can cause erroneous data to be passed to the compartments protected by barrier 150. The consequences erroneous data can disable or otherwise compromise the operation of the equipment in a compartment that has not been damaged by a fire or flood.

BRIEF SUMMARY

[0011] Reducing the reliance of a breaker on input from other breakers can improve the resiliency of a power system. For example, each breaker can independently execute a method for determining when a breaker is safe to close. Providing each breaker with the capability to independently execute such a method can reduce or eliminate reliance of each breaker on other breakers. The improved resiliency of a power system employing the autonomous breakers may result from a lower likelihood that one breaker operating erroneously can cause all breakers to operate erroneously. Thus, a power system can continue to operate normally even though one breaker may become inoperable.

[0012] According to a first aspect of the present invention, there is provided a method, comprising applying a first current to a first energized bus coupled to a breaker. The method may also include measuring a first impedance of the first energized bus after applying the first current to the first energized bus; determining if a fault exists on the first energized bus based, at least in part, on the measured first impedance; and coupling the first energized bus to a second energized bus coupled to the breaker when no fault exists on the first energized bus by synchronizing AC energy on the first energized bus with AC energy on the second energized bus and closing the breaker between the first energized bus and the second energized bus.

[0013] The method can include applying the current to the first bus through a potential transformer. The method can be initiated by receiving a command, at a controller, to close the breaker. Furthermore, the method can include checking the status of the first bus and instructing, by a controller, a contactor coupled to a sensor to either close or open. The sensor can be a voltage sensor, a current sensor, or both a voltage and current sensor.

[0014] According to an embodiment, the method can also include determining a fault detection procedure to implement based, in part, on the measured first impedance of the first bus. The method can also include processing the measured first impedance of the first bus in order to determine the status of the bus. Instructions within a controller can be executed to select the fault detection procedure to implement based, in part, on the determined status of the first bus.

[0015] The method can include instructing, by a controller, a contactor coupled to the sensor to close or open when implementing the selected fault detection procedure. A second current can be applied to the first bus in order to measure a second impedance of the first bus. The second measured impedance can be processed by a controller to determine whether a fault exists on the first bus.

[0016] According to an embodiment, the measuring of the impedance of a bus can be performed by measuring a voltage, a current, or both a voltage and a current of the bus. Furthermore, the coupling of the first bus to at least a second bus can be performed by first synchronizing the first bus to a second bus, and then closing the breaker between the first and the second bus. Moreover, the coupling of the first bus to the second bus can result in the coupling of a generator to a load on a drilling vessel.

[0017] According to a second aspect of the present invention, there is provided an apparatus comprising a breaker coupled between a first energized bus and a second energized bus, wherein the first energized bus and the second energized bus are both energized with AC energy; a controller coupled to the breaker; a synchronizer coupled to the first energized bus and an external power source on the second energized bus, wherein the synchronizer is configured to synchronize AC energy on the second energized bus with AC energy on the first energized bus; a first potential transformer coupled to the controller and the first energized bus; and a second potential transformer coupled to the controller and the second energized bus, in which the controller is configured: to apply a first current from the second energized bus to the first energized bus; to measure a first impedance of the first energized bus after applying the first current to the first energized bus; to determine if a fault exists on the first energized bus based, at least in part, on the measured first impedance; and when no fault is determined to exist, to activate the breaker and the synchronizer to synchronize and to couple the first energized bus to the second energized bus to supply AC energy from the second energized bus to the first energized bus.

[0017a] According to a third aspect of the present invention, there is provided an apparatus, comprising: a breaker coupled to a first energized energized bus and a second bus; means for applying a first current to the first energized bus; and a controller coupled to the first current applying means, in which the controller is configured: to determine if a fault exists on the

first energized bus; and to couple the first energized bus to the second energized bus through the breaker when no fault exists on the first energized bus by synchronizing AC energy on the first energized bus with AC energy on the second energized bus and closing the breaker between the first energized bus and the second energized bus.

[0018] The apparatus can also include devices that protect, such as a protection circuit coupled to the breaker and an external protection system, or devices that control the internal components of the breaker, such as an operator interface. The apparatus can also include a device for performing measurements on the breaker, such as a universal measuring transducer, coupled to the controller and to an external bus. Furthermore, the apparatus can include synchronization circuitry, such as a synchronizer coupled to an external power source. Other synchronization circuitry can include a sync check relay coupled to the operator interface and to an external power source control circuit. The protection circuit, universal measuring transducer, synchronizer, sync check relay, and/or the controller can be part of a control circuit within the apparatus.

WHAT IS CLAIMED IS:

1. A method, comprising:

applying a first current to a first energized bus coupled to a breaker;

measuring a first impedance of the first energized bus after applying the first current to the first energized bus;

determining if a fault exists on the first energized bus based, at least in part, on the measured first impedance; and

coupling the first energized bus to a second energized bus coupled to the breaker when no fault exists on the first energized bus by synchronizing AC energy on the first energized bus with AC energy on the second energized bus and closing the breaker between the first energized bus and the second energized bus.

