JOB SAFETY ANALYSIS

Updated Safety Information for AMNO & CO 2016

General Categories:

*Any responsible member should initial the RESPONSIBLE MEMBER(S) box to ensure safe operations/practices

TASK	**POTENTIAL HAZARDS**	**CONTROLS**	**RESPONSIBLE MEMBER(S)***
1. Using a 3-axis CNC machine	1.a. Physical injury from mechanical machinery 1.b. Hearing damage from loud noise 1.c. Vision impairment from flying chips or machining fluid 1.d. Chemical damage from machining fluid 1.e. Physical damage from sharp edges that result from the machining process 1.f. Damage to the machine from improper use	1.a.i. Make sure the machine doors are fully closed before operation 1.a.ii. Ensure that a qualified supervisor is present 1.a.iii. Be familiar with emergency procedures 1.a.iv. Know location of, and be prepared to use the emergency stop (red button) 1.b/c.i. Wear proper Personal Protective Equipment (PPE) at all times (ear and eye protection) 1.d.i. Properly clean finished parts and properly dispose of cleaning products 1.d.ii. Wash hands carefully after making contact with machining fluid. 1.d.iii. Do not touch face or skin while machining. 1.e.i. Deburr/sand finished parts to eliminate sharp edges 1.f.i. Preview/simulate machining code in HSMWorks before using the machine	All Initial: (Clara Orndorff)

2. Using hand tools (hacksaws, hand drills, files, screwdrivers, hammers, etc.)	2.a. Physical injury such as from sharp edges, blades, drill bits or heavy objects	2.a.i. Make sure tool users are qualified to use hand tools 2.a.ii. Make sure tool users use required PPE 2.a.iii. Avoid carelessness and do not work when tired 2.a.iv. Use the right tool for the task	All Initial: (Nicholas Orndorff)
3. Using power tools (power drills, sanders, soldering irons, etc.)	3.a. Physical injury such as from sharp edges, blades, drill bits or heavy objects 3.b. Physical injury from improper use 3.c. Physical injury from fumes (such as from soldering) 3.d. Potential chemical contamination from substances such as lead solder	3.a.i. Make sure tool users use required PPE 3.b.i. Make sure tool users are qualified to use power tools 3.b.ii. Avoid carelessness and do not work when tired 3.c.i. Use proper ventilation at all times 3.c.ii. Use proper PPE at all times 3.d.i. Use Reduction of Harmful Substance (RoHS) compliant lead solder, or lead-free solder 3.d.ii. Wash hands after use of solder and avoid unnecessary contact with skin and face	All Initial: (Alex Miller)
4. Machining with lathe or other rotary tools	4.a. Long hair or loose clothing could get trapped by machine 4.b. Large spinning discs/blades have the potential for extreme bodily harm 4.c. Blades or workpieces being machined may shatter under high stress resulting in injury	4.a.i. Tie back hair and do not under any circumstances wear loose clothing/jewelry 4.b.i. Wear work gloves, goggles and any other necessary PPE 4.c.i. Wear work gloves, goggles and any precautionary PPE necessary	All Initial: (Alex Miller)

5. Using rapid prototyping technologies	5.a. Fumes and ultrafine particle emissions from melting plastics 5.b. Fire risk from high temperatures 5.c. Physical injury risk (burns from hot parts)	5.a.i. Use proper ventilation at all times 5.b.i. Do not use a 3D printer in close proximity to flammable materials 5.b.ii. Have precautionary materials nearby, such as fire extinguishers 5.b.iii. Do not operate a 3D printer unattended 5.c.i. Wait five minutes after a print is finished before removing it from the printer 5.c.ii. Never touch the extruder head during the heating, printing or cooling processes	All Initial: (Nicholas Orndorff)
6. Electrical safety	6.a. Fumes/fires that may result from electrical shorts 6.b. Static discharge	6.a.i. Double check power connections 6.a.ii. Use proper 6.b.i. Always be properly grounded when working with electronics	All Initial: (Clara Orndorff)

7. ROV operation in the water	7.a. Potential shorts from improperly sealed connections 7.b. Tripping hazards from cables leading into the water	7.a.i. Use both silicone and heatshrink for all connections, both submerged and at the surface 7.a.ii. Use isolated power supplies in circuits 7.a.iii. Always use Ground Fault Circuit Interrupters (GFCIs) when operating near water 7.b.i. Warn company members and the public of potential hazards 7.b.ii. Put strain relief on all cables and secure systems at the surface 7.b.ii. Develop and use a tether management protocol	CEO, Senior members Initial: (Nicholas Orndorff)
8. General ROV design and construction	8.a. Potential physical hazards to others and the environment	8.a.i. Implement danger labels for moving parts and sharp edges 8.a.ii. Cover/eliminate sharp edges 8.a.iii. Use a 25A fuse with 25cm of the power source on the positive line 8.a.iv. Put strain relief on all cables and secure systems at the surface 8.a.v. In case of large or heavy systems or equipment, use a cart or other form of safe transportation 8.a.vi. Design thrusters and propellers to be both inboard and shrouded at all times	All Initial: (Alex Miller)

