipe where the pipe bore is restricted.

For example, local isolation can be achieved through the use of a hot tap inserted isolation tool such as the BISEP tool from STATS (UK) Limited. The BISEP offers double block and bleed isolation of a pipe through a single penetration in the pipe. Although hot tap inserted isolation tools offer an effective and economic solution for many applications, in some subsea applications it may be preferred to use remotely operated isolation tools or plugs, for example where access to the pipe is limited or not possible. Remotely operated isolation tools may also be preferred to minimise the vessel time and expense which may otherwise be necessary in transporting tooling to site.

Alternatively, a pigging isolation tool may be used, the pigging tool located within the pipe bore and propelled through the pipe by a pressure force generated by the pipe flow. In instances where restriction of the pipe bore is relatively small, a two plug train may be used having a high jump isolation plug (one with a large clearance to the pipe bore when deactivated), the tools being launched from one end of the pipe such that the front plug of the train passes the restriction/damaged section of pipe. The two plugs can then be set to isolate the restricted/damaged section of the pipe.

However, there is a limit to the radial jump (clearance between the plug body and the pipe bore) that can be accommodated by a double block and bleed mechanical isolation plug and in instances where restriction of the pipe bore is more substantial, use of a high jump isolation tool to pig past the bore restriction may not be feasible. For example, it is considered that current technology puts this limit at between about 5% and about 10% bore restriction dependant on pipe diameter.

For larger bore restrictions, and in particular those where the restriction is greater than 10% of the pipe bore, it may be desirable to pig tooling from both ends of the pipe and approach the restriction from both sides. However, in many situations this does not represent an effective solution. For example, in cases where there is no breach in the pipe, pigging from both ends may result in fluid in the pipe between the plugs being compressed, thereby raising the pipe pressure and risking damage to, or rupture of, the pipe or preventing pig movement.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a method according to claim 1~~for isolating a section of a pipe, the method comprising:~~

~~locating a first plug module in a pipe in a first mode using a sealing pigging array with no or minimal bypass, the first plug module configurable in a second mode to permit fluid bypass of the pigging array and the first pipe module while securing the first plug module against the pipe and configurable in a third mode to isolate the pipeline, retaining pressure on one side of the tool while allowing the other side to be fully vented;~~

~~locating a second plug module in the pipe while the first plug module is in the second mode such that fluid displaced by location of the second plug module may bypass the first plug module;~~

~~securing the second plug module and the first plug module to the pipe to isolate the pipe section between the modules; and~~

~~configuring the first plug module in the first mode to prevent fluid bypass of the pigging array for pigging both plugs to one end for removal~~.

The present invention also relates to an isolation tool according to claim 13~~comprising a first plug module as described above, and also to an isolation tool comprising first and second plug modules as described above~~.

~~The second plug module and the first plug module may be secured to the pipe to isolate the pipe section between them using double block and bleed isolation.~~

In use, embodiments of the present invention facilitate isolation of a section of a pipe for repair and/or replacement.

The first plug module may be urged through the pipe in a first direction, for example from a first end of the pipe, and the second plug module may be urged through the pipe in a second, opposing, direction, for example from a second end of the pipe.

Beneficially, embodiments of the present invention facilitate isolation of a section of pipe comprising a restriction, for example resulting from a dent in the pipe, which may otherwise hinder or prevent passage of an isolation tool through the pipe.

For example, the first plug module may be located in the pipe at a first side of a restriction and the second plug module may be located in the pipe at a second side of the restriction. In particular embodiments, the second plug module may be located in the pipe at a second side of the restriction while the first plug module is in the second, fluid bypass, mode. Accordingly, fluid displaced by location of the second plug module may bypass the first plug module, thereby mitigating or eliminating the risk of damage to the pipe caused by increased pressure in the pipe and facilitating pig movement.

The first plug module may be lockable to the pipe. In use, the first plug module may be locked to the pipe wall while permitting fluid bypass of the first plug module. The first plug module may also, or alternatively, be locked to the pipe in the third mode, for example when it is desired to isolate a section of pipe comprising a restriction.

The first plug module may comprise a lock arrangement for locking the first plug module to the pipe. The lock arrangement may comprise any suitable arrangement and may, for example, comprise a taper lock arrangement.

The second plug module may be lockable to the pipe, for example when the second plug module has reached the desired location in the section of pipe. The second plug module may comprise a lock arrangement for locking the second plug module to the pipe. The lock arrangement may comprise any suitable arrangement and may, for example, comprise a taper lock arrangement or the like.

The first plug module may be configured to seal the pipe and may comprise a seal arrangement for engaging the pipe wall when it is desired to isolate the section of pipe. The seal arrangement may comprise any suitable arrangement and may, for example, comprise a compression seal or the like. In some embodiments, the seal arrangement may be self-energised by a fluid pressure differential across the first plug module.

second, fluid bypass, mode. Fluid displaced by movement of the second plug module will bypass the first seal module.

Accordingly, embodiments of the present invention facilitate fluid-tight isolation of a section of a pipe having a restriction which may then be repaired and/or replaced, while mitigating or eliminating the risk of damaging or rupturing the pipe.