2. The method of claim 1, wherein applying a first current to a first energized bus comprises applying the first current through a transformer to the first energized bus.

3. The method of claim 1, further comprising:

receiving a command, at a controller, to close the breaker before applying the first current; and

instructing, by a controller, a contactor to close or open after measuring a first impedance.

4. The method of claim 1, wherein determining if a fault exists on the first energized bus comprises:

determining a fault detection procedure to implement based, in part, on the measured first impedance of the first energized bus; and

implementing the determined fault detection procedure.

5. The method of claim 4, wherein determining a fault detection procedure comprises:

processing the measured first impedance;

determining the status of the first energized bus after processing the measured impedance; and

selecting the fault detection procedure to implement based, in part, on the determined status of the first energized bus.

6. The method of claim 4, wherein implementing the determined fault detection procedure comprises:

instructing a contactor to close or open;

applying a second current to the first energized bus;

measuring a second impedance of the first energized bus after applying the second current; and

determining whether a fault exists on the first energized bus based, in part, on the second impedance.

7. The method of claim 1, wherein applying the first current comprises applying the first current at a first frequency, and the method further comprising:

applying a second current at a second frequency; and

measuring a second impedance of the first energized bus after applying the second current to the first energized bus, wherein the step of determining if a fault exists on the first energized bus comprises determining if a fault exists based, at least in part, on the measured first impedance and the measured second impedance.

8. The method of claim 1, wherein the breaker comprises a tie breaker and the step of coupling the first energized bus to the second energized bus comprises coupling a generator to a load on a drilling vessel.

9. An apparatus, comprising:

a breaker coupled between a first energized bus and a second energized bus, wherein the first energized bus and the second energized bus are both energized with AC energy;

a controller coupled to the breaker;

a synchronizer coupled to the first energized bus and an external power source on the second energized bus, wherein the synchronizer is configured to synchronize AC energy on the second energized bus with AC energy on the first energized bus;

a first potential transformer coupled to the controller and the first energized bus; and

a second potential transformer coupled to the controller and the second energized bus, in which

the controller is configured:

to apply a first current from the second energized bus to the first energized bus;

to measure a first impedance of the first energized bus after applying the first current to the first energized bus;

to determine if a fault exists on the first energized bus based, at least in part, on the measured first impedance; and

when no fault is determined to exist, to activate the breaker and the synchronizer to synchronize and to couple the first energized bus to the second energized bus to supply AC energy from the second energized bus to the first energized bus.

10. The apparatus of claim 9, in which the first potential transformer comprises a primary transformer and secondary transformers in a broken delta configuration.

11. The apparatus of claim 9, further comprising:

a sensor for monitoring either a voltage, current, or both the voltage and current;

a first contactor coupled between the sensor and the first potential transformer; and

a second contactor coupled between the sensor and a second potential transformer.

12. The apparatus of claim 9, further comprising a first fault sensor coupled to the first potential transformer and the controller and a second fault sensor coupled to the second potential transformer and the controller.

13. The apparatus of claim 9, further comprising a first relay coupled to the first potential transformer and the controller and a second relay coupled to the second potential transformer and the controller.

14. The apparatus of claim 9, further comprising an operator interface coupled to the controller, in which the controller is further configured to manage control commands received from the operator interface.

15. The apparatus of claim 14, wherein the controller is further configured:

to apply a second current at a second frequency;

to measure a second impedance of the first energized bus after applying the second current to the first energized bus; and

to determine if a fault exists on the first energized bus based, at least in part, on the measured first impedance and the measured second impedance

16. The apparatus of claim 14, in which the operator interface comprises:

a sync and close switch to initiate the synchronizing of the external power source;

a sync and close cancel switch to cancel the synchronizing of the external power source;

a sync potentiometer to bias a speed of a generator such that an output of the external power source can be biased; and

a synchroscope to display the phase difference between unsynchronized sources.

17. An apparatus, comprising:

a breaker coupled to a first energized bus and a second energized bus;

means for applying a first current to the first energized bus; and

a controller coupled to the first current applying means, in which the controller is configured:

to determine if a fault exists on the first energized bus; and

to couple the first energized bus to the second energized bus through the breaker when no fault exists on the first energized bus by synchronizing AC energy on the first energized bus with AC energy on the second energized bus and closing the breaker between the first energized bus and the second energized bus.

18. The apparatus of claim 17, further comprising:

a generator coupled to the second energized bus; and

a load coupled to the first energized bus,

in which the first energized bus is a main power bus and the second energized bus is a generator bus.

19. The apparatus of claim 17, further comprising means for applying a second current to the second energized bus, in which the second current applying means is coupled to the controller.