In the case of adding a further conventional control mechanism for devices, such as a valve, or sensor downhole; the inventors of the present invention also note limitations since, in the event of a blow-out, the ability to function these devices may be lost due to the inability to fluctuate pressure to control pressure activated devices, or due to the loss of control lines.

Thus it is difficult for a skilled person to design a further safety system which can practically add to the safety systems already provided in oil wells.

Embodiments of the present disclosure mitigate problems with the prior art, and preferably to improve the safety of wells.

According to a first aspect of the present disclosure there is provided a well including a packer apparatus and a sensor to detect a parameter in the well. The packer apparatus includes a packer and an activation mechanism. The activation mechanism includes an expansion mechanism for expanding the packer and a wireless receiver adapted to receive a wireless control signal sent in response to the parameter detected by the sensor and the wireless receiver is adapted to control the activation mechanism. The packer apparatus is provided downhole in either of the following locations:
(i) in a casing annulus between two different casing strings; or (ii) between the casing and formation.

According to a second aspect of the present disclosure, there is provided a method of drilling, including during a drilling phase providing the packer apparatus of the well of the first aspect in a well of the first aspect.
According to a third aspect of the present disclosure, there is provided a method of inhibiting fluid flow from a well. The well includes at least one safety

mechanism below a blowout preventer (BOP) positioned on a top of the well, the safety mechanism including: (a) an obstructing member moveable between a first position where fluid flow is permitted, and a second position where fluid flow is restricted; (b) a movement mechanism; (c) a wireless receiver, adapted to receive a wireless signal; wherein the movement mechanism is operable to move the obstructing member from one of the first and second positions to the other of the first and second positions in response to a change in the signal being received by the wireless receiver; (d) a packer; and, (e) an expansion mechanism; and wherein the movement mechanism causes the expansion mechanism to activate which expands the packer and so moves the packer between said first position and said second position. The method includes: in the event of an emergency situation, moving the obstructing member with the movement mechanism from one of the first and second positions to the other of the first and second positions automatically in response to at least one level of a parameter detected by a sensor which is indicative of the emergency situation; and wherein the safety mechanism comprises a pre-production downhole safety mechanism with the level of the parameter at which the movement mechanism is adapted to move the obstructing member to/from the first position from/to the second position being variable by an operator from a first trip point in a first phase when the BOP is in use, the first phase selected from the group consisting of drilling, suspension, injection, completion and abandonment phases, and a second trip point in a second phase, the second phase being different from the first phase, and selected from the group consisting of drilling, suspension, production, injection, completion and abandonment phases.

Thus embodiments of the present disclosure provide a significant benefit in that it can move, normally shut, an obstructing member, such as a valve,

packer, sleeve or plug in response to a wireless signal. Significantly this is independent of the provision of control lines, such as hydraulic or electric lines, between a well and a wellhead apparatus, for example the BOP. Thus in the event of a disastrous blowout or explosion, a wireless signal can be sent to the valve merely by contacting the wellhead apparatus typically at the top of the well with a wireless transmitter, which will send the appropriate signal. For certain embodiments the wireless transmitter may be mounted onto the wellhead apparatus. Indeed this can be achieved even if the wellhead apparatus has suffered extensive damage, and/or the hydraulic, electric and other control lines have been damaged and the conventional safety systems have lost all functionality, since the wireless signal requires no intact control lines in order

Claims

1. A well comprising a packer apparatus and a sensor to detect a parameter in the well, the packer apparatus comprising: a packer and an activation mechanism; wherein the activation mechanism comprises an expansion mechanism for expanding the packer and a wireless receiver adapted to receive a wireless control signal sent in response to the parameter detected by the sensor and the wireless receiver is adapted to control the activation mechanism;
   wherein the packer apparatus is provided downhole in either of the following locations:
   (i) in a casing annulus between two different casing strings; or
   (ii) between the casing and formation.

2. A well as claimed in claim 1, wherein the receiver is a transceiver.

3. A well as claimed in any preceding claim, wherein the receiver or transceiver is an acoustic receiver or transceiver respectively and the signal is an acoustic signal.