~~According to a further aspect of the present invention there is provided a plug module according to the first and/or second aspect.~~

It should be understood that the features defined above in accordance with any aspect of the present invention or below in accordance with any specific embodiment may be utilised, either alone or in combination with any other defined feature, in any other aspect of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a pipeline system into which is loaded a first plug module of an isolation tool according to an embodiment of the present invention;

Figure 1a is an enlarged view of part of Figure 1, showing the first plug module;

Figure 2 is a diagrammatic view of another part of the pipeline system, showing the first plug module of Figure 1 as it travels towards the location where it is desired to set the plug module in the pipeline;

Figure 3 is a diagrammatic view of another part of the pipeline system, showing the first plug module on arrival at the desired set location, downstream of a damaged pipe section;

Figure 3a is an enlarged view of the first plug module, with a lock module set and a bypass passage open;

Figure 4 is a diagrammatic view of an upstream part of the pipeline system, into which is loaded a second plug module of the isolation tool;

Figure 5 is a diagrammatic view of the same part of the pipeline system shown in Figure 4, showing a bi-directional plug located in the pipeline;

Figure 6 is a diagrammatic view of the part of the pipeline system shown in Figure 3, showing the first pipe module and the second plug module on arrival at its desired set location, upstream of the damaged pipe section;

Figure 6a is an enlarged view of the first plug module, with a lock module set and a bypass passage open;

CLAIMS

1. A method for isolating a section of a pipe, the method comprising:

locating a first plug module of an isolation tool in a pipe in a first mode using a sealing pigging array with no or minimal bypass;~~,~~

configuring the first plug module ~~configurable~~ in a second mode to permit fluid bypass of the pigging array and the first plug~~pipe~~ module;

~~while~~ securing the first plug module against the pipe;~~ and~~

configuring~~able~~ the first plug module in a third mode to isolate a~~the~~ pipeline section of the pipe, retaining pressure on one side of the tool while allowing the other side to be fully vented;

locating a second plug module in the pipe while the first plug module is in the second mode and urging the second plug module towards the first plug module such that fluid displaced by location of the second plug module ~~may~~ bypasses the first plug module;

securing the second plug module and the first plug module to the pipe to isolate the pipe section between the modules; and

configuring the first plug module in the first mode to prevent fluid bypass of the pigging array for pigging the first and second~~both~~ plug modules to one end of the pipe for removal.

2. The method of claim 1, further comprising securing the second plug module and the first plug module to the pipe to isolate the mid section between them using double block and bleed isolation.

3. The method of claim 1 or 2, comprising urging the first plug module through the pipe in a first direction and urging the second plug module through the pipe in a second, opposing, direction.

4. The method of any preceding claim, comprising locating the first plug module in the pipe at a first side of a restriction and locating the second plug module in the pipe at a second side of the restriction.

5. The method of claim 4, comprising locating the second plug module in the pipe at a second side of the restriction while the first plug module is in the second, fluid bypass, mode.

6. The method of any preceding claim, comprising locking the first plug module to the pipe.

7. The method of claim 6, wherein the first plug module is locked to a wall of the pipe ~~wall~~ while permitting fluid bypass of the first plug module.

8. The method of claim 6 or 7, wherein the first plug module is locked to the pipe in the third mode.

9. The method of any preceding claim, comprising locking the second plug module to the pipe.

10. The method of claim 9, wherein the second plug module is locked to the pipe when the second plug module has reached a desired location in the section of pipe.

11. The method of any preceding claim, comprising configuring the first plug module to seal the pipe.

12. The method of any preceding claim, comprising configuring the second plug module to seal the pipe.

13. An isolation tool comprising:

a first plug module configured for location in a pipe in a first mode using a sealing pigging array with no or minimal bypass, the first plug module configurable in a second mode to permit fluid bypass of the pigging array and the first plug~~pipe~~ module while securing the first plug module against the pipe and configurable in a third mode to isolate the pipe~~line, retaining pressure on one side of the tool while allowing the other side to be fully vented~~;

a second plug module configured for location in the pipe, the second plug module urged towards the first plug module while the first plug module is in the second mode such that fluid displaced by location of the second plug module ~~may~~ bypasses the first plug module;

wherein the second plug module and the first plug module are secured to the pipe to isolate the section of the pipe ~~section~~ between the modules; and

configuring the first plug module in the first mode to prevent fluid bypass of the pigging array for pigging both plug modules to an end of the pipe for removal.

14. The isolation tool of claim 13, wherein at least one of the first plug module and the second plug module comprise a lock arrangement for locking the first plug module to the pipe.

15. The isolation tool of claim 14, wherein the lock arrangement comprises a taper lock arrangement.

16. The isolation tool of any one of claims 13, 14 or 15, wherein at least one of the first plug module and the second plug module comprise a seal arrangement for engaging a wall of the pipe.

17. The isolation tool of claim 16, wherein the seal arrangement comprises a compression seal.

18. The isolation tool of claim 16 or 17, wherein the seal arrangement is configured to be self-energised.

19. The isolation tool of any one of claims 13 to 18, wherein the first plug module is configured to permit fluid bypass between the first plug module isolation seals and the ~~pipe~~ wall of the pipe.

20. The isolation tool of any one of claims 13 to 19, wherein the first plug module defines a fluid passage for directing fluid through the tool.

21. The isolation tool of any one of claims 13 to 20, wherein the first plug module comprises a valve arrangement for controlling fluid bypass.

22. The isolation tool of any one of claims 13 to 21, further comprising a control and actuation system.

23. The isolation tool of claim 22, wherein the control and actuation system comprises a hydraulic control system.

24. The isolation tool of claim 22 or 23, wherein each plug module is controlled/actuated independently and/or remotely.

~~25. A first plug module according to any one of claims 13 to 24.~~