

# ZERO ENERGY ISOLATION PROGRAM



# Zero Energy Isolation Program

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## 1 Purpose

This program has been developed to provide standardized safe work procedures and safe work practices to be followed when working with machinery, equipment or a component of building infrastructure that may expose a worker to hazardous energy.

## 2 Scope

This Zero Energy Isolation Program is applicable to all personnel employed at Memorial University within the Departments of Facilities Management, Technical Services and contractors hired by Memorial tasked with working on machinery, equipment or a component of building infrastructure while on university property that requires installation, removal, preventative maintenance service and repair's/ modifications.

This document is not intended to describe all the particulars involved with the isolation of a system(s) as that will be determined by qualified personnel of the area in question.

## 3 Definitions

**Authorized Isolation Authority:** An occupation/trade designated by the employer and is qualified to engage in hazardous energy control because of knowledge, training, experience.

**Contractor:** A person, partnership, or corporation bound under a contract to execute work on behalf of the University or at a University facility.

**Contractor Representative:** The individual authorized to act on behalf of the Contractor for the purposes of the contract. The Contractor Representative is directly responsible for the supervision of their employees on site.

**De-energized:** The removal of all hazardous energy sources. Stored or residual energy must be depressurized, dissipated or restrained by methods such as grounding, repositioning, blocking, or bleeding down.

**Effective and Orderly Transfer of Control:** The transfer of control of an isolated process from one authorized or qualified and competent worker to another. An effective and orderly transfer will ensure that the continuity of the isolated process is protected and no other worker or person will be placed at risk while the control is transferred.



**Energy Isolating Device:** A device that is a positive means to physically prevent the release of energy. Such devices can be electrical circuit breakers, disconnect switches, radio-active source shutters, valves, or blank flanges. (Push buttons, selector switches, relief valves and check valves are NOT energy isolating devices).

**Energy Isolation Point:** The location on the equipment or machinery where isolation of energy is occurring.

**Electrically Safe Working Condition:** An electrically safe work condition shall be achieved when performed in accordance with the procedures specified in CSA Z-462 and verified by the process outlined in the Facilities Management Electrical Safety Program.

**Grounding:** Can be used in any situation/voltage level to ensure safety. The act of connecting a conductor, or exposed conductive parts of an installation, to the earth. The grounding protects personnel from stray currents that could leak to the metallic enclosures.

**Group Alternate:** The worker designated by the University as responsible to back-up the Group Primary and verify every step within zero energy state/lockout sequences. Where the Group Primary is assigned an action, the Group Alternate will confirm the action has been completed. In addition, during the absence of the Group Primary, the Group Alternate will perform the duties of the Group Primary until the employee is back to work.

**Group Primary:** The worker designated by the Supervisor to direct or oversee the control of hazardous energy group lockout activity. The Group Primary will also act as the main point of contact for all workers involved in the group lockout activity including contractors, other departments and workers representing various trades.

The Group Primary will be responsible to remove the group locks from the energy isolating devices and ensure that no workers will be in danger when the equipment is returned to operation.

**Hazard:** A situation, condition, process, material or thing that may cause an injury or illness to a worker. Hazardous Energy: Electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, gravitational, or other forms of energy that could cause injury due to the unintended motion, energizing, start-up, or release of such stored or residual energy in machinery, equipment, piping, pipelines, or process systems.

**Isolate:** To disconnect all energy sources from the machinery or equipment to be worked on. An energy isolating device is any mechanical device that is used to physically restrain and prevent, regulate, direct, or dissipate the transmission or release of energy. The energy-isolating device must be “positive”,



meaning that once secured into position, it cannot fall off or be moved from its off or safe position. The use of a mechanical device to restrain, regulate, direct, or eliminate hazardous energy.

**Limited Approach Boundary:** A shock protection boundary to be crossed by only qualified persons (at a distance from a live part) it is not to be crossed by unqualified persons unless escorted by a qualified person.

**Lock Out:** To isolate all energy sources from equipment or components of that equipment, to dissipate any residual energy in a system or component, and to secure the isolation by a locking device.

**Loop Feeder System:** A loop system, as the name implies, loops through the service area and is usually tied into another power source.

**Manager:** An Employee who formally leads individuals and collective efforts to accomplish University goals. Responsibilities of the Manager include planning, directing, monitoring and evaluating the work of one or more individuals.

**Normal operating condition:** Normal operation of electric equipment may be used where a normal operating condition exists. A normal operating condition exists when the equipment is properly installed and properly maintained, when all equipment doors are closed and secured and equipment covers are in place and secured, and there is no evidence of impending failure.

**Qualified:** A competent person designated by his/her supervisor as qualified because of knowledge, training and experience to safely perform an assigned task.

**Securing Isolation:** Applying a positive locking device to machinery or equipment that will prevent any other person from re-energizing while the worker is working on it.

**Shift Personnel:** The worker(s) whom which operate and maintain equipment used for generating and disturbing mechanical energy on campus from the Central Utilities Annex.

**Stored Energy:** After applying the lockout device, all potentially hazardous stored or residual energy must be relieved, disconnected, restrained or otherwise rendered safe. If there is a possibility of re-accumulation of stored energy to a hazardous level, continuously verify isolation until servicing or maintenance is completed or until the possibility of such accumulation no longer exists.

**Supervisor:** A person authorized or designated by an employer to exercise direction and control over workers of the employer.

**Switch:** A device for opening or closing an electrical circuit. For zero energy purposes, a breaker operating handle or lever may be considered a switch.



**Temporary Protective Grounding:** Only to be installed by Facilities Management Journeyperson Electricians, a cable(s) connected to de-energized lines and equipment by jumping and bonding with appropriate clamps, to limit the voltage difference between accessible points at a worksite to safe values if the lines or equipment are accidentally re-energized.

**Toolbox Talk:** A hands-on way to remind workers that health and safety are important on the job. Each talk takes about five minutes and can help workers recognize and control hazards on the project.

**Valve:** A device for opening or closing a pneumatic, hydraulic, gas, process, or service line.

**Verifying Isolation:** Positively confirming the disconnection of all energy sources has been successful and any latent or residual energy has been dissipated.

**Worker/Employee:** An individual who is engaged to work for the University under an employment contract.

**Zero Energy State:** The state where all hazardous energy has been isolated and de-energized or otherwise controlled to the lowest reasonably achievable level.

## 4 Roles & Responsibilities

### 4.1 Director of Operations & Maintenance

- Reviewing and updating this program at least annually or more frequently as necessary
- Assigning responsibilities, establishing accountability, and delegating the authority to implement this Program.

### 4.2 Managers

- Managing the implementation of this Program within specific sections
- Ensuring that every worker who may be exposed to hazardous energy as part of their work duties has successfully completed Zero Energy Isolation System Program training.

### 4.3 Supervisors

- Ensuring that every worker who may be required to control/isolate hazardous energy as part of their work duties completes their Job Safety Analysis, documenting the hazards related to the potential release of energy and the tasks to be completed during the lockout, including controls to mitigate risks to as low as reasonably practicable
- Ensure all workers (employee's or contractors) adhere to the guidelines outlined in this Program
- Ensuring workers have received training on controlling hazardous energy & the associated hazards.





- Ensuring all changes to University infrastructure have been documented and updated with FED & Work Control.

#### 4.4 Workers

- Complying with this Zero Energy Isolation Program (following all safe work procedures and practices)
- Completing Job Safety Analysis & other related administrative controls
- Completing any and all training related to work duties.

#### 4.5 Contractors

- Ensuring all their employees working on University property are qualified and trained
- Completing their own risk assessment
- Verifying zero energy state before work begins
- Immediately report accidents and near misses to Memorial’s Environmental Health & Safety Department (EH&S) and Department of Facilities Management (FM)

#### 4.6 Environmental Health & Safety

- Auditing departments for compliance with this program annually or more frequently if necessary.

## 5 Locking & Tagging Supplies

### 5.1 Locks

APPLICATION	LOCK COLOUR	TAG COLOUR
PERSONAL	GREEN	RED
EQUIPMENT	RED	WHITE
GROUNDS	GREEN	ID TAG
LOCKBOX	YELLOW	N/A
Memorial CONTROL	BLACK	RED
SEASONAL	ORANGE	WHITE
TOS	N/A	YELLOW

Locks must be acquired by and distributed from Facilities Management Stores department and used specifically for lockout applications only. Combination locks are NOT acceptable in the control of hazardous energy. All locks must be one key per lock. All locks must be of the key retaining type.



