

EXTENDING THE LIFE OF A COMPROMISED UMBILICAL

FIELD OF INVENTION

[0001] The present invention relates to extending the life of a compromised umbilical.

BACKGROUND OF THE INVENTION

[0002] One of the most common problems with a subsea umbilical between a fluid extraction well surface platform and a well complex is degradation of the insulation impedance between internal conductors of the umbilical and earth, i.e. the surrounding sea water. In practice, the umbilical is compromised by the ingress of sea water, causing the capacitance between the conductors and earth to increase substantially, with resultant increase of leakage currents and less power available for the well complex. This invention enables a solution to this problem by saving the need to replace the umbilical.

[0003] Various systems for providing electrical power to an underwater location are described in: GB-A-2 332 220; GB-A-2 382 600; WO01/84689; WO02/37640; US-A-5 444 184; US-A-4 646,083; US-A-4 636 934; WO01/71158; US-A-4 080 025; and US-A-6 045 333.

SUMMARY OF THE INVENTION

[0004] According to the present invention from one aspect, there is provided a method of using an umbilical between a surface location and an underwater location of an underwater fluid extraction well system, the umbilical carrying an electrical power conductor and having been compromised by the leakage of current from the conductor to surrounding water, the method comprising:

converting electrical power from a source at the surface location at a first frequency to electrical power at a second frequency, lower than the first frequency, or to DC electrical power;

transmitting said electrical power at the second frequency or said DC electrical power to the underwater location via the conductor; and

at the underwater location, converting said electrical power at the second frequency or said DC electrical power to electrical power at a frequency used by underwater equipment of the well system.

[0005] Typically, the frequency of electrical power used by underwater equipment of the well system is the same as the first frequency.

[0006] The umbilical could, for example, be connected to a distribution unit at the underwater location or to a module at the underwater location before a distribution unit of the well system.

[0007] Typically, the underwater location is on the bed of a body of water surrounding the umbilical.

[0008] Typically, the method included the steps of, at the underwater location, monitoring electrical power from the umbilical and, if the voltage of the electrical power is less than a threshold, the steps of: providing at the surface location means for converting said electrical power from the source at the first frequency to said electrical power at the second frequency or to said DC electrical power; and providing at the underwater location means for converting the electrical power at the second frequency or said DC electrical power to electrical power at said frequency used by underwater equipment of the well system.

[0009] Alternatively, the method could have included the steps of, at the underwater location, monitoring electrical power from the umbilical and, if the voltage of the electrical power is less than a threshold, the steps of: causing first converting means, at the surface location, to convert said electrical power from the

source at the first frequency to said electrical power at the second frequency or to said DC electrical power; and causing second converting means, at the underwater location, to convert the electrical power at the second frequency or said DC electrical power to electrical power at said frequency used by underwater equipment of the well system.

[0010] According to the present invention from another aspect, there is provided an underwater fluid extraction well system, comprising:

a source of electrical power at a first frequency at a surface location;

an umbilical for transmitting electrical power from the source via an electrical conductor of the umbilical to an underwater location for use by underwater equipment of the well system; and

means at the underwater location for monitoring electrical power from the conductor, wherein the system further comprises:

first converting means for use at the surface location, for converting electrical power from the source to electrical power at a second frequency, lower than the first frequency, or to DC electrical power; and

second converting means, for use at the underwater location, for converting such electrical power at the second frequency or said DC electrical power to electrical power at a frequency used by said underwater equipment of the well system, so that, if said monitoring means indicates that the voltage of electrical power from the conductor is less than a threshold, said first converting means can be used to convert electrical power from the source to said lower frequency or to DC, for transmission via said conductor to the underwater location, and said second converting means can be used to convert the electrical power at the second frequency on the DC electrical power to electrical power at the frequency used by said underwater equipment of the system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Fig. 1a shows schematically a typical existing arrangement using an umbilical; and

[0012] Fig. 1b shows schematically an arrangement using an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Referring first to Fig. 1a, this shows schematically a typical existing arrangement of a surface platform 1 with an AC electrical power source 2 (typically operating at 50 or 60 Hz) connecting to the power conductors within an umbilical 3 via an electrical power and control module (EPCM) 4. The seabed end of the umbilical 3 connects to a distribution assembly 5 on the seabed B, the assembly 5 feeding electrical power to a multiplicity of wells via power connections 6.

