**FAMU-FSU College of Engineering**

**Project Hazard Assessment Policy and Procedures**

**INTRODUCTION**

University laboratories are not without safety hazards. Those circumstances or conditions that might go wrong must be predicted and reasonable control methods must be determined to prevent incident and injury. The FAMU-FSU College of Engineering is committed to achieving and maintaining safety in all levels of work activities.

**PROJECT HAZARD ASSESSMENT POLICY**

Principal investigator (PI)/instructor are responsible and accountable for safety in the research and teaching laboratory. Prior to starting an experiment, laboratory workers must conduct a project hazard assessment (PHA) to identify health, environmental and property hazards and the proper control methods to eliminate, reduce or control those hazards. PI/instructor must review, approve, and sign the written PHA and provide the identified hazard control measures. PI/instructor continually monitor projects to ensure proper controls and safety measures are available, implemented, and followed. PI/instructor are required to reevaluate a project anytime there is a change in scope or scale of a project and at least annually after the initial review.

**PROJECT HAZARD ASSESSMENT PROCEDURES**

It is FAMU-FSU College of Engineering policy to implement followings:

1. Laboratory workers (i.e. graduate students, undergraduate students, postdoctoral, volunteers, etc.) performing a research in FAMU-FSU College of Engineering are required to conduct PHA prior to commencement of an experiment or any project change in order to identify existing or potential hazards and to determine proper measures to control those hazards.
2. PI/instructor must review, approve and sign the written PHA.
3. PI/instructor must ensure all the control methods identified in PHA are available and implemented in the laboratory.
4. In the event laboratory personnel are not following the safety precautions, PI/instructor must take firm actions (e.g. stop the work, set a meeting to discuss potential hazards and consequences, ask personnel to review the safety rules, etc.) to clarify the safety expectations.
5. PI/instructor must document all the incidents/accidents happened in the laboratory along with the PHA document to ensure that PHA is reviewed/modified to prevent reoccurrence. In the event of PHA modification a revision number should be given to the PHA, so project members know the latest PHA revision they should follow.
6. PI/instructor must ensure that those findings in PHA are communicated with other students working in the same laboratory (affected users).
7. PI/instructor must ensure that approved methods and precautions are being followed by :
   1. Performing periodic laboratory visits to prevent the development of unsafe practice.
   2. Quick reviewing of the safety rules and precautions in the laboratory members meetings.
   3. Assigning a safety representative to assist in implementing the expectations.
   4. Etc.
8. A copy of this PHA must be kept in a binder inside the laboratory or PI/instructor’s office (if experiment steps are confidential).