### **5.1.1 Personal Safety Locks**

Green in colour. Marked with the workers' name and phone number. Used to control hazardous energy while a worker is currently at risk while of being exposed to hazardous energy while working on equipment. It will also be traceable to the worker who owns and installs it, with its key under the control of the worker identified on the lock.

### **5.1.2 Equipment Locks**

Red in colour. Equipment locks are not to be used as Personal Safety Locks, they are used to secure assets or equipment in a non-operational or zero energy state so they cannot be energized, operated or started for a variety of reasons. Equipment locks are required to be numbered and will be to be used for the operational isolation of equipment, machinery or component of building infrastructure when a Lockbox is required to be used or when a job is incomplete and a worker is not actively working on the equipment.

### **5.1.3 Lockbox Locks**

Yellow in colour. Used when a Lockbox is required. The Lockbox lock must be permanently attached to the Lockbox and numbered so that the lockbox number and the lockbox lock number matches.

### **5.1.4 Memorial Control Locks**

Black in colour. Used to maintain control of isolation while a contractor is performing work and at risk of being exposed to hazardous energy while on university property. It must be installed when only one energy isolation device is used with a multi-lock scissor hasp. The Contractor Representative will provide and install their own Personal Safety Lock in conjunction with the Memorial Control Lock on the Multi-Lock Scissor Hasp or Lockbox.

### **5.1.5 Seasonal Locks**

Orange in colour. Only used for seasonal isolations on University property. Must be placed on equipment.

### **5.1.6 Ground Locks**

Green in colour. Must be used in conjunction with a Grounds ID Tag indicating exactly which set of Temporary Protective Grounds (Ground cluster) it represents. Once grounds have been installed for an isolation the Lock must be placed on the energy isolation device or if used Lockbox. The key for the lock will then be secured to the set of grounds in which it represents.

### **5.1.7 Multi-Lock Scissors Hasp**

A device which provides a means of adding additional locks. Use a multi-lock scissors hasp when there is only one position remaining on the equipment's locking mechanism for the attachment of a Lock, and an additional lock is to be attached. The multi-lock scissors hasp will allow additional workers to attach their locks. Multi-lock scissors hasps must be attached directly to



The equipment's locking mechanism or another multi-lock scissors hasp in such a way that the equipment cannot be operated without first removing all locks and multi-lock scissors hasps. Never attach a lock to the last remaining hole/position on a multi-lock scissors hasp.

## 5.2 Tags

Tags are to be attached to each Lock used to secure equipment during the process of controlling hazardous energy. Tags should be securely fastened to the lock and should clearly indicate the equipment to which it is attached may not be operated until the Tag is removed.

If a tag is to be attached to an item that does not have a lock; it should be located in a position that will be immediately obvious to anyone attempting to operate the device.

There are four different types of tags used at the Memorial University - Personal Tags, Equipment Tags, Out of Service Tags and Ground ID Tags.

### 5.2.1 Personal Tags

Red "DANGER" tags are to be used with Personal Safety Locks and indicate a worker is actively working on the equipment, machinery or component of building infrastructure. These danger tags must state the worker's name, date tag was applied, shop/department, work order number and must indicate the equipment to which it was attached. Red "Danger" tags are also to be used when a black Memorial Control lock is installed on an energy isolation device.

### 5.2.2 Equipment Tags

White "DO NOT OPERATE" tags are used with Equipment Locks and must indicate the equipment to which it was attached may not be operated until the tag is removed. When a "DO NOT OPERATE" tag is being used with a red Equipment Lock, it must state the worker's name who applied it, the contact information of the worker, date tag was applied, shop/department and work order number. If the Equipment Lock & Tag is being applied after a Personal Lock & Tag are removed while a worker is not present, the Equipment Tag must state an updated status of the work that is in progress and should indicate that the equipment to which it is attached may not be operated until the tag is removed. When a "Do Not Operate" tag is being used with a group lockout, the group primary and group alternate names must be stated on each tag.

### 5.2.3 Out of Service Tags

Yellow "OUT OF SERVICE" tags will be applied when a piece of equipment is to be tagged out of service because service or maintenance is to be carried out. This type of tag is primarily used for portable/mobile equipment that is not practical to lockout. Under no circumstance is this tag considered an approved method for not following an isolation procedure when anyone is at risk for being exposed to hazardous energy.



#### **5.2.4 Ground ID Tags**

All Temporary Protective Grounds (Ground clusters) will be uniquely identified with two tags attached to each set and that no two sets have the same ID number. One metal tag will be permanently attached to the cables and the other will be attached via the Ground Lock which will be installed on the energy isolation device when cables are in use. Temporary Protective Grounds are sized to carry the maximum available fault current at the worksite. Wherever the grounds are installed there must be a magnetic or temporary signage posted on or near the equipment advising staff that Temporary Protective Grounds have been placed in service.

### **5.3 Key Securing Systems**

A system which physically prevents access to keys when locks or isolation devices are applied for an individual, group or contractor isolation lockout procedure. These items may include red lockbox or built-in cabinet compartments located in designated locations.

#### **5.3.1 Lockbox**

A specifically designed box used by a department to secure the keys of equipment locks that isolate multiple energy sources within a process system. A lockbox can be permanently installed or it may be portable. There must also be a completed Equipment Lockout Form (Appendix I) attached on the outside of the lockbox prior to authorized workers applying their lock(s). When a lockbox is in use for isolation, the lockbox must be secured with a yellow Lockbox Lock. All Lockbox's are required to be numbered.

#### **5.3.2 Key Storage Cabinet**

A cabinet located in each shop that performs isolations. The Key Storage Cabinet will be used for storage of Memorial Control Lock keys, Lockbox keys and/or Equipment Lock keys, for isolations that are on-going. When a key is hung in the storage cabinet, it will be identified with a white tag stating the work order number, worker's name, the location of where the lock is left installed, and if applicable, group primary name and group alternate name.

Access to keys in the key storage cabinet will only be authorized through the supervisor/ Lead Hand, or designate, of the corresponding shop. A worker will only gain access to a key if one or more of the following conditions are met: the worker installed the lock; the worker is the Group Primary or Group Alternate of the isolation.

### **5.4 Energy Isolation Devices**

A device which physically prevents the changing of the status of an energy isolation point. Once installed correctly, the mechanism will be controlled by the use of an appropriate lock.



### 5.4.1 Blank/ Blind Flanges

A plate for covering or closing the end of a pipe or preventing flow by being inserted in a flanged connection in a pipe. A flanged joint is a connection of pipes, where the connecting pieces have flanges by which the parts are bolted together.

### 5.4.2 Circuit Breaker Lock-out

A device which physically attaches to an energy isolating device. Various electrical circuit breakers will require different “styles” of devices so that the energy isolation point can be controlled in a safe and appropriate manner.

### 5.4.3 Valve Lock-out

A device which ensures that any system that is valve-operated stays in a safe operating status during service or maintenance work. Valve lockouts function by attaching a sturdy lockout device over the operational part of the valve. It is then secured in place with the use of hasps and appropriate lock. A chain is an acceptable valve lockout device providing that it is adequate for the isolation.

## 5.5 Lock-out/ Tag-out Supply Stations

Lockout/Tag-out stations are used to store lockout tag-out equipment securely and in one place. Lockout stations are to be wall-mounted and fixed in position near the energy source so that Lockout Tag-out equipment is always ready and at hand.

One Lockout Station should be available in every major building (preferably the buildings main mechanical room) and or one station for a group of smaller buildings (Mount Scio, Burton's Pond Apartments and Paton College).

### 5.5.1 Locations

NORTH	SOUTH	RESIDENTS	OFF-CAMPUS
HSC: H-3303	PS: PS-1000A	DH: DH-0004	MT. SCIO: V-15
FOM: M-6M300	ED: ED-6000	CA: CA-1001	OSC: AX-2002
UA: UA-2006	PE: PE-1005	GB: GB-312	SIGNAL HILL: B-0119C
UC: UC-3007A	L: L-1007	EX: EX-1008	
ER: ER-1000	IIC: IIC-0004	WX: WX-1008	
EN: EN-1036C	AA: A-1018		
BN: BN-1003A	SN: SN-1111		
QC: QC-2012A	C: C-6007		
	MU: MU-1035		
	HH: HH-1010		



## 6 Documentation

### 6.1 Permits

#### 6.1.1 Isolation Permit

Obtained in the Shop directly responsible for the isolation. Each Isolation Permit is uniquely numbered and only one permit is necessary for isolation. The Isolation Permit is required to have all the information mandatory to complete the work task safely. An Isolation Permit must be issued by the Group Primaries Supervisor and prior to work commencing. Once issued the permit is to be kept in a safe and secure location and filed away once the work task is completed. Module 3 of the Zero Energy Isolation Program Training will cover how to complete this permit in detail.

