

THE CLAIMS

We claim:

1. A method of retrieving a mobile platform (100) from a tank (10) having a hatch (24) and at least partially filled with a non-conductive, energetic substance (12, 14), the method characterized by:

- configuring the mobile platform (100) to include at least:
 - an enclosure (200),
 - at least one control unit (300) positioned inside the enclosure (200),
 - at least one propulsion system (400) positioned at least partially inside the enclosure (200),
 - at least one power supply (500) positioned inside the enclosure (200), and
 - at least one retrieval system (700) disposed at least partially on the enclosure (200) and including at least:
 - at least one buoyant body (702),
 - at least one primary tether (1100) connected to the at least one buoyant body (702) and to the enclosure (200);
 - at least one secondary tether (1102) connected to the at least one buoyant body (702) and to the enclosure (200);
- predetermining a buoyant body retrieval zone (1104) within the tank (10), wherein the buoyant body retrieval zone (1104) is below the hatch (24);
- lowering the mobile platform (100) into the tank (10) using a deployment carrier (50, 764, 780);
- submerging the enclosure (200) in a non-conductive, liquid energetic substance (12);

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- moving the mobile platform (100) using the at least one propulsion system (400) to perform at least one task in the tank (10);
 - releasing the at least one buoyant body (702) and the at least one primary tether (1100) from the enclosure (200);
 - positioning the released at least one buoyant body (702) within the buoyant body retrieval zone (1104) by using the at least one primary tether (1100);
 - accessing the at least one buoyant body (702) through the hatch (24);
 - retrieving the at least one primary tether (1100) by using the at least one buoyant body (702);
 - using the at least one primary tether (1100) to release the at least one secondary tether (1102); and
 - inserting a retrieval member (1110) through the hatch (24) to retrieve at least one of: (i) the at least one buoyant body (702), (ii) the at least one primary tether (1100), and (iii) the at least one secondary tether (1102).
2. The method of claim 1, further characterized by:
- estimating a height of the non-conductive, liquid energetic substance (12) above the mobile platform (100) inside the tank (10); and
 - selecting a length of the at least one primary tether (1100) based on at least the estimated height of the non-conductive, liquid energetic substance (12) above the mobile platform (100) inside the tank (10) to position the at least one buoyant body (702) within the buoyant body retrieval zone (1104).
3. The method of claim 2, wherein the length of the at least one primary

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tether (1100) is also selected using at least a distance between a retrieval location (1112) of the mobile platform (100) and a wall (20) of the tank (10).

4. The method of claim 1, further characterized by:

- configuring the at least one primary tether (1100) to release the least one secondary tether (1102) in response to an applied predetermined releasing force; and
- applying a force that is at least as great as the predetermined releasing force to the at least one primary tether (1100) to release the at least one secondary tether (1102).

5. The method of claim 4, further characterized in that the predetermined releasing force is greater than a net buoyancy of the buoyant body (702) in the non-conductive, liquid energetic substance (12) and less than a net downward force of the mobile platform (100) in the non-conductive, liquid energetic substance (12).

6. The method of claim 1, further characterized in that the at least one secondary tether (1102) is at least long enough to traverse a distance between the mobile platform (100) and a location proximate to a top wall (16) of the tank (100).

7. The method of claim 1, further characterized in that a combined length of the at least one primary tether (1100) and the at least one secondary tether (1102) is at least long enough to traverse a distance between the mobile platform (100) and a location proximate to a top wall (16) of the tank (100).

8. The method of claim 1, further characterized in that the at least one

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secondary tether (1102) is used to pull the mobile platform (100).

9. The method of claim 1, further characterized in that the length of the at least one primary tether (1100) is selected to maintain a predetermined gap between the buoyant body (702) and a top wall (16) of the tank (10).

10. The method of claim 1, further characterized in that the at least one primary tether (1100) includes a plurality of primary tether segments.

11. The method of claim 1, further characterized in that the at least one secondary tether (1102) includes a plurality of secondary tether segments.

12. The method of claim 1, further characterized in that the at least one primary tether (1100) connects the at least one secondary tether (1102) to the enclosure (200).

13. The method of claim 1, further characterized in that the at least one secondary tether (1102) connects the at least one primary tether (1100) to the enclosure (200).

14. The method of claim 1, further characterized in that the enclosure (200) includes a plurality of separate enclosures, and at least one enclosure (200) of the plurality of separate enclosures is submerged in the non-conductive, liquid energetic substance (12).