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| **Project Hazard Assessment Worksheet** | | | | | | | | | | | | |
| PI/instructor:Shayne McConomy | | Phone #850-410-6624: | | | Dept.:Mechanical Engineering | | Start Date: 08/2019 | | | Revision number:1 | | |
| Project: TCC Assembly Line Trainer | | | | | | | Location(s):TCC AMTC/ Eventually CoE for showcase | | | | | |
| Team member(s):Damira Solms, Justin Law, Nick Salerno, Robert Smith, Ryan Dodson | | | | | | | Phone #: 954-210-2454 | | | Email:ds15d@my.fsu.edu | | |
| **Experiment Steps** | **Location** | | **Person assigned** | **Identify hazards or potential failure points** | | **Control method** | | **PPE** | **List proper method of hazardous waste disposal, if any.** | | **Residual Risk** | **Specific rules based on the residual risk** | |
| 1. All materials needed to assemble the product will be gathered in assembly box kit for transportation between closet and classroom | TCC AMTC | | Damira Solms | If the box does not contain stabilizing material (foam or cardboard) then the individual components could knock into each other and damage each other. Also,the components may be dropped and lead to injury if not held securely | | Provide foam and cardboard to hold each part in a stable manner when placed in the carrying box | | Gloves and steel toed shoes in case of dropping a part on feet | No hazardous waste | | HAZARD: 2  CONSEQ:  Minor | Second worker must be present to help carrying heavy objects | |
| Residual:  Low Medium |
| 1. Assemble 80/20 Stand   and fasten conveyor belts to stand | TCC AMTC | | Nick Salerno | Hands may get caught between sliding metal parts and could lead to cuts | | Wear thick work gloves during construction and keep sleeves out of the way of getting stuck | | Thick gloves | No hazardous waste | | HAZARD:  1  CONSEQ:  Moderate | Second worker must be present to avoid slicing injuries and no more than two people should work on construction at a time to avoid overcomplication. | |
| Residual:  Low Medium |
| 1. Fasten mounts for motors, PLC, actuators, and sensors | TCC AMTC | | Justin Law | Overtightening of fasteners may cause the fastener to be stripped or break into pieces that could get in someone’s eyes. If the mounts are not fastened tightly enough they may cause bodily harm to shorter people who could be under the falling objects. | | The fasteners will not be overtightened or left too loose. | | Eye protection and gloves | No hazardous waste | | HAZARD:  2  CONSEQ:  Significant | Two people must work on fastening at a time to ensure one person holds the objects stable while another fastens. Do not allow more people than necessary to ensure that everything is fastened appropriately and attention to detail is given. | |
| Residual:  Medium |
| 1. Wire the motors, PLC, actuators, and sensors. | TCC AMTC | | Ryan Dodson  and Robert Smith | This crucial step involves the wiring and testing of our project. If wired incorrectly there could be damage to the components, overheating, fire, or undesired motion. | | To avoid this we will make sure to safely test each component before wiring the complete system and to use a multimeter to ensure that the electronic components and logic are performing their desired tasks. Ensure that appropriate pressure is used in pneumatic actuator | | ESD Bracelet to avoid shock and damage to electronic components | No hazardous waste | | HAZARD:  5  CONSEQ:  Significant | Since we are dealing with building air there is a risk of explosion and the electrical components lead to fire risk. Have both electrical engineers double check the wires are connected correctly before supplying power. | |
| Residual:  Medium High |
| 1. Calibrate the motors, actuators, and sensors | TCC AMTC | | Robert Smith | This step determines the timing of the pneumatic actuated arm, and when the sensors communicate to the rotating arm to rotate. Jewelry, clothing, or hands could get caught in the system if placed in the way of moving objects. This step involves a lot of testing and understanding how the electrical input affects the logical signals and mechanical output. | | When calibrating to test code only the tested object will be wired until it is deemed to be working correctly. Additionally, another person will be standing by the power supply to turn off the controller if it is not functioning correctly. | | Stand behind protective barrier when testing and wear protective eyewear | No hazardous waste | | HAZARD:  2  CONSEQ:  Minor | Stand behind protective barrier when testing and wear protective eyewear. Only perform this task if two team members are present. | |
| Residual:  Low Medium |

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| **Experiment Steps** | **Location** | **Person assigned** | **Identify hazards or potential failure points** | **Control method** | **PPE** | **List proper method of hazardous waste disposal, if any.** | **Residual Risk** | **Specific rules based on the residual risk** |
| 1. Place object on conveyor | TCC AMTC | Damira Solms | Too fast conveyor speeds may propel the object too quickly | Turn the conveyor on and check speed calibration before placing test object on it | Safety goggles, stand on only the loading side | N/A | HAZARD: 1  CONSEQ:  Minor | Stand only on loading end of conveyor to avoid any potential injury due to moving parts |
| Residual:  Low |
| 1. Transport the object past the sensors via conveyor | TCC AMTC | Nick Salerno | Sensors are powered electronically and miswiring/exposed wire could cause damage to sensor or fire | Double check that wiring is correct using a multimeter | ESD Bracelet to avoid shock and damage to electronic components | No hazardous waste | HAZARD: 1  CONSEQ:  Minor | Place the object on the conveyor initially gently, do not throw any objects onto conveyor. |
| Residual:  Low |
| 1. Use data from the sensors to use PLC to decide which servo arm to move   to sort by material | TCC AMTC | Ryan Dodson | Moving arm’s rotation may cause harm to an unaware person who passes too closely by hitting them or if someone touches it their hand/clothing/orjewelry could get caught in the system | Ensure that onlookers stand at least 2 feet away from the device while in operation and that operators are not wearing anything that may get caught in the rotating arm or conveyor system. | Protective eyewear | No hazardous waste | HAZARD:  2  CONSEQ:  Minor | Ensure that the onlookers stand at least 2 feet away and only on the loading side. |
| Residual:  Low Medium |
| 1. After being sorted by material type each material will be on a separate conveyor | TCC AMTC | Robert Smith | If the rotational sorting arm is not strong enough to overcome friction and push the test piece then it may break and cause harm after breaking | Do not overload the machine with objects that are heavier than the maximum loads calculated for. |  | No hazardous waste | HAZARD:  1  CONSEQ:  Negligible | Ensure that the onlookers stand at least 2 feet away and only on the loading side. |
| Residual:  Low |
| 1. Transport past a pneumatic actuated arm to sort size and push off the conveyor into sorting bin | TCC AMTC | Justin Law | Pushing action may cause danger by objects being thrown/propelled if there is no bin to catch and stop the object’s motion | Ensure that there is a bin to receive the items being propelled off of the conveyor belt. | Ensure that the bins are always placed before starting any tests or presentations | No hazardous waste | HAZARD:  4  CONSEQ:  Negligible | Ensure that the onlookers stand at least 2 feet away and only on the loading side.  Do not check the results of sorting demo until all objects are off of the conveyor and the power supply is off. |
| Residual:  Low |