#### 6.1.2 Energized Electrical Work Permit

When working within the limited approach boundary or the arc flash boundary of exposed energized electrical conductors or circuit parts that are not placed in an electrically safe work condition (e.g., for the reasons of increased risk or additional hazards or infeasibility in accordance with CSA Z-462), the work to be performed shall be considered energized electrical work and shall be performed only after a written permit specific to the work has been obtained.

An Energized Electrical Work Permit must be completed by the Supervisor requesting the energized electrical work, two qualified electrical workers (QEW) and if work task is deemed high risk the Manager of Electrical Systems and the Director of Operations and Maintenance must sign the permit granting approval. Copies of the EEWP can be found in the Facilities Management Electrical Safety Program or through Supervisor(s) of F.M Electrical Systems.

Exemptions for an Energized Electrical Work Permit include, work performed by qualified persons within the limited approach boundary of energized electrical conductors or circuit parts related to tasks such as testing, troubleshooting, and voltage measuring may be performed without an energized electrical work permit, provided that appropriate safe work practices and PPE in accordance with CSA Z-462 are provided and used. If crossing the limited approach boundary is for visual inspection only and the restricted approach boundary will not be crossed, an energized electrical work permit shall not be required.

### 6.2 Forms

All relevant forms must be completed in accordance with this program. Job Safety Analysis Forms, Equipment Lockout Form (Appendix I) and Emergency Lock Removal Form(Appendix G) can be obtained either in this program, through your Supervisor or in the appropriate folder on the Public Cabot Drive.



## 7 Safe Work Procedures

All workers tasked with duties that will put themselves or others at risk of exposure to hazardous energy must use one of the following Memorial standardized procedures approved for mitigating risks to as low as reasonably practicable:

- Refer to Appendix A - Individual Worker Isolation
- Refer to Appendix B - Group of Workers Isolation
- Refer to Appendix C - Contractor Isolation
- Refer to Appendix D - Memorial Staff HV Isolation
- Refer to Appendix E – Contractor HV

## 8 Tagging Equipment Out of Service

When a piece of equipment is to be tagged out of service because service or maintenance is to be carried out, the equipment shall be secured with an “Out of Service” tag. The “Out of Service” tag must include contact information (name and phone number) of the person taking it out of service, date tag was applied and reason for equipment being taken out of service. Examples of acceptable use of the “Out of Service” tag include but not limited to tagging cleaning equipment, tagging automotive equipment or tagging a piece of PPE. Placing an “Out of Service” tag on a piece of equipment is under no circumstance considered an approved method for not following an isolation procedure when a worker is at risk for being exposed to hazardous energy.

While work is being carried out, an electrical plug cover will be installed and secured with a worker’s personal safety lock and a red danger tag. If the cord end is being repaired, a lock may not be necessary as long as the worker is in control of the equipment.

## 9 Render Inoperative

When it is determined equipment or infrastructure will no longer be needed (five years or longer), the equipment will not be left “locked out”, it will be recommended to be removed from service in a manner that prevents its accidental reactivation. Approval for this task should be given from a management representative, please see the appropriate Supervisor or Manager.



## 10 Central Utilities Annex

While working in the Central Utilities Annex, there are additional procedures that must be followed when performing isolations in that facility. First, all visitors including authorized personnel must sign in to the visitors log book upon entry. Qualified personnel must identify the most suitable energy isolation point(s) to perform their work safely and seek authorization from the Shift Personnel. Once given, the Shift Personnel will conduct or direct the isolation process as outlined in this program. This facility however, only approves the use of fixed lockbox(s). When a lockbox is used in addition to the box being secured with the Lockbox Lock, it will also be secured with a numbered ty-wrap. The Annex requires a lockbox and isolation permit be used for every isolation, no matter the number of locks required or whether or not it is an individual or group isolation.

## 11 Mechanical Patrol Person

When a piece of equipment or component of building infrastructure is to be isolated or taken out of service during the hours that are not covered by day-shift staff, the Mechanical Patrol Person will perform temporary isolation until qualified staff take over the job and perform the necessary work to return the equipment back to service.

The Mechanical Patrol Person will always install multi-lock scissors hasp, to allow a person to add their Personal Safety Lock right away so they can start to carry out work as soon as they arrive on the scene. They will also install a red Equipment Lock and install a "Do Not Operate" tag. The Mechanical Patrol Person is then responsible to create a detailed work order and schedule it to corresponding trades and adding the information to the on-shift log book. Once a qualified "day shift" worker has been given the work order, they will then contact the Utilities Annex to schedule the Mechanical Patrol Person currently on shift to meet and remove the red Equipment Lock, and also pass along any other relevant information. The Mechanical Patrol Person will store the key to the equipment lock in the key storage cabinet located in the control room at the Utilities Annex.

## 12 Under Ground Water Mains

This program requires the task of isolating underground water mains follow a Group of Workers Isolation procedure. Landscape technicians will act as the Group Primary and the Plumbers will act as a Group Alternate for this task only. Facilities Management recognizes that energy isolation devices may not perform their duty properly due to access issues, modern equipment not adaptable for use on aging infrastructure etc. however provisions must be in place to prevent accidental re-energization.



## 13 Emergency Lock Removal Procedure

It may be necessary for a personal safety lock to be removed by someone other than the worker who applied it. When the worker who applied the lock is unable to remove their lock, the following procedure will be applied before the lock is removed:

1. The supervisor will make every reasonable attempt to contact the worker before removing the lock. If successfully contacted, the worker is made aware of the situation and asked to come back to the worksite to remove the lock.
2. If the supervisor is unable to contact the worker or the worker is unable to return to the worksite, they must confirm the status of the equipment or process and verify it to be in a state that will allow for the safe removal of the lock and that no person will be put at risk when the lock is removed. At this point, the Emergency Lock Removal Form (Appendix G) will be filled out and approved by the Director of Operations & Maintenance for Facilities Management (or Designate), or equivalent within other departments, prior to the removal of the lock.
3. The lock and tag are removed with a witness present and secured by the individual responsible for the removal.
4. Provisions are made to ensure the owner of the lock is notified that their lock and tag have been removed.
5. The individual responsible for the lock removal will complete a lock removal form detailing why it was necessary to remove the lock and what steps were taken to verify the equipment or process was in a state allowing for the safe removal of the lock. The worker whose lock was removed shall sign the Emergency Lock Removal Form (Appendix G) upon return to work. Where energized electrical equipment has been installed that is of similar size, shape, construction and colour and an Electrically Safe Work Condition has been established for the electrical equipment appropriate alerting techniques, as identified in Section Alerting Techniques, shall be utilized to ensure that the Qualified Electrical Worker doesn't accidentally enter the look-alike electrical equipment that would still be in an energized state. It is recommended that appropriate permanent identification be added to the front and back of electrical distribution equipment to avoid human error in incorrectly identifying the wrong equipment that may still be energized.

## 14 Non-Zero Energy Methods

For all Non-Zero Energy Work, please see the applicable Facilities Management Safe Work Practices located in the Facilities Management Electrical Safety Program (currently under revision).



Energized electrical conductors and circuit parts that operate at less than or equal to 30 V shall not be required to be de-energized when the capacity of the source and any overcurrent protection between the energy source and the worker are considered and it is determined that there will be no increased exposure to electrical burns or to explosion due to electric arcs.

### **14.1 Energized Electrical Work**

Energized work may ONLY be performed when the employer can demonstrate that de-energizing introduces additional hazards or increased risk. Energized work may also be performed when the employer can demonstrate that the task to be performed is infeasible in a de-energized state because of equipment design or operational limitations. Examples of additional hazards or increased risk include interruption of life support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Examples of work that might be performed within the limited approach boundary of exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performance of diagnostics and testing (i.e., start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down to permit work on one circuit or piece of equipment. The Canadian Electrical Code, Part I, requires that “no repairs or alterations be carried out on any live equipment except where complete disconnection of the equipment is not practicable”.

