CLAIMS:

1. A system for monitoring a subsea well, comprising:

the subsea well, comprising:

a production tube;

an annulus A co-axial to the production tube and positioned exterior to the production tube;

an annulus B co-axial to the annulus A and positioned exterior to the annulus A;

a casing wall disposed between the annulus A and the annulus B;

a first sensor disposed on or about the production tube, the annulus A, the casing wall, or combinations thereof and configured to measure a first parameter;

a controller operatively coupled to the subsea well and configured to:

analyze the first parameter measured by the first sensor; and

detect an anomaly in one or more components of the subsea well.

2. The system of claim 1, wherein the first sensor comprises a fixed sensor, a wire-line tool, or a combination thereof.

3. The system of claim 2, wherein the fixed sensor comprises a magnetic field sensor, a magnetostrictive sensor, an inductive coil, a Villari effect sensor, an acoustic transducer, an optical fiber sensor, a temperature sensor, or combinations thereof.

4. The system of claim 2, wherein the wire-line tool comprises a sensor operatively coupled to a wire-line cable, and wherein the sensor comprises magnetic field sensor, a magnetostrictive sensor, an inductive coil, a Villari effect sensor, an

acoustic transducer, an optical fiber sensor, a temperature sensor, or combinations thereof.

5. The system of claim 1, further comprising a locking mechanism configured to operatively couple the first sensor to one or more of the production tube, the annulus A, and the casing wall.

6. The system of claim 5, wherein the locking mechanism comprises a spring based mechanism, a hydraulic mechanism, a servomotor actuation mechanism, a magnetic mechanism, or combinations thereof.

7. The system of claim 1, wherein the casing wall comprises one or more segments configured to sense the first parameter.

8. The system of claim 7, wherein the one or more segments with sensing capability comprise one or more magnetically encoded regions.

9. The system of claim 8, wherein the one or more magnetically encoded regions comprise a plurality of magnetized lines having at least two polarities formed along a length of the casing wall.

10. The system of claim 8, wherein the one or more magnetically encoded regions comprise a plurality of magnetized lines having at least two polarities formed in a spiral configuration around the casing wall.

11. The system of claim 10, further comprising an optical fiber disposed in a spiral configuration around the casing wall.

12. The system of claim 1, further comprising a second sensor disposed on or about the annulus B and configured to measure one or more of a pressure and a temperature on or about the annulus B.

13. The system of claim 1, wherein the first parameter comprises a pressure, compression stress, hoop stress, residual stress, longitudinal stress, tensional stress, bending stress, torque induced stress, or combinations thereof.

14. A method for monitoring a subsea well, the method comprising:

disposing a first sensor on or about one or more of a production tube, an annulus A, and a casing wall of the subsea well, wherein the first sensor is configured to measure a first parameter;

analyzing the measured first parameter using a controller; and

identifying an anomaly in one or more components of the subsea well based on the analysis of the first parameter.

15. The method of claim 14, further comprising magnetizing the casing wall of the subsea well.

16. The method of claim 15, wherein magnetizing the casing wall comprises applying a determined value of an electrical current, a determined value of a magnetic field, or a combination thereof to the casing wall.

17. The method of claim 15, wherein magnetizing the casing wall comprises magnetizing the casing wall in a spiral configuration.

18. The method of claim 15, wherein magnetizing the casing wall comprises magnetizing the casing wall in a longitudinal configuration.

19. The method of claim 14, further comprising locking the first sensor to one or more of the production tube, the annulus A, and the casing wall, via a locking mechanism.

20. The method of claim 14, further comprising disposing a second sensor on or about an annulus B of the subsea well before sealing the annulus B.

21. The method of claim 20, wherein the second sensor is configured to measure one or more of a pressure, a stress, and a temperature on or about the annulus B.

22. The method of claim 14, wherein the anomaly comprises a fault in one or more of the casing wall, the production tube, cement employed in the subsea well, a subsea wellhead, a tubing hanger, or combinations thereof.

23. The method of claim 14, wherein identifying an anomaly in one or more components of the subsea well based on the analysis of the first parameter comprises employing a physics based model.

24. The method of claim 23, wherein the physics based model comprises:

determining a parameter corresponding to a healthy state of the one or more components of the subsea well;

identifying a parameter corresponding to an actual condition of the one or more components of the subsea well; and

comparing the parameter corresponding to the healthy state of the one or more components of the subsea well to the parameter corresponding to the actual condition of the one or more components of the subsea well.

25. A non-transitory computer readable medium comprising one or more tangible media, wherein the one or more tangible media comprise routines for causing a computer to perform the steps of:

measuring a first parameter using a first sensor disposed on or about one or more of a production tube, an annulus A, and a casing wall of a subsea well;

analyzing the measured first parameter using a controller; and

identifying an anomaly in one or more components of the subsea well based on the analysis of the first parameter.

CLAIMS

The invention claimed is:

1. A system for monitoring a subsea well, comprising:

the subsea well, comprising:

a production tube;

an annulus A co-axial to the production tube and positioned exterior to the production tube;

an annulus B co-axial to the annulus A and positioned exterior to the annulus A;

a casing wall disposed between the annulus A and the annulus B;

a first sensor disposed on or about the production tube, the annulus A, the casing wall, or combinations thereof and configured to measure a first parameter, wherein the first sensor comprises:

a fixed sensor that is fixed relative to one or more of the production tube, the annulus A, the annulus B, and the casing wall; and

a wire-line tool, wherein the wire-line tool is in a closed condition and configured to open up for measurement when introduced into at least one of the production tube and the annulus A;

a controller operatively coupled to the subsea well and configured to:

analyze the first parameter measured by the first sensor; and

detect an anomaly in one or more components of the subsea well based on the analysis of the first parameter.