[0014] Referring to Fig. 1b, this shows schematically an arrangement operating according to an embodiment of the invention. In Fig. 1b, items which correspond with those in Fig. 1a have the same reference numerals as Fig. 1a. The umbilical 3 has been compromised by the ingress of sea water, causing the capacitance between its power conductors and earth to increase substantially with resultant increase of leakage currents and less power available to the well complex.

[0015] An electronic converter 7 is installed in the EPCM 4 and receives AC electrical power from source 2 (typically at 50 or 60 Hz) and outputs electrical power at a lower frequency. A frequency of $16 \frac{2}{3}$ Hz is a favoured choice as communications on power (COP) electrical power control equipment operating at this frequency is readily available as a result of this frequency being a standard for the railway industry. A possible alternative is for the converter 7 to be one which simply rectifies the AC input power to produce DC electrical power and thus feed this DC electrical power down the umbilical 3 instead of AC electrical power. Both lower frequency AC and DC will substantially overcome the initial problem with the increased capacitance of the insulation of the compromised umbilical 3.

[0016] At the seabed end of the umbilical 3, a second electronic converter 8 is installed in the distribution assembly 5 or, as a possible alternative, is housed in a module on the seabed B and connected to the end of the umbilical 3 before it reaches

the distribution assembly 5. The actual location of the subsea converter 8 will depend on the existing installation configuration. The converter 8 receives electrical power at the lower frequency, or DC, and outputs electrical power at the original power supply frequency for use by underwater equipment of the well complex via power connections 6.

[0017] The steps by which it had been determined that the umbilical 3 had become compromised were as follows. If conventional monitoring equipment 9 at the underwater location, for example (as shown) at the distribution assembly 5 or a module before it, indicated that the voltage of power from the power conductors in the umbilical 3 had dropped below a threshold, detection of this at the platform 1 is an indication, on the one hand, to install inverter 7 in EPCM 4 and, on the other hand, to install inverter 8 subsea, typically using a remotely operated vehicle (ROV).

[0018] Alternatively, the converters 7 and 8 could be pre-installed at the surface location and subsea respectively, and switched into operation in the EPCM 4 and in the distribution assembly 5 or module if the monitoring equipment 9 indicates that the voltage of power from the power conductors in the umbilical 3 drops below a threshold.

[0019] The present invention allows the problems of an umbilical which is failing due to water ingress to be substantially overcome, thus allowing a prolonged life for a well complex without having to replace the expensive umbilical.

CLAIMS

1. A method of using an umbilical between a surface location and an underwater location of an underwater fluid extraction well system, the umbilical carrying an electrical power conductor for transmitting to the underwater location electrical power from a source at the surface location at a first frequency, for use by underwater equipment of the well system, the method comprising the steps of:

detecting that the umbilical has been compromised by the ingress of water and, in response thereto:

converting electrical power from the source to electrical power at a second frequency, lower than the first frequency, or to DC electrical power;

transmitting said electrical power at the second frequency or said DC electrical power to the underwater location via the conductor; and

at the underwater location, converting said electrical power at the second frequency or said DC electrical power to electrical power at a frequency used by the underwater equipment of the well system.

2. The method of claim 1, wherein the frequency of electrical power used by underwater equipment of the well system is the same as the first frequency.

3. The method of claim 1, wherein the umbilical is connected to a distribution unit at the underwater location.

4. The method of claim 1, wherein the umbilical is connected to a module at the underwater location before a distribution unit of the well system.