**Test Safety precaution:**

This project will be completely controlled via a PLC device. Since the PLC will be used to run the code consistently and can’t be stopped unless powered off, when testing whether the servo or pneumatic arms are functioning appropriately to the sensor output we will only connect the one component we are planning on testing and we will make sure to place a shielding device between us and the test unit. Additionally, we will not attach the arms until we are sure that the code is directing the moving parts correctly. The conveyor speed is controlled by a separate constant speed motor.

**OSHA Safety Protocol:**

Due to accessibility issues OSHA protocol was the only protocol referenced for safety. We will employ the following in our conveyor system and our circuitry:

Conveyor safety:

1926.555(a)(4)

Screw conveyors shall be guarded to prevent employee contact with turning flights.

The rail guards attached on either side of the conveyor makes it so that people cannot stick their hands under the belt’s moving parts

1926.555(a)(1)

Means for stopping the motor or engine shall be provided at the operator's station. Conveyor systems shall be equipped with an audible warning signal to be sounded immediately before starting up the conveyor.

There will be a lockout system incorporated into the PLC code and the system will not be able to be restarted until the issues that caused the off code are addressed.

<https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.555>

Circuit and Wiring Safety:

1910.305(a)(2)(v)(A)

Branch circuits shall originate in an approved power outlet or panelboard.

1910.305(a)(2)(vii)

No bare conductors nor earth returns may be used for the wiring of any temporary circuit.

1910.305(a)(2)(x)

Flexible cords and cables shall be protected from accidental damage, as might be caused, for example, by sharp corners, projections, and doorways or other pinch points.

1910.305(a)(2)(xi)

Cable assemblies and flexible cords and cables shall be supported in place at intervals that ensure that they will be protected from physical damage. Support shall be in the form of staples, cables ties, straps, or similar type fittings installed so as not to cause damage

1910.305(h)(6)

*Fittings*. Connectors used to connect lengths of cable in a run shall be of a type that lock firmly together. Provisions shall be made to prevent opening or closing these connectors while energized. Strain relief shall be provided at connections and terminations.

1910.305(j)(4)(vi)

An individual disconnecting means shall be provided for each motor, but a single disconnecting means may be used for a group of motors under any one of the following conditions:

<https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.305>

**Principal investigator(s)/ instructor PHA:** I have reviewed and approved the PHA worksheet.

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| **Name**  **Shayne McConomy** | **Signature** | **Date** | **Name** | **Signature** | **Date** |
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**Team members:** I certify that I have reviewed the PHA worksheet, am aware of the hazards, and will ensure the control measures are followed.