4. A well as claimed in either of claims 1 or 2, wherein the receiver or transceiver is an electromagnetic receiver or transceiver respectively and the signal is an electromagnetic signal.

5. A well as claimed in any preceding claim, wherein the information provided by the sensor is retrieved wirelessly.

6. A well as claimed in any preceding claim, wherein the packer is adapted to expand, in use, by compression.

7. A well as claimed in any one of claims 1 to 5, wherein the packer is adapted to expand, in use, by inflation.

8. A well as claimed in any preceding claim, the well comprising a safety mechanism, the safety mechanism comprising the packer and the expansion mechanism, wherein the packer is moveable between a first position where fluid flow is permitted and a second position where fluid flow is restricted; and
   the safety mechanism comprises a movement mechanism, the movement mechanism in use causing the expansion mechanism to activate which expands the packer and so moving the packer from said first position to said second position; and
   wherein the safety mechanism is adapted to move the packer from one of the first and second positions to the other of the first and second positions automatically in response to at least one level of the parameter detected by the sensor.

9. A well as claimed in any preceding claim, wherein the well is a subsea well.

10. A well apparatus comprising:

    a well as claimed in any preceding claim;

    a plurality of casing strings;

    wherein the packer apparatus is on at least one of the plurality of casing strings in order to restrict flow of fluid through an annulus between the at least one of the plurality of casing strings and an adjacent elongate member.

11. A well apparatus as claimed in claim 10, wherein sensors and/or receivers are provided in at least one casing annulus defined between two of the casing strings.

12. A well apparatus as claimed in claim 10 or claim 11, wherein the packer is provided on the casing string adjacent to a cemented-in portion of the casing.

13. A well apparatus as claimed in any one of claims 10 to 12, wherein the packer is provided in use in the expanded configuration and acts as a permanent barrier to resist fluid flow.

14. A well apparatus as claimed in any one of claims 10 to 12, wherein the packer is provided in use in the unexpanded configuration and adapted to activate as required.

15. A well apparatus as claimed in claim 14, wherein the packer is activatable as required in response to an emergency situation.

16. A well apparatus as claimed in any one of claims 10 to 15, wherein the packer is adapted to expand in an inward direction.

17. A well apparatus as claimed in any one of claims 10 to 16, wherein the packer is provided within 100m of a wellhead, optionally more within 50m, especially within 20m, and more especially within 10m.

18. A well apparatus as claimed in any one of claims 10 to 17, wherein the elongate member is one of a drill pipe and production tubing.

19. A method of drilling, comprising during a drilling phase providing the packer apparatus of the well of any of claims 1 to 9 in a well of any of claims 1 to 9.

20. A method of inhibiting fluid flow from a well, the well comprising at least one safety mechanism below a blowout preventer (BOP) positioned on a top of the well, the safety mechanism comprising:

(a) an obstructing member moveable between a first position where fluid flow is permitted, and a second position where fluid flow is restricted;

(b) a movement mechanism;

(c) a wireless receiver, adapted to receive a wireless signal; wherein the movement mechanism is operable to move the obstructing member from one of the first and second positions to the other of the first and second positions in response to a change in the signal being received by the wireless receiver;

(d) a packer; and,

(e) an expansion mechanism; and wherein the movement mechanism causes the expansion mechanism to activate which expands the packer and so moves the packer between said first position and said second position;

wherein the method comprises: in the event of an emergency situation, moving the obstructing member with the movement mechanism from one of the first and second positions to the other of the first and second positions automatically in response to at least one level of a parameter detected by a sensor which is indicative of the emergency situation; and

wherein the safety mechanism comprises a pre-production downhole safety mechanism with the level of the parameter at which the movement mechanism is adapted to move the obstructing member to/from the first position from/to the second position being variable by an operator from a first trip point in a first phase when the BOP is in use, the first phase selected from the group consisting of:

drilling, suspension, injection, completion and abandonment phases, and

a second trip point in a second phase, the second phase being different from the first phase, and selected from the group consisting of:

drilling, suspension, production, injection, completion and abandonment phases.