5. The method of claim 1, wherein the underwater location is on the bed of a body of water surrounding the umbilical.

6. The method of claim 1, wherein said detecting step includes monitoring the voltage of electrical power from the umbilical for use in producing an indication that the umbilical has been compromised by the ingress of water if the voltage is less than a threshold.

7. The method of claim 1, which includes the steps of:

if it is detected that the umbilical has been compromised by the ingress of water, providing means at the surface location for converting said electrical power from the source at the first frequency to said electrical power at the second frequency or to said DC electrical power; and

providing at the underwater location means for converting the electrical power at the second frequency or said DC electrical power to electrical power at said frequency used by underwater equipment of the well system.

8. The method of claim 1, which includes the steps of:

if it is detected that the umbilical has been compromised by the ingress of water, causing first converting means, at the surface location, to convert said electrical power from the source at the first frequency to said electrical power at the second frequency or to said DC electrical power; and

causing second converting means, at the underwater location, to convert the electrical power at the second frequency or said DC electrical power to electrical power at said frequency used by underwater equipment of the well system.

9. A method of using an umbilical between a surface location and an underwater location of an underwater fluid extraction well system, the umbilical carrying an electrical power conductor for transmitting to the underwater location electrical power from a source at the surface location at a first frequency, for use by underwater equipment of the well system, the method comprising the steps of:

detecting that the umbilical has been compromised by the ingress of water and, in response thereto:

converting electrical power from the source to electrical power at a second frequency, lower than the first frequency, or to DC electrical power;

transmitting said electrical power at the second frequency or said DC electrical power to the underwater location via the conductor; and

at the underwater location, converting said electrical power at the second frequency or said DC electrical power to electrical power at a frequency used by the underwater equipment of the well system, wherein:

the frequency of electrical power used by underwater equipment of the well system is the same as the first frequency; and

said detecting step includes monitoring the voltage of electrical power from the umbilical for use in producing an indication that the umbilical has been compromised by the ingress of water if the voltage is less than a threshold.

10. The method of claim 9, which includes the steps of:

if it is detected that the umbilical has been compromised by the ingress of water, providing means at the surface location for converting said electrical power from the source at the first frequency to said electrical power at the second frequency or to said DC electrical power; and

providing at the underwater location means for converting the electrical power at the second frequency or said DC electrical power to electrical power at said frequency used by underwater equipment of the well system.

11. The method of claim 9, which includes the steps of:

if it is detected that the umbilical has been compromised by the ingress of water, causing first converting means, at the surface location, to convert said electrical power from the source at the first frequency to said electrical power at the second frequency or to said DC electrical power; and

causing second converting means, at the underwater location, to convert the electrical power at the second frequency or said DC electrical power to electrical power at said frequency used by underwater equipment of the well system.

12. An underwater fluid extraction well system, comprising:

a source of electrical power at a first frequency at a surface location;

an umbilical for transmitting electrical power from the source via an electrical conductor of the umbilical to an underwater location for use by underwater equipment of the well system; and

means for detecting that the umbilical has been compromised by the ingress of water, wherein the system further comprises:

first converting means, for use at the surface location, for converting electrical power from the source to electrical power at a second frequency, lower than the first frequency, or to DC electrical power; and

second converting means, for use at the underwater location, for converting such electrical power at the second frequency or said DC electrical power to electrical power at a frequency used by said underwater equipment of the well system, so that, if said detecting means indicates that the umbilical is compromised by the ingress of water, said first converting means can be used to convert electrical power from the source to said second frequency or to DC, for transmission via said conductor to the

underwater location, and said second converting means can be used to convert the electrical power at the second frequency or the DC electrical power to electrical power at the frequency used by said underwater equipment of the system.

13. The system of claim 12, wherein said detecting means comprises means for monitoring the voltage of electrical power from the umbilical for use in producing an indication that the umbilical is compromised by the ingress of water if the voltage is less than a threshold.