

## **Job Safety Analysis (JSA)**

### **HOUSEKEEPING**

TASK HAZARD PROTOCOL Follow safety checklist, use personal protection equipment(PPE), Keep all non-authorized people out of work areas, and/or at a safe distance.

Smithsonian Machine Room:

- Mentor Supervision of Machine Room on Site at all times as per Smithsonian protocol.

Keep a Well Organized CLEAN Environment at all times. Follow Safety Check List for each situation.

- Machine Rooms
- Electrical Work Area
- Pool Side Protocol

### **PERSONAL PROTECTIVE EQUIPMENT**

#### HAZARD PROTOCOL

- MUST WEAR PPE (personal protection equipment) at all times.
- Use Personal Protection Equipment when working with machinery and electrical equipment
- Safety Glasses, Gloves, Thermal Gloves, Close toe shoes, appropriate clothing; no loose clothing that can entangle in machinery or catch fire. Hair appropriately restrained.
- Deck Crew near edge of pool wear life vests in case of unexpected immersion in water. Deck crew handling ROV wear helmets in case of slip and fall while carrying/handling ROV.

#### **Electrical Work Area Protocol:**

- Follow safety checklist, use personal protection equipment(PPE)
- Electrical wiring avoid equipment failure -use correct voltage-power down before any work or connection of electrical wires.
- Proper grounding, double, triple check wires are in proper location before powering on. All PCB, Microcontroller current turned off while connecting, splicing or soldering.

**POOL SIDE PROTOCOL: Mission Runs, Perform Operational and Safety Checklist(see add.list)**

- all electrical wiring and motor are appropriately waterproofed and sealed prior to submersion. No exposed wires or motors.
- WPC is vacuumed checked prior mission to ensure NO LEAKS!
- Leaking and breaching of electrical systems preform immediate shut down and removal from water.
- Keep all electrical tools and extension cords at a safe distance from the pool side, ask for driver assistance if unforeseen problem occur with ROV or Tether entanglement.
- No Running

**General Shop work:**

- Keep tools organized and area swept at appropriate intervals,
- Wear PPE:
- Prevents stepping on sharp items and tools, Putting all items back where they belong,
- Wear close toed shoes, no loose clothing or hair to prevent entanglement or a fire hazard.
- Electrical Power Tool (soldering iron), use appropriate holding stand and wear PPE, keep at specified safe temperatures.
- Avoid Unsafe contact with skin or clothing, flying or hot debris.
- Hold and use tools as per manufacturer's instruction for intended use.
- Accident Prevention: Puncturing of skin, burns, flying debris;WEAR Eye protection, gloves, close toed shoes.
- Stay alert of your surroundings.

**HAND SAFETY**

## HAZARD PROTOCOL

- Laser Cutter: Contact with fingers, keep lid closed, watch for sharp edges.
- Drilling: Contact with fingers, wear work gloves, keep hand clear of drill bit.
- Soldering: The use and contact of hot objects, keep clear of hot surfaces, notify others of hot surfaces, stow hot iron in designated areas.
- Drill Press: To prevent hitting fingers,use designated clamps, Keep hands clear.

**LIFTING & BACK SAFETY**

## HAZARD PROTOCOL

- Moving the ROV- Heavy lifting injury prevention; appropriately lift heavy objects- Lift with the knees.
- Launch/Recovery of ROV poolside from awkward position. Kneel on deck, use caution,- don't overreach and don't fall in the water.

- ROV supply boxes- Lift with the knees, use handholds, keep the load close, Moving ROV Monitors, Batteries, Case- Use wheels when possible, ONLY lift in pairs; transport of ROV Heavy weight/ Use rolling cart.

## **TOOL SAFETY**

### **HAZARD PROTOCOL**

- Drill Press; Damage to skin / Crushing of fingers  
Safety Glasses, Gloves, Close Toed Shoes
- Dremel; Breaking of skin, flying debris eye injury; Safety Glasses, Gloves, Close Toed Shoes
- Soldering Iron; Serious burning of skin or eye injury, solder splattering- Safety Glasses, Close Toed Shoes,
- Hot tip always returns to holder/cleaner
- PVC cutter; Cutting of fingers, flying debris eye injury- Safety Glasses, Close Toed Shoes
- Compressed Air /Pneumatics – MATE Fluid Pressure Quiz- must Pass.

## **ELECTRICAL SAFETY**

### **HAZARD PROTOCOL**

- ROV Operation / Electrical Shock Prevention
- Follow all checklists, keep extension cord dry.
- Troubleshooting ROV Control System/ shock - Power Off.
- ROV Electrical Design & Fabrication
- Electrical systems failure: Use fuse, diodes, comply with MATE regulations.
- No AC Current on ROV
- Non-ROV powered equipment limited to DC power with 3 amp fuse.
- OBS WP container built in such a way that it cannot hold pressure more than a few PSA above ambient in case of venting of gases. Two rubber stoppers at each end of a Lucite tube held only by friction applied by hand
- Marine approved waterproof power cables- power supply in water.
- Anderson Pole Connectors/ No Lithium Batteries on board

## **Operational and Safety Checklist**

### **Vacuum Test Procedure**

- Connect vacuum hand pump to ROV electronics housing
- Pump electronics housing to -35 kpa vacuum
- Verify electronics chamber holds -35 kpa vacuum for 5 minutes
- Remove vacuum pump and securely cap vacuum port

### **Pre-Power**

- Area clear/safe (no tripping hazards, items in the way)
- Tether laid-out on deck
- Tether connected to Control Box and Secured
- Control Box/Composite Camera connected to Monitor
- Power source connected to Monitor
- Tether connected and secured to ROV
- Tether strain relief connected to ROV
- Electronics housing sealed
- Visual inspection of electronics for damaged wires, loose connection
- Penetrators tight on electronics housing
- Thrusters free from obstructions
- Check vacuum port is securely capped
- Deck crew check each other to make sure all wearing appropriate Personal Protection Equipment.

### **Power-Up**

- Air Compressor connected/receiving 12 Volts nominal
- Control computers up and running
- Ensure deck crew members are attentive
- Call out, “powering on!”
- Power on: Top control box, Xbox, Monitors
- Call out, “performing thruster test”
- Verify video feeds, QGround Control
- ROV lights indicate “Safe Mode” (blue)
- Calibrate Sensors

### **Launch**

- Call out, “prepare to launch”
- Deck crew members handling ROV call out “ready”
- Call “launch”
- Launch ROV, maintain hand hold
- Perform thruster test/verify thrusters are working properly (xBox movements correspond with thruster activity) Test Thrusters: Forward, Reverse, Left, Right, Up, Down
- Wait for release order

### **In Water**

- Visually inspect for water leaks
- If there are large bubbles, pull to surface immediately
- Engage thrusters and begin operations

### **ROV Retrieval**

- Pilot calls “ROV surfacing”
- Deck crew calls “ROV on surface”
- “ROV captured”, kill thrusters
- ROV lights indicate “Safe Mode” (green)
- Power Down
- Call out “safe to remove ROV”
- After securing the ROV on deck, deck crew calls out “ROV secured on deck”

### **Leak Detection Protocol**

- Surface immediately
- Power down ROV
- Inspect (may require removal of electronics)

### **Loss of Communication**

- Cycle power on TCU to reboot ROV
- If no communication, power down ROV, retrieve via tether
- If communication restored, confirm there are no leaks, resume operations

### **Pit Maintenance**

- Verify thrusters are free of foreign objects and spin freely
- Visual inspection for any damage
- All cables are neatly secured
- Verify tether is free of kinks
- Visual inspection for leaks
- Washdown ROV