2. The system of claim **1**, wherein the fixed sensor comprises a magnetic field sensor, a magnetostrictive sensor, an inductive coil, a Villari effect sensor, an acoustic transducer, an optical fiber sensor, a temperature sensor, or combinations thereof.

3. The system of claim **1**, wherein the wire-line tool comprises a sensor operatively coupled to a wire-line cable, and wherein the sensor comprises magnetic field sensor, a

magnetostrictive sensor, an inductive coil, a Villari effect sensor, an acoustic transducer, an optical fiber sensor, a temperature sensor, or combinations thereof.

4. The system of claim **1**, further comprising a locking mechanism configured to operatively couple the first sensor to one or more of the production tube, the annulus A, and the casing wall.

5. The system of claim **4**, wherein the locking mechanism comprises a spring based mechanism, a hydraulic mechanism, a servomotor actuation mechanism, a magnetic mechanism, or combinations thereof.

6. The system of claim **1**, wherein the casing wall comprises one or more segments configured to sense the first parameter.

7. The system of claim **6**, wherein the one or more segments with sensing capability comprise one or more magnetically encoded regions.

8. The system of claim **7**, wherein the one or more magnetically encoded regions comprise a plurality of magnetized lines having at least two polarities formed along a length of the casing wall.

9. The system of claim **7**, wherein the one or more magnetically encoded regions comprise a plurality of magnetized lines having at least two polarities formed in a spiral configuration around the casing wall.

10. The system of claim **9**, further comprising an optical fiber disposed in a spiral configuration around the casing wall, wherein the optical fiber is wound in a spiral configuration between the plurality of magnetized lines.

11. The system of claim **1**, further comprising a second sensor disposed on or about the annulus B and configured to measure one or more of a pressure and a temperature on or about the annulus B.

12. The system of claim **1**, wherein the first parameter comprises a pressure, compression stress, hoop stress, residual stress, longitudinal stress, tensional stress, bending stress, torque induced stress, or combinations thereof.

13. A method for monitoring a subsea well, the method comprising:

disposing a first sensor on or about one or more of a production tube, an annulus A, and a casing wall of the subsea well, wherein the annulus A is co-axial to the production tube and positioned exterior to the production tube, an annulus B is co-axial to the annulus A and positioned exterior to the annulus A, and the casing wall is disposed between the annulus A and the annulus B, wherein the first sensor is configured to measure a first parameter, wherein the first sensor comprises a fixed sensor that is fixed relative to one or more of the production tube, the annulus A, the annulus B, and the casing wall and a wire-line tool, and wherein the wire-line tool is in a closed condition and configured to open up for measurement when introduced into at least one of the production tube and the annulus A;

analyzing the measured first parameter using a controller; and

identifying an anomaly in one or more components of the subsea well based on the analysis of the first parameter.

14. The method of claim **13**, further comprising magnetizing the casing wall of the subsea well.

15. The method of claim **14**, wherein magnetizing the casing wall comprises applying a determined value of an electrical current, a determined value of a magnetic field, or a combination thereof to the casing wall.

16. The method of claim **14**, wherein magnetizing the casing wall comprises magnetizing the casing wall in a spiral configuration.

17. The method of claim **14**, wherein magnetizing the casing wall comprises magnetizing the casing wall in a longitudinal configuration.

18. The method of claim **13**, further comprising locking the first sensor to one or more of the production tube, the annulus A, and the casing wall, via a locking mechanism.

19. The method of claim **13**, further comprising disposing a second sensor on or about the annulus B of the subsea well before sealing the annulus B.

20. The method of claim **19**, wherein the second sensor is configured to measure one or more of a pressure, a stress, and a temperature on or about the annulus B.

21. The method of claim **13**, wherein the anomaly comprises a fault in one or more of the casing wall, the production tube, cement employed in the subsea well, a subsea wellhead, a tubing hanger, or combinations thereof.

22. The method of claim **13**, wherein identifying the anomaly in one or more components of the subsea well based on the analysis of the first parameter comprises employing a physics based model.

23. The method of claim **22**, wherein the analysis of the first parameter employing the physics based model comprises:

determining a parameter corresponding to a healthy state of the one or more components of the subsea well;

identifying a parameter corresponding to an actual condition of the one or more components of the subsea well; and

comparing the parameter corresponding to the healthy state of the one or more components of the subsea well to the parameter corresponding to the actual condition of the one or more components of the subsea well to identify the anomaly in the one or more components of the subsea well.

24. A non-transitory computer readable medium comprising one or more tangible media, wherein the one or more tangible media comprise routines for causing a computer to perform the steps of:

measuring a first parameter using a first sensor disposed on or about one or more of a production tube, an annulus A, and a casing wall of a subsea well, wherein the annulus A is co-axial to the production tube and positioned exterior to the production tube, an annulus B is co-axial to the annulus A and positioned exterior to the annulus A, and the casing wall is

disposed between the annulus A and the annulus B, wherein the first sensor comprises a fixed sensor that is fixed relative to one or more of the production tube, the annulus A, the annulus B, and the casing wall and a wire-line tool, and wherein the wire-line tool is in a closed condition and configured to open up for measurement when introduced into at least one of the production tube and the annulus A;

analyzing the measured first parameter using a controller; and

identifying an anomaly in one or more components of the subsea well based on the analysis of the first parameter.