15. A method of retrieving a mobile platform (100) from a tank (10) at least partially filled with a non-conductive, energetic substance (12, 14), the

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method characterized by:

- configuring the mobile platform (100) to include at least:
 - an enclosure (200),
 - at least one control unit (300) positioned inside the enclosure (200),
 - at least one propulsion system (400) positioned at least partially inside the enclosure (200),
 - at least one power supply (500) positioned inside the enclosure (200),
 - at least one retrieval system (700) disposed at least partially on the enclosure (200), the at least one retrieval system (700) including at least one buoyant body (702), an electrically conductive member (1130), and at least one tether (1100), the at least one tether (1100) having at least a portion that is not conductive, the at least one tether (1100) electrically isolating the at least one buoyant body (702) from the enclosure (200);
- lowering the mobile platform (100) into the tank (10) using a deployment carrier (50, 764, 780);
- submerging the enclosure (200) in a non-conductive, liquid energetic substance (12);
- moving the mobile platform (100) using the at least one propulsion system (400) to perform at least one task in the tank (10);
- releasing the buoyant body (702) to convey the at least one tether (1100) toward a surface (1116) of the non-conductive, liquid energetic substance (12);
- conveying an electrically conductive cable (1304) to the electrically conductive member (1130) of the mobile platform (100) using the at least one tether (1100);
- electrically connecting a voltage neutralizing end (1306) of the

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electrically conductive cable (1304) to a voltage differential neutralizing body (1302) in a spark inhibiting ambient condition;

- electrically connecting a mobile platform end (1308) of the electrically conductive cable (1304) to the electrically conductive member (1300) of the mobile platform (100) while the electrically conductive member (1300) is below the surface (1116) of the non-conductive, liquid energetic substance (12); and
- retrieving the mobile platform (100) from inside to outside of the tank (10).

16. The method of claim 15, further characterized in that the spark inhibiting ambient condition is at least one of: (i) energetic substance deficient, (ii) and oxygen deficient.

17. The method of claim 15, further characterized in that the voltage differential neutralizing body (1302) is the tank (10).

18. The method of claim 15, further characterized in that the electrically conductive cable (1304) has an electrical connector (1314) disposed at the mobile platform end (1308), and further characterized by:

- conveying the electrical connector (1314) to the mobile platform (100) using the at least one tether (1100) and electrically connecting the electrical connector (1314) to the electrically conductive member (1300).

19. The method of claim 15, further characterized by estimating when a voltage differential between the mobile platform (100) and the tank (10) is below a predetermined value and retrieving the mobile platform (100) from inside to outside of the tank (10) only after the estimated voltage differential is below the predetermined value.

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20. The method of claim 15, further characterized by:

- retrieving the buoyant body (702) with a retrieval member (1110);
- attaching a mobile platform end (1308) of the electrically conductive cable (1304) to the at least one tether (1100); and
- sliding the mobile platform end (1308) along the at least one tether (1100) to the mobile platform (100), wherein the mobile platform end (1308) is electrically connected to the electrically conductive member (1300).

21. The method of claim 15, further characterized in that the mobile platform end (1308) of the electrically conductive cable (1304) is connected electrically to the electrically conductive member (1300) before the neutralizing body end (1306) of the electrically conductive cable (1304) is connected electrically to the voltage differential neutralizing body (1302).

22. The method of claim 15, further characterized in that the mobile platform end (1308) of the electrically conductive cable (1304) is connected electrically to the electrically conductive member (1300) after the neutralizing body end (1306) of the electrically conductive cable (1304) is connected electrically to the voltage differential neutralizing body (1302).

23. The method of claim 22, further characterized in that the electrically conductive cable (1304) is conveyed using the at least one tether (1100) before the neutralizing body end (1306) of the electrically conductive cable (1304) is connected electrically to the voltage differential neutralizing body (1302).

24. The method of claim 15, further characterized in that the enclosure (200)

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includes a plurality of separate enclosures, and at least one enclosure (200) of the plurality of separate enclosures is submerged in the non-conductive, liquid energetic substance (12).