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| **Name**  **Damira Solms** | **Signature** | **Date** | **Name**  **Nick Salerno** | **Signature** | **Date** |
| \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Ryan Dodson** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Justin Law** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_ |
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**Robert Smith**

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**Matrix Results for Steps To Determine Residual Risk**

**\*Numbers correspond to numbers on chart**

|  |  |  |
| --- | --- | --- |
| **Number on Chart** | **Hazard Assessment Result** | **Residual Risk Assessment Result** |
|  | **2** | **Low Medium** |
|  | **1** | **Low Medium** |
|  | **2** | **Medium** |
|  | **5** | **Medium High** |
|  | **3** | **Low Medium** |
|  | **1** | **Low** |
|  | **1** | **Low** |
|  | **2** | **Low Medium** |
|  | **1** | **Low** |
|  | **4** | **Low** |

**DEFINITIONS**:

**Hazard:** Any situation, object, or behavior that exists, or that can potentially cause ill health, injury, loss or property damage e.g. electricity, chemicals, biohazard materials, sharp objects, noise, wet floor, etc. OSHA defines hazards as “*any source of potential damage, harm or adverse health effects on something or someone".* A list of hazard types and examples are provided in appendix A.

**Hazard control:** Hazard control refers to workplace measures to eliminate/minimize adverse health effects, injury, loss, and property damage. Hazard control practices are often categorized into following three groups (priority as listed):

1. **Engineering control:** physical modifications to a process, equipment, or installation of a barrier into a system to minimize worker exposure to a hazard. Examples are ventilation (fume hood, biological safety cabinet), containment (glove box, sealed containers, barriers), substitution/elimination (consider less hazardous alternative materials), process controls (safety valves, gauges, temperature sensor, regulators, alarms, monitors, electrical grounding and bonding), etc.
2. **Administrative control:** changes in work procedures to reduce exposure and mitigate hazards. Examples are reducing scale of process (micro-scale experiments), reducing time of personal exposure to process, providing training on proper techniques, writing safety policies, supervision, requesting experts to perform the task, etc.
3. **Personal protective equipment (PPE):** equipment worn to minimize exposure to hazards. Examples are gloves, safety glasses, goggles, steel toe shoes, earplugs or muffs, hard hats, respirators, vests, full body suits, laboratory coats, etc.

**Team member(s):** Everyone who works on the project (i.e. grads, undergrads, postdocs, etc.). The primary contact must be listed first and provide phone number and email for contact.

**Safety representative:** Each laboratory is encouraged to have a safety representative, preferably a graduate student, in order to facilitate the implementation of the safety expectations in the laboratory. Duties include (but are not limited to):

* Act as a point of contact between the laboratory members and the college safety committee members.
* Ensure laboratory members are following the safety rules.
* Conduct periodic safety inspection of the laboratory.
* Schedule laboratory clean up dates with the laboratory members.
* Request for hazardous waste pick up.

**Residual risk:** Residual Risk Assessment Matrix are used to determine project’s risk level. The hazard assessment matrix (table 1) and the residual risk assessment matrix (table2) are used to identify the residual risk category.

The instructions to use hazard assessment matrix (table 1) are listed below:

1. Define the workers familiarity level to perform the task and the complexity of the task.
2. Find the value associated with familiarity/complexity (1 – 5) and enter value next to: HAZARD on the PHA worksheet.

**Table 1. Hazard assessment matrix.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | **Complexity** | | |
| Simple | Moderate | Difficult |
| **Familiarity Level** | Very Familiar | 1 | 2 | 3 |
| Somewhat Familiar | 2 | 3 | 4 |
| Unfamiliar | 3 | 4 | 5 |

The instructions to use residual risk assessment matrix (table 2) are listed below:

1. Identify the row associated with the familiarity/complexity value (1 – 5).
2. Identify the consequences and enter value next to: CONSEQ on the PHA worksheet. Consequences are determined by defining what would happen in a worst case scenario if controls fail.
   1. Negligible: minor injury resulting in basic first aid treatment that can be provided on site.
   2. Minor: minor injury resulting in advanced first aid treatment administered by a physician.
   3. Moderate: injuries that require treatment above first aid but do not require hospitalization.
   4. Significant: severe injuries requiring hospitalization.
   5. Severe: death or permanent disability.
3. Find the residual risk value associated with assessed hazard/consequences: Low –Low Med – Med– Med High – High.
4. Enter value next to: RESIDUAL on the PHA worksheet.