## **15 Training**

All Memorial University workers (within Facilities Management & Technical Services) including contractors, who may be tasked with working on systems with hazardous energy must receive adequate training. The required training and frequency of delivery will be defined within the training matrix for each applicable job classification. Please see Appendix K, ZEIP Training Matrix for reference. Where necessary, the worker’s department will provide or arrange for training on site-specific requirements, standard operating procedures, safe work practices and emergency procedures.

New employees shall be provided with training on this program before they are permitted to complete any isolation. Contractors hired by the University who will be tasked with working on systems with hazardous energy will also be required to complete training on this program.

Additional training will be required at regular intervals to ensure workers remain competent to perform the work and requirements of the applicable programs and procedures.



Records of worker training must be maintained by the worker's department.

## 16 Program Review & Audit

The goal of the program review is to continuously improve the Zero Energy Isolation Program. Facilities Management Director of Operations and Maintenance, along with the Zero Energy Isolation Working Group, will review the Zero Energy Isolation Program annually and will conduct audits/assessments of the departmental compliance to the program yearly. Review and revisions may be done more frequently if deemed necessary by Facilities Management Director of Operations and Maintenance.

Environmental Health & Safety will audit the performance of the program and compliance within the various departments and contractors using and FM's Zero Energy Isolation Program. These audits must be performed on an annual basis.

Program review and audit will include a review of the written procedures, training records, incident investigations, controls of hazardous energy requirements and any other safe work practices.

## 17 References / Guidelines

- CSA-Z460 Lockout Tag-out
- CSA-Z462 Workplace Electrical Safety
- FM - Electrical Safety Program (Currently under revision)
- Memorial University of Newfoundland - EH&S
- Provincial OH&S



## Appendix A – Individual Worker Isolation Procedure

The following lockout sequence will be used to ensure the device, machinery or equipment is stopped, isolated from all energy sources, de-energized, locked out, and tested before workers perform any service or maintenance:

1. Job Safety Analysis (JSA): Worker to complete Job Safety Analysis, to document hazards related to the potential release of energy and the tasks to be completed during the lockout, including controls to mitigate risks to as low as reasonably practicable. If necessary, the worker will also complete Equipment Lock-out Form and store the original copy of the form with the Lockbox that is used.
2. Notification: Where practicable, notify the appropriate personnel when servicing or maintenance is required on the equipment. The notice will inform the appropriate personnel that the equipment must be shut down and locked out to perform servicing or maintenance (i.e.: staff/faculty that may be directly affected; office computers, lab equipment used for teaching; posting bathroom out of service signage etc.; or EBI-controlled building components such as air handler(s), generators or main electrical distribution centers etc).
3. Shut Down: All energy sources providing energy must be identified, isolated and secured to prevent energy from reaching the machinery or equipment at the most suitable energy isolation point. An energy isolating device will be attached to each energy source to prevent the transmission of energy to the device, machinery or equipment. In the case where more than one isolation point is required then complete Equipment Lockout Form (Appendix I)

Sheet while installing isolation devices. If the equipment is operating, shut it down by the normal stopping procedure (i.e.: depress the “Stop” button, open switch, or closed valve).

4. Lock Out: An energy isolating device will be secured in place using a worker’s assigned Personal Safety Lock. If two or more locks are required for one person to isolate a piece of equipment or process, a lockbox must be used and left at the location of the work and any isolation devices used will have equipment locks applied. Lockboxes must be secured with a lockbox lock. If a lockbox is used, an Equipment Lockout Form (Appendix I) must be completed and posted with the lockbox. Each person at risk shall install a danger tag applied to all Personal Safety Locks, white equipment tags will be applied to equipment locks. Tags must state the worker’s name, the date the tag was applied, shop/department, work order number and must indicate that the equipment to which it is attached may not be operated until the tag is removed.

If all the above information is not added to the tag the lock-out will be considered incomplete.



By the end of the worker's shift, if the job is not completed to maintain effective and orderly transfer of control, the Personal Safety Lock must be removed before the worker leaves site and he/she must install an Equipment Lock with a white tag containing all the information that was on the personal tag and an updated status of the work that is in progress. The key to the equipment lock left in service during the time the worker is not actively working on the job will be stored in the Key Storage Cabinet. Upon returning to work, the worker will remove the Equipment Lock and reinstall their Personal Safety Lock.

5. De-energize: Stored or residual energy (such as that in capacitors, springs, elevated machine components, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) must be dissipated or restrained by methods such as grounding, repositioning, blocking, or bleeding down.

6. Verification: Prior to starting work on a system that has been locked out; the employee must verify that the system is at a zero-energy state. This is to be achieved by purging, venting and draining all lines, performing voltage checks and a test starts to verify electrical isolation, releasing other forms of stored energy and otherwise verifying the isolation and de-energizing of all hazardous energy sources. The machinery or equipment is now at a zero energy state and is safe to work on.

#### Restoring Equipment to Service

7. Inspect Equipment: Check the equipment/device and the immediate area around the equipment to ensure that non-essential items have been removed and that the equipment components are operationally intact.

8. Verification: Check the work area to ensure that all worker(s) have been safely positioned or removed from the area.

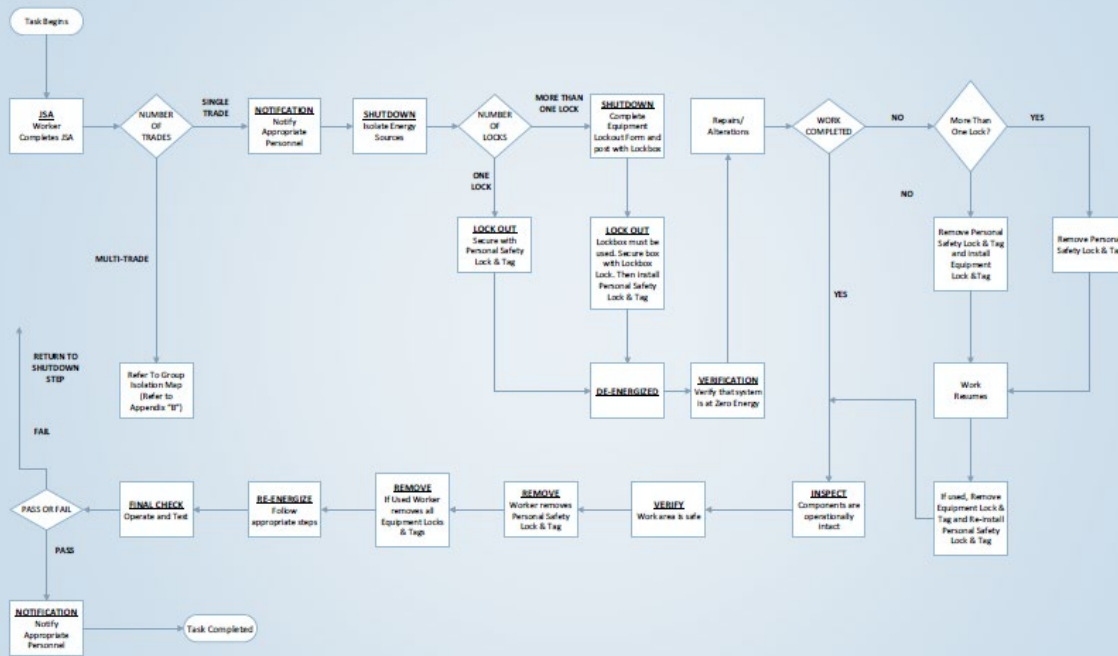
9. Remove: Remove all personal safety locks and tags and then the lockbox lock and tags placed on energy isolation device(s). Followed by Equipment Locks and tags if used for the isolation. Workers must ensure all temporary protective grounds are removed from service and grounds ID tag has also been removed from the energy isolation device.

10. Re-energize: Follow the appropriate steps for re-energizing the equipment. All steps should be documented on your JSA and or Equipment Lockout Form (Appendix I).

11. Final Check: Operate/test the device(s), machinery or equipment to confirm the repair or service has been successfully completed and the machinery or equipment is operating as intended.

12. Notification: Notify appropriate personnel that the servicing or maintenance is completed and the machine or equipment is ready for operation.

Appendix A – Individual Worker Isolation





## Appendix B - Group of Worker Isolation Procedure

The following lockout sequence will be used when two or more workers are involved to ensure that the devices, machinery or equipment is stopped, isolated from all energy sources, de-energized and locked out before workers perform any service or maintenance. Where the Group Primary has been identified as responsible to carry out an action, the Group Alternate will also be responsible to confirm the action has been completed. The Group Alternate must re-verify and test every step the Group Primary has performed.