25. A method of operating a mobile platform (100) in a tank (10) at least partially filled with a non-conductive, energetic substance (12, 14), the method characterized by:

- configuring the mobile platform (100) to include at least:
 - an enclosure (200),
 - at least one control unit (300) positioned in the enclosure (200),
 - at least one propulsion system (400) at least partially positioned in the enclosure (200),
 - at least one electrical power supply (500) positioned in the enclosure (200) and configured to supply electrical power to at least one electrical power consumer (1330) associated with the mobile platform (100), wherein the supply of electrical power is capable of adding an electrical charge to the mobile platform (100),
 - at least one retrieval system (700) disposed at least partially on the enclosure (200) and including at least one buoyant body (702), and
 - at least one charge accumulation control system (250, 1003) disposed at least partially on the enclosure (200), the at least one charge accumulation control system (250, 1003) being configured to control an accumulation of the electrical charge on the mobile platform by one of: (i) reducing the supplied power and preventing an increase in the supplied power later while the mobile platform (100) is inside the tank (10), and (ii)

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disengaging the at least one electrical power consumer (1330) from the supplied power and preventing a reengagement of the supplied power with the at least one electrical power consumer (1330) later while the mobile platform (100) is inside the tank (10);

- lowering the mobile platform (100) into the tank (10) using a deployment carrier (50, 764, 780);
 - submerging the enclosure (200) in a non-conductive, liquid energetic substance (12);
 - moving the mobile platform (100) using the at least one propulsion system (400) to perform at least one task in the tank (10);
 - controlling the electrical charge accumulation on the mobile platform (100) using the at least one charge accumulation control system (250, 1003).
 - indicating an activation state of the charge accumulation control system (250, 1003) by releasing the at least one buoyant body (702) from the enclosure (200), the activation state being one of: (i) prior activation of the charge accumulation control system (250, 1003), and (ii) activation of the charge accumulation control system (250, 1003) after a predetermined time delay;
- and
- retrieving the mobile platform (100) from inside to outside of the tank (10).

26. The method of claim 25, further characterized in a relative motion between at least a portion of the mobile platform (100) and an adjacent surface adds an electrical charge to the mobile platform (100), and that the charge accumulation control system (250, 1003) controls the electrical charge accumulation by one of: (i) reducing the relative motion and preventing an

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increase in the relative motion later while the mobile platform (100) remains inside the tank (10), (ii) stopping the relative motion and preventing the relative motion later while the mobile platform (100) remains inside the tank (10).

27. The method of claim 26, further characterized in that the adjacent surface is at least one of: (i) a contact surface of the non-conductive, liquid energetic substance (12), and (ii) a surface of a wall (16, 18, 20) of the tank (10).

28. The method of claim 25, further characterized by:

- detecting the presence of the released buoyant body (702) inside the tank (10);
- estimating a magnitude of the electrical charge accumulation based on the presence of the released buoyant body (702) inside the tank (10); and
- retrieving the mobile platform (100) from inside to outside of the tank (10) after the estimated magnitude of the electrical charge accumulation is below a predetermined value.

29. The method of claim 28, further characterized in that the presence of the released buoyant body (702) indicates that the magnitude of the electrical charge accumulation is below the predetermined value.

30. The method of claim 28, further characterized in that an expiration of a predetermined time duration after the presence of the released buoyant body (702) is detected indicates that the magnitude of the electrical charge accumulation is below the predetermined value.

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31. The method of claim 25, further characterized in that the tank (10) is at least partially separated from the non-conductive, liquid energetic substance (12) by a non-conductive material.

32. The method of claim 31, further characterized in that the non-conductive material is at least one of: (i) paint, (ii) a coating, (iii) rust, and (iv) sludge.

33. The method of claim 25, further characterized in that the charge accumulation control system (250, 1003) includes an electrical charge dissipater (1500) electrically connected to the mobile platform (100) and an actuator (1502) configured to actuate the electrical charge dissipater (1500), and further characterized by:

- electrically engaging the electrical charge dissipater with a voltage differential neutralizing body (1504) using the actuator (1502), wherein the electrical charge accumulation on the mobile platform (100) is controlled by electrically connecting the mobile platform (100) to the voltage differential neutralizing body (1504) using the electrical charge dissipater (1500).

34. The method of claim 33, wherein the voltage differential neutralizing body is selected from one of: (i) the tank (10), (ii) the non-conductive, liquid energetic substance (12), and (iii) an object (1506) positioned inside the tank (10).

35. The method of claim 34, further characterized in that the enclosure (200) includes a plurality of separate enclosures, and at least one enclosure (200) of the plurality of separate enclosures is submerged in the non-conductive, liquid energetic substance (12).

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36. The method of claim 25, wherein only a portion of the enclosure (200) is submerged in the non-conductive, liquid energetic substance (12).

37. The method of claim 25, wherein a portion of the mobile platform (100) is not submerged in the non-conductive, liquid energetic substance (12).