		8.a.vii. Develop and use a safety checklist/protocol	
9. Lifting and back safety	9.a. Physical injury from lifting heavy or unwieldy objects 9.b. Potential vehicle damage	9.a.i. In case of large or heavy systems or equipment, use a cart or other form of safe transportation 9.a.ii. Always lift from the legs 9.a.iii. Never lift a large object with only one person	All Initial: (Nicholas Orndorff)
10. Working at other sites	10.a. Physical damage to an unfamiliar environment	10.a.i. If the site has a supervisor, alert them to the potential hazards and get approval for site usage 10.a.ii. Show the supervisor safety features and procedures 10.a.iii. Be alert for unexpected testing conditions	CEO, Senior members Initial: (Clara Orndorff)
11. Performing unscheduled maintenance	11.a. Hazards from poor solutions	11.a.i. Stay calm and focused 11.a.ii. Don't rush into inferior solutions	All Initial: (Alex Miller)
12. *Additional notes*			

13. *Additional notes*			

Site Tasks (Working at Other Sites)

TASK	**POTENTIAL HAZARDS**	**CONTROLS**	**RESPONSIBLE MEMBER(S)**
1. Unloading and unpacking of ROV and support systems	1.a. Back injury from the lifting of heavy shipping crates 1.b. Tripping hazard from packing material	1.a.i. In case of large or heavy systems or equipment, use a cart or other form of safe transportation 1.a.ii. Always lift from the legs 1.a.iii. Never lift a large object with only one person 1.b.i. Always keep work environment clean and free of clutter	All Initial: _____ (Nicholas Orndorff)
2. Pre-operation inspection	2.a. Cuts and laceration from items such as plastics that have shattered during transportation	2.a.i. Always use safety glasses and work slowly but methodically. Do not assume systems are Ok without checking them first	Pilot(s) Initial: _____ (Nicholas Orndorff)

3. Dry equipment operations test	3.a. Electrical fire from damaged components 3.b. laceration from potentially moving broken components	3.a.i. Thorough visual electrical inspections, especially of high power components 3.b.i. Check the integrity of components through the application of small amounts of force with the intent to discover broken items	Pilot(s) Initial: (Clara Orndorff)
4. Wet equipment operations test	4.a. Risk of electric shock from close proximity of electricity and water, wires that may have become exposed during transport 4.b. Risk of accidental human immersion at unfamiliar launch sites	4.a.i. Always use a GFCI and fuse 4.a.ii. Always verify the power source is outputting the correct voltage 4.b.i. Wear life jacket equipment at particularly hazardous locations. (surface conditions with wind, rain etc)	Pilot(s) Initial: (Alex Miller)
5. Potential unscheduled maintenance	5.a. Bodily injury resulting from stressful, high stakes situations	5.a.i. DO NOT RUSH A good solution is better than a poor quick one. 5.a.ii. Always have high quality spares on hand and ready to go at a moments notice	All Initial: (Alex Miller)
6. Engineering presentations *(additional unforeseen notes)*			All Initial: (All)

7. Product demonstration (3)	7.a. Tripping hazard from improperly routed tether and control cables 7.b. Electric shock 7.c. Human immersion in extreme (unfamiliar) environments	7.a.i. Prior to product demonstration construct a mental or physical plan on the locations of particular equipment with the specific location in mind 7.b.i. Use GFCI and fuse within 25cm of the battery terminations 7.c.i. Wear life jacket equipment at particularly hazardous locations. (surface conditions with wind, rain etc)	All Initial: (All)
8. Packing of ROV systems	8.a. Back injury from the lifting of heavy shipping crates 8.b. Tripping hazard from packing material	8.a.i. In case of large or heavy systems or equipment, use a cart or other form of safe transportation 8.a.ii. Always lift from the legs 8.a.iii. Never lift a large object with only one person 8.b.i. Always keep work environment clean and free of clutter	All Initial: (Nicholas Orndorff)
9. *Additional notes*			

10. *Additional notes*			

Required Training:

1. Experience with computer controlled manufacturing techniques
2. Pool practice sessions are more or less mandatory, as important safety and product information changes day to day
3. An understanding of the basic electrical components on the ROV will provide an intuitive logical grasp of how to operate the ROV safely around water

Required Personal Protective Equipment (PPE):

1. Safety glasses and closed toe shoes for all work on or around the ROV and its peripheries, no matter the circumstances
2. Hearing protection for use with power tools and loud machinery
3. Gloves and masks for use with potentially hazardous substances

Other Information:

1. When unsure, consult MSDS (Material Safety Data Sheets) for unfamiliar substances/materials
2. Company members should recognize potential hazards and hazardous materials utilized. These include but are not limited to the following:
    a. Polyisocyanurate closed cell foam present in main float
    b. Various resins and other chemical sealing agents
    c. Acetone and alcohol used for cleaning and post processing of components
    d. Lead based solder in all electronics systems
    e. High speed rotating propeller blades
    f. High voltage electronics

Sample MSDS for key materials/components used:

Polyisocyanurate foam: https://www.generalplastics.com/pdf/R-3300_Series/R-Rigid-Foam-SDS.pdf

3M™ Scotchcast™ resin: http://multimedia.3m.com/mws/mediawebserver?mwsId=SSSSSuUn_zu8l00xM8tePxmZMv70k17zHvu9lxtD7SSSSSS--

Acetone: http://primarychemicals.com/documents/Acetone_MSDS.pdf

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For safety issues or concerns contact AMNO & CO at amnoandco@live.com