1. Job Safety Analysis (JSA): As part of the JSA and prior to starting work, the Group Primary must investigate, identify and document the type and magnitude of energy supplied, understand the hazards of the energy, and know the procedures to control the energy, including controls to mitigate risks to as low as reasonably practicable. The Group Primary, Group Alternate and all workers at risk must review and sign the JSA prior to starting work.
2. Isolation Permit: An Isolation Permit (Appendix F) will have to be completed and once issued, workers will have to sign off on the accepted portion of the form. If necessary, the Group Primary and Group Alternate must complete an Equipment Lock-out Form.
3. Notification: The Group Primary notifies the appropriate personnel when service or maintenance is required. The notice will inform the appropriate personnel that the equipment must be shut down and locked out to perform servicing or maintenance (i.e.: staff/faculty that may be directly affected; office computers, lab equipment used for teaching; posting bathroom out of service signage etc.; or EBI-controlled building components such as air handler(s), generators or main electrical distribution centers etc).
4. Shut Down: The Group Primary ensures all energy sources are identified and isolated using energy isolation devices before the work begins at the most suitable energy isolation point. The energy isolation devices must prevent energy from reaching the device(s), machinery or equipment. In the case where more than one isolation point is required then complete Equipment Lockout Form (Appendix I) while installing isolation devices. If the equipment is operating, shut it down by the normal stopping procedure (i.e: depress the "Stop" button, open switch, or closed valve).
5. Lock Out: The Group Primary ensures all energy isolating device(s) are secured with designated locks. If only one isolation device is used, personal locks will be applied to multi-lock scissors hasp; but if two or more energy isolating devices are used, equipment locks will be applied and used with key securing systems (i.e.: Lockbox). Lockboxes must be secured with a lockbox lock. If a lockbox is used, an Equipment Lockout Form (Appendix I) must be completed and posted with the lockbox, prior to workers installing their personal safety locks. Tags will be applied to all locks. Equipment locks will have white



tags stating group primary, date the tag was applied, shop/department, work order number and must indicate the equipment to which it was attached may not be operated until the tag is removed.

Personal Safety Locks that will be placed on job Lockbox or Multi-lock Scissors Hasp must have a danger tag stating the worker's name, the date the tag was applied, work order number and must indicate the equipment to which it was attached may not be operated until the tag is removed. All workers with potential risk to be exposed to hazardous energy must install a Personal Safety lock.

By the end of the worker's shift, if the job is not completed then in order to maintain effective and orderly transfer of control, all Personal Safety Locks must be removed before the workers leave site and the Group Primary or Group Alternate must install one Equipment Lock (Group Primary shop) with a white tag containing all the information that was on the personal tag and an updated status of the work that is in progress. Upon returning to work, the worker will reinstall their personal safety lock.

6. De-energize: Stored or residual energy (such as that in capacitors, springs, elevated machine components, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) must be dissipated or restrained by methods such as grounding, repositioning, blocking, or bleeding down.

7. Verification: Prior to starting work on a system that has been locked out, the Group Primary will direct qualified personnel to verify that the system is at a zero-energy state. This is to be achieved by purging, venting and draining all lines, performing voltage checks and a test starts to verify electrical isolation, releasing other forms of stored energy and otherwise verifying the isolation and de-energizing of all hazardous energy sources. Group Primary shall verify that all energy sources have been brought to a zero-energy state. Group Alternate will recheck to verify completeness.

#### Restoring Equipment to Service

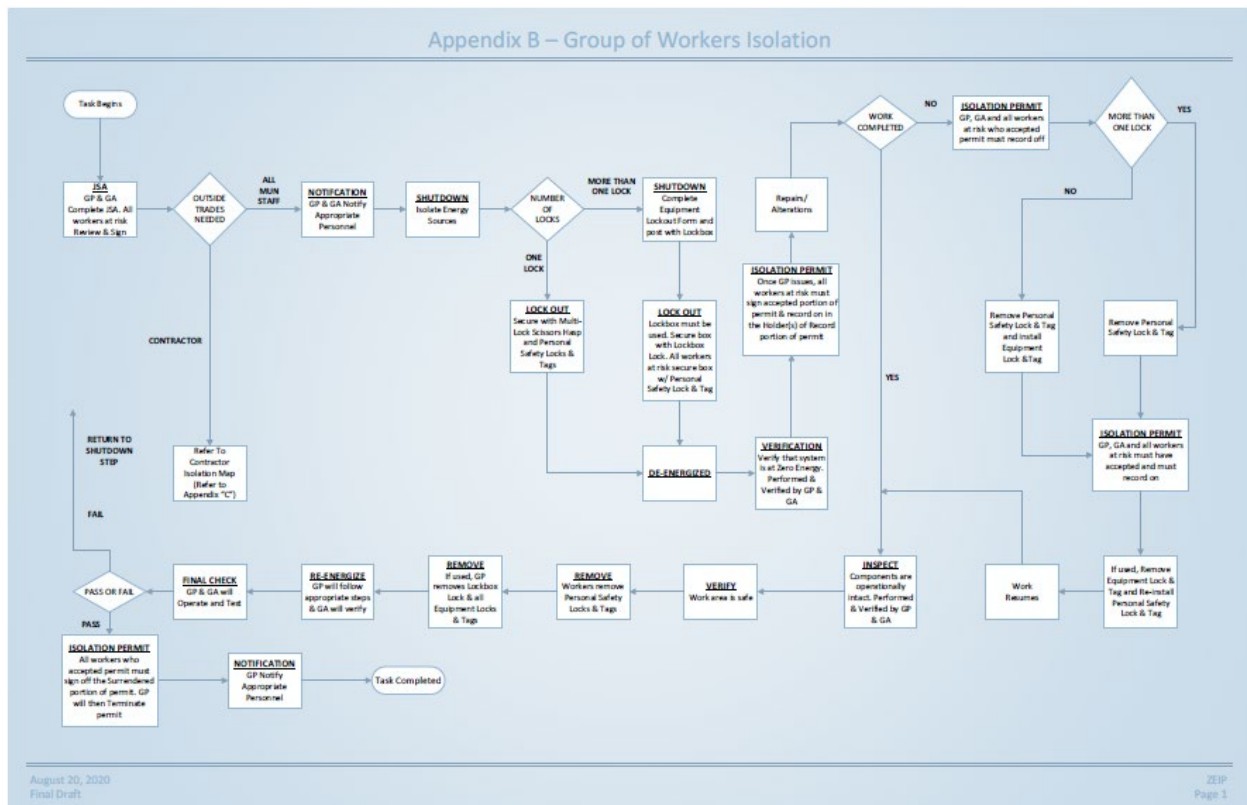
8. Inspect Equipment: The Group Primary checks the equipment and the immediate area around the equipment to ensure that non-essential items have been removed and that the equipment components are operationally intact. The Group Alternate will verify.

9. Verification: Check the work area to ensure that all worker(s) have been safely positioned or removed from the area. The Group Primary will ensure no other worker is endangered when the equipment is returned to service. The Group Alternate will verify.

10. Remove: The Group Primary ensures all workers are accounted for and have removed their personal safety locks from the group lockout device. The Group Primary's Personal Safety Lock is the last personal safety lock to be removed. Group Primary will remove all equipment locks and tags placed on the energy isolation device(s). Workers must ensure all temporary protective grounds are removed from service and grounds ID tag has also been removed from the energy isolation device.



11. Re-energize: Follow the appropriate steps for re-energizing the equipment. All steps should be documented on your JSA and or Equipment Lockout Form (Appendix I).
12. Final Check: The Group Primary will operate/test the device(s), machinery or equipment to confirm the repair or service has been successfully completed and the machinery or equipment is operating as intended.
13. Isolation Permit: Group Primary and Group Alternate and any other worker who accepted the Isolation Permit (Appendix F) must sign off on the surrendered portion of the document and the Isolation Permit must be filed away for auditing purposes.
14. Notification: The Group Primary notifies the appropriate personnel when service or maintenance has been completed and the equipment is returned to service.





## Appendix C - Contractor Isolation Procedure

The following lockout sequence will be used to ensure that the device(s), machinery or equipment is stopped, isolated from all energy sources, de-energized and locked out before contractor workers perform any service or maintenance.

