



Company:		Job Title:	Date:
Company Coordinator:		Contractor: Manta Robotics LLC	
JSA Team Members:			
Personal Protective Equipment Required:			
Steps in Sequence	Hazards Involved	Recommendations for Safe Work	
1. Obtain signatures for Work Authorization from Operations. Lock out / Tag out tank.	None	Follow lock out / tag out procedure as outlined by operations.	
2. Stage equipment outside tank	Potential for blocking road.	Obtain proper road closure and vehicle entry permit if required.	
3. Lift robot and equipment to roof of tank.	Falling objects, tripping, lifting hazards, back strain.	Use proper lifting equipment (crane, winch) and follow safe lifting techniques. Obtain confined entry work permit to be on roof of tank.	
4. Lay umbilical cord/hose from trailer to breakout box at base of stairs, and umbilical cord/hose from the breakout box to the robot.	Lifting hazards, back strain, tripping.	Use proper lifting equipment and follow safe lifting techniques.	
5. Start the generator at control trailer.	Sparks, noise.	Generator located outside tank dike. Obtain low energy permit from Operations prior to starting generator.	
6. Purge and pressurize, with nitrogen, the umbilical, breakout box, and robot. Test integrity of equipment.	Potential hose leaks.	This is the safety inspection step. Allow for system pressure to stabilize. Check systems. Ensure proper grounding.	
7. Prepare spill containment on roof around manway.	Slipping, tripping hazards.	Follow safe work practices.	
8. Open roof manway to product.	Vapors, odors. Personnel exposure to product.	Rim watch monitoring LEL. Use proper personnel protective equipment. Rubber gloves, face shield & goggles as required.	
9. Install lifting tripod over manway.	Lifting, tripping hazards.	Use proper lifting techniques. Follow safe work practices.	
10. Lower robot into product after system has been pressurized with nitrogen and energized.	Potential static discharge. Lifting hazards. Sparks from robot, fittings, cable hitting roof manway rim. Personnel exposure to product.	Winch and cable grounded to tank. Cable, fittings, robot, and hose made of non-sparking materials. Use proper personnel protective equipment. Rubber gloves, face shield & goggles as required	



<p>11. Attach floatation devices to umbilical cord/hose as robot and umbilical is being lowered to maintain neutral buoyancy of the umbilical.</p>	<p>Sparks</p> <p>Personnel exposure to product.</p>	<p>Floatation devices made of non-sparking nonmetallic material.</p> <p>Use proper personnel protective equipment. Rubber gloves, face shield & goggles as required</p>
<p>12. Put additional hose slack into tank for maneuvering.</p>	<p>Potential tangling with internals of tank.</p>	<p>Limit slack allowed into tank. Route of robot is pre-planned using engineering drawings to determine obstacles and length of umbilical.</p>
<p>13. Seal off manway opening on roof with covering material to limit exposure of product to atmosphere, equipment and personnel.</p>	<p>Tripping hazards.</p> <p>Umbilical pulling covering into tank.</p> <p>Personnel exposure to product.</p>	<p>Follow safe work practices.</p> <p>Ensure covering is secured to roof manway.</p> <p>Use proper personnel protective equipment. Rubber gloves, face shield & goggles as required</p>
<p>14. Commence survey of tank bottom.</p>	<p>Tangled umbilical</p> <p>Running into tank internal objects.</p> <p>Running in tank sumps.</p> <p>Loss of pressurization in robotic system or umbilical integrity compromised at any point from tank to trailer.</p> <p>Loss of power to robot or system.</p> <p>Sparks, static discharge.</p>	<p>Survey mission preplanned using engineering drawings.</p> <p>See previous.</p> <p>See previous.</p> <p>Automatic shut down of power from the robot system to the control trailer. System is purged at positive pressure with nitrogen. Retrieve robot with winch.</p> <p>No consequence. Retrieve robot with winch.</p> <p>Equipment is grounded. Also equipment is made of non-sparking material.</p>
<p>15. Conclusion of survey for the day.</p> <p>Retrieve robot and umbilical.</p>	<p>See hazards for #14 listed above.</p> <p>Vapors, odors, product on equipment, personnel exposure.</p> <p>Personnel exposure to product.</p>	<p>See recommendations for #14 above.</p> <p>Rim watch monitoring LEL. Product will be wiped and squeegeed off equipment as it is removed. Spill containment is set up on roof of tank.</p> <p>Use proper personnel protective equipment. Rubber gloves, face shield & goggles as required.</p>
<p>16. Remove floatation devices from umbilical hose as it is being withdrawn from tank.</p>	<p>See #11 hazards above.</p>	<p>See #11 recommendations above.</p>



17. Hot bolt roof manway for night.	Tripping, lifting hazards. Personnel exposure to product.	Follow safe work practices. Use proper personnel protective equipment. Rubber gloves, face shield & goggles as required.
18. Shut down, de-energize, depressurize, and secure equipment for night. Leave robotic equipment on roof until end of survey.	NA	NA
19. Restart survey next work day.	Follow Job Safety Analysis from step #5 above.	Obtain Safe Work Authorization from Operations. Recheck for confined space on roof. Obtain Low Energy Permit for generator.
20. Demobilize equipment off roof- Survey complete.	See steps #15-18.	See steps #15-18. Remove equipment from roof with proper lifting equipment.
21. Clean-up of job site.	Lifting, tripping hazards. Personnel exposure to contaminated equipment, or spill containment waste.	Dispose of waste in proper specified waste containers. Use proper personnel protective equipment. Rubber gloves, face shield & goggles as required.

Approvals:

Production supervisor: _____ Date: _____

Operations Supervisor: _____ Date: _____

Field Services Supervisor: _____ Date: _____