**Table 2. Residual risk assessment matrix.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Assessed Hazard Level** | **Consequences** | | | | |
| Negligible | Minor | Moderate | Significant | Severe |
| 5 | Low Med | Medium | Med High | High | High |
| 4 | Low | Low Med | Medium | Med High | High |
| 3 | Low | Low Med | Medium | Med High | Med High |
| 2 | Low | Low Med | Low Med | Medium | Medium |
| 1 | Low | Low | Low Med | Low Med | Medium |

**Specific rules for each category of the residual risk:**

Low:

* Safety controls are planned by both the worker and supervisor.
* Proceed with supervisor authorization.

Low Med:

* Safety controls are planned by both the worker and supervisor.
* A second worker must be in place before work can proceed (buddy system).
* Proceed with supervisor authorization.

Med:

* After approval by the PI, a copy must be sent to the Safety Committee.
* A written Project Hazard Control is required and must be approved by the PI before proceeding. A copy must be sent to the Safety Committee.
* A second worker must be in place before work can proceed (buddy system).
* Limit the number of authorized workers in the hazard area.

Med High:

* After approval by the PI, the Safety Committee and/or EHS must review and approve the completed PHA.
* A written Project Hazard Control is required and must be approved by the PI and the Safety Committee before proceeding.
* Two qualified workers must be in place before work can proceed.
* Limit the number of authorized workers in the hazard area.

High:

* The activity will not be performed. The activity must be redesigned to fall in a lower hazard category.

**Appendix A: Hazard types and examples**

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| **Types of Hazard** | **Example** |
| Physical hazards | Wet floors, loose electrical cables objects protruding in walkways or doorways |
| Ergonomic hazards | Lifting heavy objects Stretching the body  Twisting the body  Poor desk seating |
| Psychological hazards | Heights, loud sounds, tunnels, bright lights |
| Environmental hazards | Room temperature, ventilation contaminated air, photocopiers, some office plants acids |
| Hazardous substances | Alkalis solvents |
| Biological hazards | Hepatitis B, new strain influenza |
| Radiation hazards | Electric welding flashes Sunburn |
| Chemical hazards | Effects on central nervous system, lungs, digestive system, circulatory system, skin, reproductive system. Short term (acute) effects such as burns, rashes, irritation, feeling unwell, coma and death.  Long term (chronic) effects such as mutagenic (affects cell structure), carcinogenic (cancer), teratogenic (reproductive effect), dermatitis of the skin, and occupational asthma and lung damage. |
| Noise | High levels of industrial noise will cause irritation in the short term, and industrial deafness in the long term. |
| Temperature | Personal comfort is best between temperatures of 16°C and 30°C, better between 21°C and 26°C.  Working outside these temperature ranges: may lead to becoming chilled, even hypothermia (deep body cooling) in the colder temperatures, and may lead to dehydration, cramps, heat exhaustion, and hyperthermia (heat stroke) in the warmer temperatures. |
| Being struck by | This hazard could be a projectile, moving object or material. The health effect could be lacerations, bruising, breaks, eye injuries, and possibly death. |
| Crushed by | A typical example of this hazard is tractor rollover. Death is usually the result |
| Entangled by | Becoming entangled in machinery. Effects could be crushing, lacerations, bruising, breaks amputation and death. |
| High energy sources | Explosions, high pressure gases, liquids and dusts, fires, electricity and sources such as lasers can all have serious effects on the body, even death. |
| Vibration | Vibration can affect the human body in the hand arm with `white-finger' or Raynaud's Syndrome, and the whole body with motion sickness, giddiness, damage to bones and audits, blood pressure and nervous system problems. |
| Slips, trips and falls | A very common workplace hazard from tripping on floors, falling off structures or down stairs, and slipping on spills. |
| Radiation | Radiation can have serious health effects. Skin cancer, other cancers, sterility, birth deformities, blood changes, skin burns and eye damage are examples. |
| Physical | Excessive effort, poor posture and repetition can all lead to muscular pain, tendon damage and deterioration to bones and related structures |
| Psychological | Stress, anxiety, tiredness, poor concentration, headaches, back pain and heart disease can be the health effects |
| Biological | More common in the health, food and agricultural industries. Effects such as infectious disease, rashes and allergic response. |