Where the Group Primary has been identified as responsible to carry out an action, the Group Alternate will also be responsible to confirm the action has been completed. The Group Alternate must re-verify and test every step the Group Primary has performed. Contractor representative must be present during the isolation process and must perform their own test to confirm equipment is in a zero-energy state.

1. Job Safety Analysis (JSA): As part of the JSA and prior to starting work, the Group Primary must investigate and identify the type and magnitude of energy supplied, understand the hazards of the energy, and know the procedures to control the energy including controls to mitigate risks to as low as reasonably practicable. The Group Primary, Group Alternate, Contractor Representative and all workers at risk must review and sign the JSA prior to starting work. Contractor representative must complete their own JSA in accordance with the requirements of their company health and safety program.
2. Isolation Permit: An Isolation Permit (Appendix F) will have to be completed and once issued, workers will have to sign off on the accepted portion of the form. If necessary, the Group Primary and Group Alternate must complete an Equipment Lockout Form (Appendix I).
3. Notification: The Group Primary notifies the appropriate personnel when service or maintenance is required. The notice will inform the appropriate personnel that the equipment must be shut down and locked out to perform servicing or maintenance (i.e.: staff/faculty that may be directly affected; office computers, lab equipment used for teaching; posting bathroom out of service signage etc.; or EBI-controlled building components such as air handler(s), generators or main electrical distribution centers etc.).
4. Shut Down: The Group Primary ensures all energy sources are identified and isolated using energy isolation devices before the work begins at the most suitable energy isolation point. The energy isolation devices must prevent energy from reaching the device(s), machinery or equipment. In the case where



more than one isolation point is required then complete Equipment Lockout Form (Appendix I) while installing isolation devices. If the equipment is operating, shut it down by the normal stopping procedure (i.e.: depress the “Stop” button, open switch, or closed valve).

5. Lock Out: The Group Primary ensures all energy isolating device(s) are secured with designated locks. If only one isolation device is used, a black Memorial Control Lock will be applied to multi-lock scissored hasp; but if two or more energy isolating devices are used, equipment locks will be applied and used with key securing systems (i.e.: Lockbox). Lockboxes must be secured with a lockbox lock and a Memorial Control Lock. If a lockbox is used, an Equipment Lockout Form (Appendix I) must be completed and posted with the lockbox. Tags will be applied to all locks. Equipment locks will have white tags stating group primary, date the tag was applied, shop/department, work order number and must indicate the equipment to which it was attached may not be operated until the tag is removed

Memorial Control locks will have danger tags stating group primary, date the tag was applied, work order number and must indicate that the equipment to which it was attached may not be operated until the tag is removed. Worker(s) with the contractor company must install Personal Safety Locks that will be placed on project Lockbox(s) or Multi-lock Scissors Hasp. These locks must have a danger tag stating the worker’s name, name of Contractor Company, the date the tag was applied, work order number and must indicate that the equipment to which it was attached may not be operated until the tag is removed.

All workers with potential risk to be exposed to hazardous energy must install a Personal Safety lock.

The Group Primary must then store the Memorial Control Lock key applied to the isolation device (or key securing system) for the unfinished job in the Key Storage cabinet located in the corresponding shop. Key must be tagged with the location of lock.

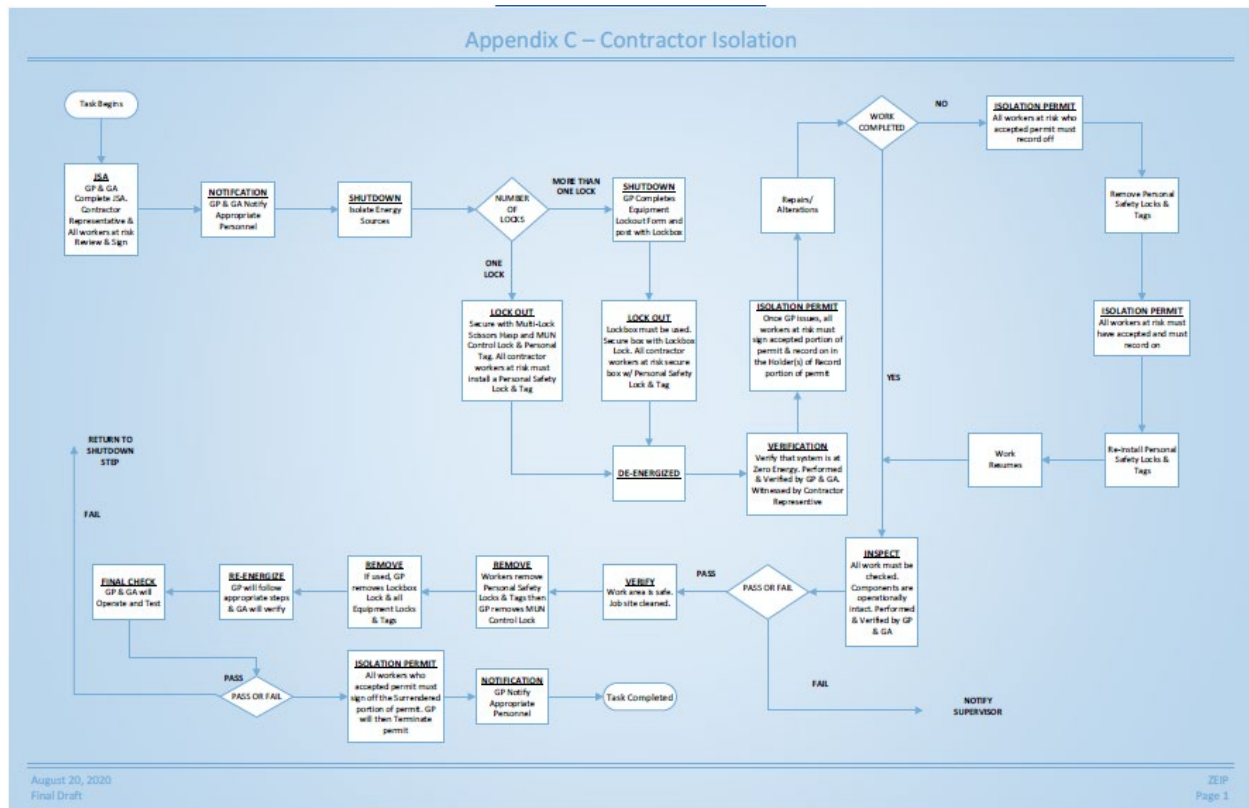
6. De-energize: Stored or residual energy (such as that in capacitors, springs, elevated machine components, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) must be dissipated or restrained by methods such as grounding, repositioning, blocking, or bleeding

7. Verification: Prior to starting work on a system that has been locked out, the Group Primary will direct qualified personnel to verify that the system is at a zero-energy state. This is to be achieved by purging, venting and draining all lines, performing voltage checks and a test starts to verify electrical isolation, releasing other forms of stored energy and otherwise verifying the isolation and de-energizing of all hazardous energy sources. Contractors must confirm with their own testing equipment or other industry-standard methods that initial equipment is in a zero energy state while Memorial representative (Group Primary or Alternate) is present.

Restoring Equipment to Service



8. Inspect Equipment: Once contacted by the contractor, the Group Primary checks the equipment and the immediate area around the equipment to ensure that non-essential items have been removed and that the equipment components are operationally intact. This action must also be verified by the Group Alternate and Contractor Representative.
9. Verification: The Group Primary will ensure no other worker is endangered when the equipment is returned to service. The Group Alternate will verify.
10. Remove: The Group Primary ensures all workers are accounted for and have removed their personal safety locks. Group Primary will remove all locks and tags placed on the energy isolation device(s). Workers must ensure all Temporary protective grounds are removed from service and grounds ID tag has also been removed from the energy isolation device.
11. Re-energize: Follow the appropriate steps for re-energizing the equipment. All steps should be documented on your JSA and or Equipment Lockout Form (Appendix I).
12. Final Check: The Group Primary, Group Alternate and the Contractor Representative will operate/test the device(s) machinery or equipment to confirm the repair or service has been successfully completed and the machinery or equipment is operating as intended.
13. Isolation Permit: Group Primary and Group Alternate and any other worker who accepted the Isolation Permit (Appendix F) must sign off on the surrendered portion of the document and the Isolation Permit must be filed away for auditing purposes.
14. Notification: The Group Primary notifies the appropriate personnel when service or maintenance has been completed and the equipment is returned to service.



