CLAIMS

What is claimed is:

1. A probe with no moving parts for use in a tank, the tank having a floor and at least one wall, the probe configured for continuous measurement of a fluid while immersed in the fluid, wherein the probe comprises:

   a. a processor housing;

   b. a plurality of sensor housings connected to the processor housing;

   c. a plurality of pressure transducers, each pressure transducer of the plurality of pressure transducers within a sensor housing of the plurality of sensor housings, each pressure transducer of the plurality of pressure transducers having a diaphragm, wherein the plurality of pressure transducers measure pressure through direct contact with the fluid in the tank;

   d. a plurality of temperature sensors, each temperature sensor of the plurality of temperature sensors within a sensor housing of the plurality of sensor housings or contained in each pressure transducer of the plurality of pressure transducers, wherein each temperature sensor of the plurality of temperature sensors is configured for continuous temperature measurement of the fluid in the tank;

   e. optionally, an inclinometer mounted to a floating vessel or within the processor housing for measuring angles of the floating vessel relative to gravity;

   f. a probe processor in the processor housing, the probe processor electrically and bidirectionally connected to the plurality of pressure transducers, to the plurality of temperature sensors, the inclinometer and a network; and

   g. a probe data storage in the processor housing, the probe data storage in communication with the probe processor, the probe data storage being a non-transitory computer readable medium with computer instructions for instructing the probe processor to control the plurality of temperature sensors and the plurality of pressure transducers to produce bidirectional signals to the network,

to the plurality of temperature sensors and to the plurality of pressure transducers, the probe data storage containing:

(i) a tank capacity table;

(ii) computer instructions instructing the probe processor to calculate at least one physical property for the fluid, the physical property selected from the group consisting of:

1. a mass of the fluid;
2. a volume of the fluid;
3. a density strata of the fluid;
4. an average density of the fluid;
5. a level of the fluid;
6. a fluid temperature;
7. a fluid flow rate;
8. a fluid pressure;
9. an amount of impurity in the fluid;
10. an entrained water content in the fluid; and
11. a free water content in the fluid;

(iii) computer instructions instructing the probe processor to: perform adaptive measurement for at least one of:

1. a synchronized measurement of the fluid and a non-synchronized measurement of the fluid in static operation; or
2. a synchronized measurement of the fluid and a non-synchronized

measurement of the fluid in dynamic operation;

(iv) computer instructions instructing the probe processor to determine which of the plurality of temperature sensors and the plurality of pressure transducers are not covered by the fluid by comparing signals from the plurality of temperature sensors and the plurality of pressure transducers to each other;

(v) computer instructions instructing the probe processor to measure movement of the fluid in the tank;

(vi) computer instructions instructing the probe processor to calibrate pressure transducers of the tank when the pressure transducers are no longer in the fluid;

(vii) computer instructions instructing the probe processor to use inclinometer values when present to recalculate the location of each of the temperature sensors and each of the pressure transducers in the fluid, and use the tank capacity table to determine accurate volume and mass of liquid and vapor of the fluid; and

(viii) computer instructions instructing the probe processor to communicate with a client device via the network using the bidirectional signals.

2. The probe of claim 1, comprising at least one temperature sensor and pressure transducer located in a vapor space of the tank.

3. The probe of claim 1, wherein an outer surface of the probe expands in a stepped configuration, increasing at least ten percent in diameter.

4. The probe of claim 1, comprising a channel in the sensor housing to provide contact with the fluid from the tank to at least one temperature sensor of the plurality of temperature sensors and at least one of the plurality of pressure transducers.

5. The probe of claim 1, comprising a plurality of switches in the tank that each provide a notification signal to the probe processor, the network, or both the probe processor and

the network when the liquid exceeds or fails to meet a preset level.

6. The probe of claim 1, comprising a tank movement measuring device connected to at least one of: the probe processor and a remote processor for displaying and measuring probe movement due to flexing of the floor of the tank or due to flexing of a roof of the tank.

7. The probe of claim 1, wherein the probe data storage comprises at least one of:

a. computer instructions instructing the probe processor to perform self-calibration;

b. computer instructions instructing the probe processor to perform self-diagnostics; and

c. computer instructions instructing the probe processor to perform self-configuration.

8. The probe of claim 1, wherein the probe data storage comprises computer instructions instructing the probe processor to configure and reconfigure online.

9. The probe of claim 4, comprising a plurality of inclined surfaces on at least one side of the channel, the plurality of inclined surfaces enabling fluid to contact with at least one pressure transducer of the plurality of pressure transducers and with at least one temperature sensor of the plurality of temperature sensors.

10. The probe of claim 1, comprising a temperature sensor simulation circuit in the probe processor with a temperature reference value in the probe data storage and a pressure transducer simulation circuit in the probe processor with a pressure reference value in the probe data storage, the temperature sensor simulation circuit and the pressure transducer simulation circuit for calibrating the probe processor.

11. The probe of claim 6, comprising the remote processor bidirectionally connected to the probe processor via the network, the remote processor further comprising a remote data storage, the remote data storage comprising at least one of:

a. computer instructions instructing the remote processor to calculate parameters

necessary for emissions monitoring;

b. computer instructions instructing the remote processor to calculate parameters necessary for leak detection and unauthorized movement of fluid into or out of the tank;

c. computer instructions instructing the remote processor to calculate parameters necessary for overfill protection of the tank; and

d. computer instructions instructing the remote processor to calculate tank overpressure or vacuum parameters in the tank.

12. The probe of claim 2, comprising an external sensor outside of the tank and electrically connected to the probe processor, the external sensor configured to measure ambient pressure and ambient temperature outside the tank, the external sensor providing signals to the probe processor, the probe processor using computer instructions in the probe data storage, the computer instructions configured to instruct the probe processor to compare measured ambient pressure and temperature to measured pressure and temperature inside the tank for gas blanket monitoring and asset protection of the tank.

13. The probe of claim 12, comprising computer instructions in the probe data storage, the computer instructions instructing the probe processor to use the plurality of pressure transducers and the plurality of temperature sensors internal to the tank, any temperature sensors and any pressure transducers located in the vapor space of the tank and the external sensor to calculate parameters necessary for emissions monitoring.

14. The probe of claim 1, comprising computer instructions in the probe data storage instructing the probe processor to use the plurality of temperature sensors and the plurality of pressure transducers to calculate parameters necessary for leak detection and unauthorized movement of fluid into and out of the tank.

15. The probe of claim 1, further comprising at least one compound containing sulfur detector in communication with the probe processor for detecting compounds containing sulfur and computer instructions in the probe data storage instructing the probe processor to compute compounds containing sulfur concentration for protection of personnel or for

estimation of quality of crude oil, wherein the compound containing sulfur detector is in liquid in the tank, in vapor in the tank or mounted external to the tank.

16. The probe of claim 1, wherein the processor housing is weatherproof or explosion proof.

17. The probe of claim 1, comprising a plurality of conduits connecting the processor housing with the sensor housings and extending to a bottom of the probe.

18. The probe of claim 11, comprising computer instructions instructing the remote processor to use a computed mass of the fluid for balancing during loading and unloading of the floating vessel and for inventory control and custody transfer.

19. The probe of claim 1, wherein the processor housing is configured to prevent degradation in marine environments.