RoboCenter	Job Safety Analysis (JSA)					20.05.2019
Step	**Task**	**Hazard**		**Controls**	**Responsible**	**Responsible person(s)**
Research and Design. Software development						
All the time building ROV	Searching, programming, working in CADs, communicating and other PC work	Spinal, neck, arm and joint injuries. Eyestrain and stress.		Organize workflow and workspace right. Use ergonomic chair and keyboard. Make short rest breaks and do stretching exercises	All	Shevchenko V.
Manufacturing						
Making electrical components: Custom PCBs performing	Etching PCBs	Chemical reagents	Inhalation	Work in well-ventilated areas and use mask or respirator	Electronic Engineer	Duchinskii M.
			Chemical burns and skin injury	Use gloves and proper clothing		
	Cutting copper board and drilling holes in PCB	Eye injuring with cuttings		Use safety glasses	Electronic Engineer, Design Engineer	Duchinskii M.
		Dust inhalation		Use mask or respirator		
		Hand or skin injury		Use proper clothing		
Making electrical components: Soldering components and wires	Manual components soldering with solder iron and/or hot air blower	Chemical reagents	Lead/flux fume inhalation	Work in well-ventilated areas and use mask or respirator	Electronic Engineer	Sukhanov I.
			Lead solder poisoning	Use gloves and washing hands with soap after work		
			Skin injury	Use gloves and proper clothing		
			Lead/flux fume eye injuring	Work in well-ventilated areas and use safety glasses		
		Thermal burns with hot surfaces		Use proper clothes. Do not touch hot surfaces with hands. Use appropriate equipment. Turn off equipment when you don’t work with it		
		Eye injury with solder “spit”		Use safety glasses		

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Step	**Task**	**Hazard**		**Controls**	**Responsible**	**Responsible person(s)**
		Fire and surround property damage		Keep work area tidy and clean. Do not work near flammable things. Turn off equipment when you don't work with it		
		Electrocution		Make sure that object is powered off from power source		
Making electrical components: Postprocessing	Cutting wires and cleaning flux	Chemical reagents	Inhalation	Work in well-ventilated areas and use mask or respirator	Electronic Engineer	Duchinskii M.
			Chemical burns and skin injury	Use gloves and proper clothing		
		Eyes injuring with wire offcuts from using side-cutters		Use safety glasses		
Making mechanical components: Performing parts	Working with machine and power tools	Machine entanglement		Avoid loose-fitting closes	Design Engineer	Duchinskii M.
		Eyes injury caused by cuttings		Use safety glasses		
		Ear injury caused by noise		Use hearing protection		
		Cuts, punctures and scrapes		Use gloves and proper clothing		
	Working with hand tools	Cuts, punctures and scrapes caused by hand tools		Use gloves and proper clothing		
Making mechanical components:	Grinding and polishing	Dust inhalation, eyes injuring		Use safety glasses and respirators	Design Engineer	Duchinskii M.
	Coating	Paint aerosol inhalation, eyes injuring		Use safety glasses and respirators. Work in wellventilated areas		

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Step	**Task**	**Hazard**	**Controls**	**Responsible**	**Responsible person(s)**
Postprocessing	Sealing with resins	Poisoning: inhalation reagents and skin injury	Use gloves and respirators. Work in well-ventilated areas	all	Duchinskii M.
Assembling: Electrical	Connecting wires and mounting parts and boards	Electrocution; fire caused by short circuit	Use right connectors, proper color marking and tagout. Make sure that object is powered off from power source	Electronic Engineer	Sukhanov I.
Assembling: Mechanical	Screwing and other working with handtools	Cuts, punctures and scrapes by hand tools	Use gloves and proper clothing. Choose right tools. Make sure that tools are in fine condition	Design Engineer	Duchinskii M.
Testing					
Primary components testing	Electrical testing	Electrocution; fire caused by short circuit	Use right connection scheme, proper color marking and tagout for components. Make sure that object is powered off from power source or make sure that you have easy access to killswitch	Design Engineer, Electronic Engineer	Sukhanov I.
	Mechanical testing. Pressure testing for tubes	Cuts, punctures and scrapes by broken and/or weak mounted parts	Use proper tools, safety glasses and right clothing		
Storage and transportation					
Storing	Placing ROV on storage	ROV falling down from shelf can cause injuries	Before placing to storage shelf make sure that all cables disconnected and neatly folded and locks on control box are closed. Make sure that ROV placed	All	Shevchenko V.
		Overexertion injury: spinal or arm injuries	Use proper lifting technics		
Transportation	Carrying ROV by hands	Entangling in tether	Make sure that tether neatly folded	All	Shevchenko V.
		Overexertion injury: spinal or arm injuries	Use proper lifting and carrying technics		

RoboCenter	Job Safety Analysis (JSA)				20.05.2019
Step	**Task**	**Hazard**	**Controls**	**Responsible**	**Responsible person(s)**
ROV operating					
Operations before launching	Placing ROV on the pool side	Fall into water	Use non-slipper shoes. Avoid standing close to the water unless necessary	All	Duchinskii M.
		Overexertion injury: spinal or arm injuries	Use proper lifting and carrying technics		
		Entangling in tether	Make sure that tether neatly folded		
	Connecting cables	Electrocution	Make sure that there are no exposed wires. Also, make sure that ROV and Surface Equipment are fully powered off		
Launching	Startup Surface Equipment and ROV	Electrocution	Make sure that there are no exposed wires. Do not touch Surface Equipment with wet hands	All	Sukhanov I.
Operating ROV	Put ROV into water	Fall into water. Spinal or arm injuries	Be careful when you put ROV into water. Use proper throwing technics	Electronic Engineer	Shevchenko V.
		Injuries caused by ROV	Make sure that Pilot don't manipulate ROV when you put ROV into water		
	Pilot's working	Spinal, neck, arm and joint injuries	Use right workspace organization. Use special preparing technics	Pilot	Shevchenko V.
	Surface Tether management	Fall into water	Use non-slipper shoes	Mechanical Engineer	
		Entangling in tether	Cable always should be under control		Shevchenko V.
Shutting down and packing	ROV retrieval from pool	Fall into water	Use non-slipper shoes	All	
		Overexertion injury: spinal or arm injuries	Use proper lifting and carrying technics		Shevchenko V.
		Entangling in tether	Cable always should be under control		

Step	Task	Hazard	Controls	Responsible	Responsible person(s)
	Disconnecting cables	Electrocution	Make sure that there are no exposed wires. Also, make sure that ROV and Surface Equipment are fully powered off		Sukhanov I.
		Overexertion injury: spinal or arm injuries	Use proper lifting and carrying technics		
	Packing and removing from pool side	Fall into water	Use non-slipper shoes		
		Entangling in tether	Fold tether neatly		

Theory and practice	
Required training	1. Knowledge of safety precautions for working with electrical appliances. 2. Knowledge of the procedure for loading and unloading the ROV. 3. Experience in the management of an underwater robot in the pool.
Necessary personal protective equipment (PPE)	1. Safety glasses and closed footwear for all work with the ROV. 2. Hearing protection during use with power tools and loud equipment. 3. Gloves and masks/respirators for use with potentially hazardous substances. 4. Non-slip footwear when working in the pool.
A short list of things considered potentially dangerous	1. High-speed rotating propeller blades. 2. Various resins and other chemical sealants. 3. Chemical reagents used for cleaning and subsequent processing of components. 4. Mechanical and power tools for manufacturing parts of ROV. 5. High-voltage electronics of ROV.
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