## Appendix D - Memorial Staff HV Isolation Procedure

The following lockout sequence will be used to ensure that cables and equipment are isolated from all energy sources, de-energized (grounded if necessary) and locked out before any service or maintenance is performed. Where the Group Primary has been identified as responsible to carry out an action the Group Alternate will also be responsible to confirm the action has been completed. For every isolation Facilities Management, Electrical Shop Supervisor will be present, and at least two Electrical Journeymen from Facilities Management Electrical Shop will perform the isolation.



When there is isolation to be carried out on a system identified as being a part of a Loop Feeder System, the supervisor's JSA must take into account the additional potential of risk for personnel and include steps necessary to perform the isolation safely.

1. Job Safety Analysis (JSA): As part of the JSA and prior to starting work, the Electrical Shop Supervisor must investigate, identify and document the type and magnitude of energy supplied, understand the hazards of the energy, know the procedures to control the energy, including controls to mitigate risks to as low as reasonably practicable. The Electrical Shop's Supervisor must sign and review the JSA with all staff tasked with working on the isolation (Toolbox Talk) before any work is to begin. Safe working distances must be established
2. Isolation Permit: An Isolation Permit (Appendix F) will have to be completed and once issued, workers will have to sign off on the accepted portion of the form. The Supervisor of Electrical Systems must complete an Equipment Lockout Form (Appendix I) prior to starting work.
3. Notification: The Electrical Shop's Supervisor notifies the appropriate personnel when service or maintenance is required. The notice will inform the appropriate personnel that the equipment must be shut down and locked out to perform servicing or maintenance. Ensure Newfoundland Power is notified if main feeders are involved.
4. Shut Down: The Electrical Shop ensures all energy sources are identified and isolated using energy isolation devices before the work begins. The energy isolation devices must prevent energy from reaching the cables or equipment that could put any person at risk (employees, contractors, members of the public, etc.). When possible, breakers must be racked out and remain in that position until work is completed. For the purposes of preventing back-feeds, the load at the point of distribution shall be electrically isolated from the system. If the equipment is operating, shut it down by the normal stopping procedure (i.e.: open circuit breaker).
5. Lock Out: The Group Primary ensures all energy isolating device(s) are secured with equipment locks. If only one isolation devices are used, Personal Safety Locks will be applied to multi-lock scissors hasp; but if two or more energy isolating devices are used, Equipment Locks will be applied and used with key securing systems (i.e.: Lockbox). Lockboxes must be secured with a lockbox lock. Tags will be applied to all locks, Equipment locks will have white tags stating group primary, date the tag was applied, shop/department, work order number and must indicate the equipment to which it was attached may not be operated until the tag is removed. Equipment Lockout Form (Appendix I) must be completed and displayed with the Lockbox prior to workers installing their personal safety locks.

All workers with potential risk to be exposed to hazardous energy must place their Personal Safety Locks on the project Lockbox or Multi-lock Scissors Hasp must have a tag stating the worker's name, date the



tag was applied, work order number and must indicate the equipment to which it was attached may not be operated until the tag is removed.

If the job is not completed by the end of the worker's shift, all Personal Safety Locks must be removed before the worker leaves site and must install one Equipment Lock with a white tag containing all the information that was on the personal tag and an updated status of the work that is in progress. Upon returning to work, the worker will remove the Equipment Lock and reinstall their personal safety lock.

Should it be necessary to restore power during an ongoing project, the lockout in effect will be terminated; and then a new JSA will be completed, along with a Toolbox Talk defining a new scope of work, followed by a new lockout.

6. Verification: Prior to starting work on a system that has been locked out, the Group Primary and Group Alternate must verify that the system is at a zero-energy state. This must be witnessed by an Electrical Shop Supervisor. This is to be achieved by performing voltage checks; first with the non-contact high voltage meter, then with the contact meter. Be sure to check retest date on testing equipment to confirm it is still valid. Testing can be performed on exposed metal components of cables, bus work or using the capacitive test point on a load/dead break termination.

7. De-energize: Stored or residual energy must be dissipated by a method known as grounding. Temporary Protective Grounds must be installed on any system with a nominal voltage exceeding 600 Volts.

Once the energy isolation device is in the open position (if the ground position is available, continue to that state) and cables or bus have been tested and confirmed isolated, the workers will use the ground stick to bleed any stored energy to ground. Install ground clamp of the stick to building ground first, then touch stick off exposed metal components which are to be de-energized.

Once this is completed, the worker will then maintain contact with the ground stick while other worker installs Temporary Protective Grounds (ground cluster) moving the stick to each phase before the other worker makes contact. The first step for the installation of the Temporary Protective Grounds is to attach the main ground clamp to building ground, then add a clamp to each phase one at a time so that the completed product involves having a clamp on the building ground and each phase of the system to be worked on. Every effort must be made to ensure Temporary Protective Grounds are installed in such a way that they will not loosen at any point during the job and that the ground cluster doesn't impede any work which is to be carried out. It is also a best practice to install the ground cluster as close to the source of hazardous energy as possible. When a set of Temporary Protective Grounds are to be used there must be a Temporary Protective Ground ID tag attached to the energy isolation device.



Wherever the grounds are installed must have a magnetic or temporary signage posted on or near the equipment advising staff that temporary protective grounds are in service.

The equipment or cables are now locked out. Work may begin.

#### Restoring Equipment to Service

8. Inspect Equipment: The Group Primary checks the equipment and the immediate area around the equipment to ensure that non-essential items have been removed and that the equipment components are operationally intact. The Group Primary ensures all workers are accounted for and have removed their Personal Safety Locks from the key securing systems. Remove all locks and tags placed on the energy isolation device(s). This must be witnessed by an Electrical Shop Supervisor.

9. Verification: The Group Primary will ensure no other worker is in danger when the equipment is returned to service. A Supervisor of the Electrical Shop must present for the verification.

10. Remove: The Group Primary ensures all workers are accounted for and have removed their personal safety locks. Group Primary will remove all locks and tags placed on the energy isolation device(s). Workers must ensure all Temporary protective grounds are removed from service and grounds ID tag has also been removed from the energy isolation device. A Supervisor of the Electrical Shop must be present and verify.

11. Re-energize: Follow the appropriate steps for re-energizing the equipment. All steps should be documented on your JSA and or Equipment Lockout Form (Appendix I).

12. Isolation Permit: Group Primary and Group Alternate and any other worker who accepted the Isolation Permit (Appendix F) must sign off on the surrendered portion of the document and the Isolation Permit must be filed away for auditing purposes.

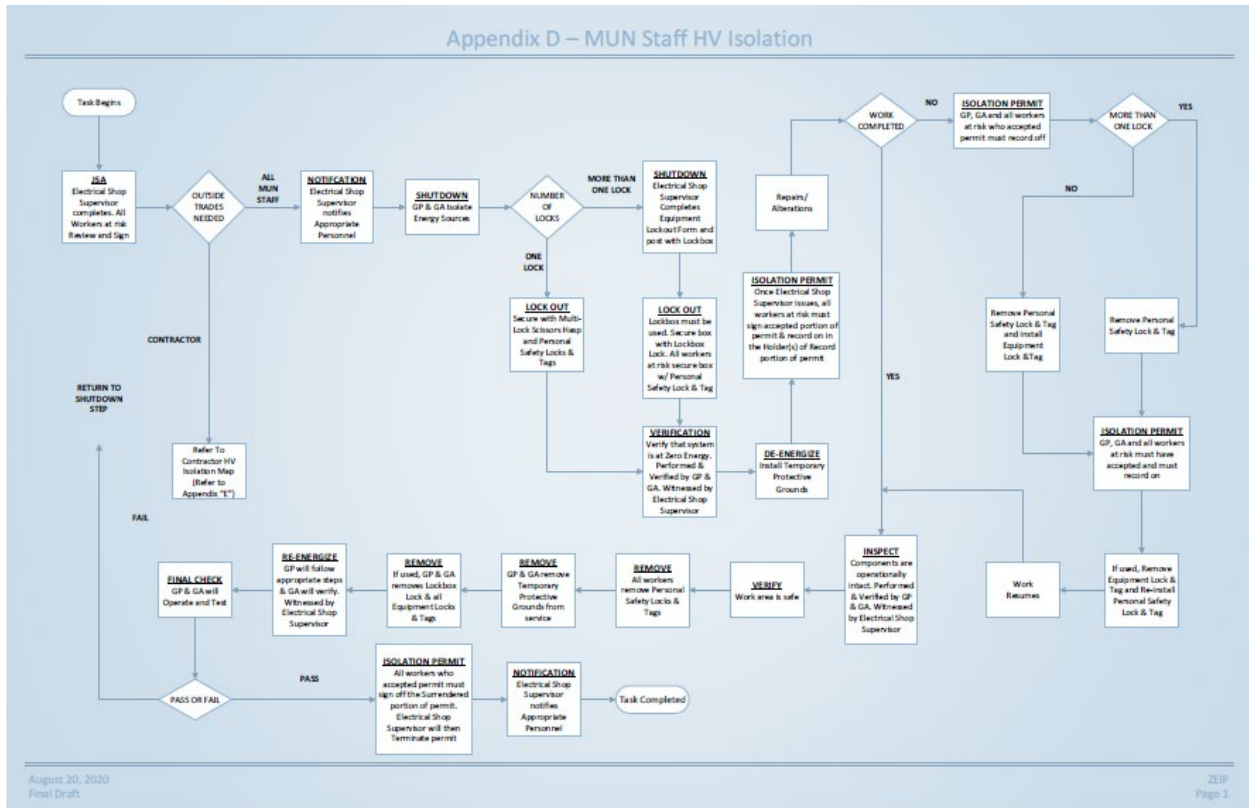
13. Final Check: The Group Primary will confirm the isolation device is back to a closed position and must ensure phase rotation is correct if there was cable or equipment replacement.

