wellbore, along with the sealing devices, prevent loss of stimulation fluids from each desired stimulation location during the stimulation operation. In this manner, an operator performing the stimulation operation can be assured that all of the stimulation fluids intended to be injected into a formation at a desired location are indeed entering the formation at that location.

Summary

[0004a] According to a first aspect of the present invention, there is provided a system for powering electronics located in a wellbore intersecting a subterranean earth formation, including: a battery locatable in the wellbore; a turbine generator locatable in the wellbore so as to be in fluid communication with a flow path in the wellbore; an electronic device locatable in the wellbore and electrically coupled to the battery and the turbine generator; a power sensor electrically coupled to the battery and the turbine generator and configured to measure a parameter associated with the power condition of any one or a combination of the battery and the turbine generator; and a processor electrically coupled to the power sensor and configured to determine if a power condition is satisfied to allow the turbine generator to power the electronic device, wherein the processor determines whether the power condition is satisfied in response to any one or a combination of the parameter measured by the power sensor, a time duration, a pressure, a flow rate, and a temperature.

[0004b] According to a second aspect of the present invention, there is provided a method of powering electronics located in a wellbore intersecting a subterranean earth formation, including: powering an electronic device located in the wellbore using a battery; opening a closed flow path in communication with a turbine generator; monitoring a power condition using a power sensor coupled to the battery and the turbine generator; and selecting the turbine generator to power the electronic device if the power condition is satisfied, wherein the power condition includes any one or a combination of a power threshold of the battery, a power threshold of the turbine generator, a time duration, a pressure, a flow rate, and a temperature.

[0004c] According to a third aspect of the present invention, there is provided a power control device, including: a battery locatable in a wellbore; a turbine generator locatable in the wellbore so as to be in fluid communication with a flow path in the wellbore; a power sensor electrically coupled to the battery and the turbine generator and configured to measure a parameter associated with the power condition of any one or a combination of the battery and the turbine generator; and a processor electrically coupled to the power sensor and configured to determine if a power condition is satisfied to allow the turbine generator to power an electronic device locatable in the wellbore, wherein the processor determines whether the power condition is satisfied in response to any one or a combination of the parameter measured by the power sensor, a time duration, a pressure, a flow rate, and a temperature.

Description of the Drawings

[0005] Embodiments of the invention are described with reference to the following figures. The same numbers are used throughout the figures to reference like features and components. The features depicted in the figures are not necessarily shown to scale. Certain features of the embodiments may be shown exaggerated in scale or in somewhat schematic form, and some details of elements may not be shown in the interest of clarity and conciseness.

[0006] FIG. 1 shows an elevation view of a well system, according to one or more embodiments;

[0007] FIG. 2 shows a block diagram view of a power control device electrically coupled to one or more electronic device(s), according to one or more embodiments; and

[0008] FIG. 3 shows a flowchart view of a method of powering electronics in a wellbore during a completion operation according to one or more embodiments.

Detailed Description

[0009] FIG. 1 shows an elevation view of a well system 110 including a screen section 124 and a power control device 140, in accordance with one or more embodiments. As shown, a wellbore 112 intersects a subterranean earth formation 120. The wellbore 112 has a vertical section 114, which is at least partially cemented with a casing string 116, and a horizontal section 118, which can be an open-hole section of the wellbore 112. Other wellbore configurations may also be suitable.

[0010] Positioned within the wellbore 112 and extending from the surface is a tubing string 122, which provides a conduit for formation fluids to travel from the formation 120 to the surface and for stimulation fluids to travel from the surface to the formation 120. The tubing string 122 includes a screen section 124, each of which is positioned between a pair of annular barriers depicted as packers 126 that provides a fluid seal between the tubing string 122 and the wellbore 112, thereby defining a production intervals 130. The screen section 124 is employed to inject stimulation fluid into the formation or filter particulate matter out of the production fluid stream. A flow control device 132 may also be located in the wellbore

Claims

1. A system for powering electronics located in a wellbore intersecting a subterranean earth formation, comprising:

a battery locatable in the wellbore;

a turbine generator locatable in the wellbore so as to be in fluid communication with a flow path in the wellbore;

an electronic device locatable in the wellbore and electrically coupled to the battery and the turbine generator;

a power sensor electrically coupled to the battery and the turbine generator and configured to measure a parameter associated with the power condition of any one or a combination of the battery and the turbine generator; and

a processor electrically coupled to the power sensor and configured to determine if a power condition is satisfied to allow the turbine generator to power the electronic device,

wherein the processor determines whether the power condition is satisfied in response to any one or a combination of the parameter measured by the power sensor, a time duration, a pressure, a flow rate, and a temperature.

2. The system of claim 1, wherein the processor is further configured to power the electronic device only by the battery if the power condition is not satisfied.

3. The system of claim 1, wherein the electronic device includes any one or combination of a sensor, a valve, a pump, and an actuator.

4. The system of claim 3, wherein the sensor is configured to measure any one or combination of pressure, flow rate, tool position, tool orientation, valve position, vibration, fluid composition, and temperature.

5. The system of claim 1, wherein the processor is configured to select only the turbine generator to power the electronic device when the power condition is satisfied.

6. The system of claim 1, further comprising a flow control device in communication with and configured to control the flow of fluid through the flow path.

7. The system of claim 1, wherein the battery is a primary battery, and wherein the parameter associated with the power condition of any one or a combination of the battery and the turbine generator includes a power threshold of either or both of the primary battery and the turbine generator.

8. A method of powering electronics located in a wellbore intersecting a subterranean earth formation, comprising:

powering an electronic device located in the wellbore using a battery;

opening a closed flow path in communication with a turbine generator;

monitoring a power condition using a power sensor coupled to the battery and the turbine generator; and

selecting the turbine generator to power the electronic device if the power condition is satisfied, wherein the power condition includes any one or a combination of a power threshold of the battery, a power threshold of the turbine generator, a time duration, a pressure, a flow rate, and a temperature.

9. The method of claim 8, further comprising performing a completion operation while using the electronic device.

10. The method of claim 8, further comprising stimulating the formation while using the electronic device.

11. The method of claim 8, wherein the electronic device includes any one or combination of a sensor, a valve, a pump, and an actuator.

12. The method of claim 11, wherein the sensor is configured to measure any one or combination of pressure, flow rate, tool position, tool orientation, valve position, vibration, fluid composition, and temperature.

13. The method of claim 8, further comprising closing the flow path in communication with the turbine generator using a flow control device during a completion operation.

14. The method of claim 8, wherein the battery is a primary battery.

15. The method of claim 8, further comprising opening the closed flow path only after formation stimulation is completed.

16. The method of claim 8, further comprising opening the closed flow path during formation stimulation.

17. A power control device, comprising:

a battery locatable in a wellbore;

a turbine generator locatable in the wellbore so as to be in fluid communication with a flow path in the wellbore;

a power sensor electrically coupled to the battery and the turbine generator and configured to measure a parameter associated with the power condition of any one or a combination of the battery and the turbine generator; and

a processor electrically coupled to the power sensor and configured to determine if a power condition is satisfied to allow the turbine generator to power an electronic device locatable in the wellbore, wherein the processor determines whether the power condition is satisfied in response to any one or a combination of the parameter measured by the power sensor, a time duration, a pressure, a flow rate, and a temperature.

18. The power control device of claim 17, wherein the processor is further configured to power the electronic device only with the battery if the power condition is not satisfied.

19. The power control device of claim 17, wherein the battery is a primary battery, and wherein the parameter associated with the power condition of any one or a combination of the battery and the turbine generator includes a power threshold of either or both of the primary battery and the turbine generator.