14. Notification: The Electrical Shop's Supervisor notifies the appropriate personnel when service or maintenance has been completed and the equipment is returned to service. Ensure

Newfoundland Power is notified if main feeders are involved.



Appendix D – MUN Staff HV Isolation



## Appendix E - Contractor HV Isolation Procedure

The following lockout sequence will be used to ensure that cables and equipment are isolated from all energy sources, de-energized (grounded if necessary) and locked out before any service or maintenance is performed. For every isolation Facilities Management, Electrical Shop supervisor will be present, and at least two Electrical Journeypersons from Facilities Management Electrical Shop will perform the isolation. Where the Group Primary has been identified as responsible to carry out an action the Group Alternate will also be responsible to confirm the action has been completed. The Group Alternate must re-verify and test every step the Group Primary has performed. Contractor representative must be present during the isolation process. Contractor representative must witness system is in a zero energy state and sign off on the Supervisor's copy of the JSA. When there is isolation to be carried out on a system identified as being a part of a Loop Feeder System, the supervisor's JSA must take into account the additional potential of risk for personnel and cover steps necessary to perform the isolation.

1. Job Safety Analysis (JSA): As part of the JSA and prior to starting work, the Electrical Shop's Supervisor must investigate, identify and document the type and magnitude of energy supplied, understand the hazards of the energy, know the procedures to control the energy, including controls to mitigate risks to as low as reasonably practicable. The Electrical Shop's Supervisor must sign and review the JSA with all staff tasked with working on the isolation (Toolbox Talk) before any work is to begin. All employee's with the contractor company tasked with duties that may put them at risk must attend Toolbox Talk and sign the attendance sheet.
2. Isolation Permit: An Isolation Permit (Appendix F) will have to be completed and once issued, workers will have to sign off on the accepted portion of the form. The Supervisor of Electrical Systems must complete an Equipment Lockout Form (Appendix I) prior to starting work.
3. Notification: The Electrical Shop's Supervisor notifies the appropriate personnel when service or maintenance is required. The notice will inform the appropriate personnel that the equipment must be shut down and locked out to perform servicing or maintenance.
4. Shut Down: The Electrical Shop ensures all energy sources are identified and isolated using energy isolation devices before the work begins. The energy isolation devices must prevent energy from reaching the cables or equipment that could put any person at risk (employees, contractors, members of the public etc.) When possible, breakers must be racked out and remain in that position until work is complete. For the purposes of preventing back-feeds, the load at the point of distribution shall be electrically isolated from the system. If the equipment is operating, shut it down by the normal stopping procedure (i.e.: open circuit breaker).



5. Lock Out: The Electrical Shop ensures all energy isolating device(s) are secured with equipment locks. If only one isolation devices are used a Memorial Control Lock will be applied to multi-lock hasp but if two or more energy isolating devices are used, Equipment Locks and Memorial Control Lock will be applied and used with key securing systems (IE: Lockbox). Lockboxes must be secured with a lockbox lock. Tags will be applied to all locks, Equipment locks will have white tags stating group primary, date the tag was applied, shop/ department, work order number and must indicate the equipment to which it was attached may not be operated until the tag is removed. Equipment Lockout Form (Appendix I) must be completed and displayed with the Lockbox prior to workers installing their personal safety locks.

Memorial Control Lock) that will be placed on project Lockbox(s) or, Multi-lock Scissors Hasp must have a danger tag stating the Group Primary's name, the date the tag was applied, work order number and must indicate the equipment to which it was attached may not be operated until the tag is removed.

All workers with potential risk to be exposed to hazardous energy must install a Personal Safety Lock on either the multi-lock scissors hasp or key securing system IE: Lockbox. If the job is not completed by the end of the workers shift all Personal Safety Locks must be removed before the worker leaves the site. The Memorial Control Lock will remain installed on the isolation device or lockbox until the project is completed.

The Group Primary must then store the Memorial Control Lock key applied to the isolation device (or key securing system) for the unfinished job in the Key Storage Cabinet located in the Electrical Shop. Key must be tagged with the location of lock. If a Lockbox is used for securing isolation, the box along with a copy of the JSA will be stored safely in the area of primary isolation. Equipment Lockout Form (Appendix I) must be completed and displayed with the Lockbox.

Should it be necessary to restore power during an ongoing project, the lockout in effect will be terminated; and then a new JSA will be completed, along with a Toolbox Talk defining the new scope of work, followed by a new lockout.

6. Verification: Prior to starting work on a system that has been locked out; the Group Primary and Group Alternate must verify that the system is at a zero-energy state. This must be witnessed by an Electrical Shop supervisor. This is to be achieved by performing voltage checks, first with the non-contact high voltage meter than with the contact meter. Be sure to check re-test date on testing equipment to make sure it is still valid. Testing can be performed on exposed metal components of cables, bus work or using the capacitive test point on a load/dead break termination.

7. De-energize: Stored or residual energy must be dissipated by a method known as grounding. Personal Safety Grounds must be installed on any system with a nominal voltage exceeding 600 Volts.



Once the energy isolation device is in the open position (if the ground position is available to continue to that state) and cables or bus have been tested and confirmed isolated, the Group Primary or Group Alternate will use a ground stick to bleed any stored energy to ground. Install ground clamp of stick to building ground first then touch stick off exposed metal components which are to be de-energized.

Once this is completed either the Group Primary or Group Alternate will then maintain contact with the ground stick while the other installs Temporary Protective Grounds (ground cluster) moving the stick to each phase before the other worker makes contact. The first step for the installation of the Temporary Protective Grounds is the attach main ground clamp to building ground then add a clamp to each phase one at a time so that the completed product involves having a clamp on the building ground and each phase of the system to be worked on. Every effort must be made to ensure Temporary Protective Grounds are installed in such a way that they will not loosen at any point during the job and that the ground cluster doesn't impede any work which is to be carried out. It is also best practice to install the ground cluster as close to the source of hazardous energy as possible. When a set of Temporary Protective Grounds are to be used there must be a Temporary Protective Ground ID tag attached to the energy isolation device.

Wherever the grounds are installed must have a magnetic or temporary signage posted on or near the equipment advising staff that temporary protective grounds are in service.

The equipment or cables are now locked out. Contractor work may now begin work.

#### Restoring Equipment to Service

8. Inspect Equipment: Once contacted by the contractor the Group Primary checks the equipment and the immediate area around the equipment to ensure that non-essential items have been removed and that the equipment components are operationally intact. The Group Primary ensures all workers are accounted for and have removed their Personal Safety Locks. This action must also be verified by Contractor representative and Electrical Shop Supervisor they must be present during the restoring of the equipment. Remove all locks and tags placed on energy isolation device(s) and or key securing system.

9. Verification: The Group Primary will ensure no other worker is endangered when the equipment is returned to service. The Group Primary must ensure all Temporary Protective Grounds are removed and follow appropriate steps to re-energizing the equipment. This must be verified by an Electrical Shop Supervisor.

10. Remove: The Group Primary ensures all workers are accounted for and have removed their personal safety locks. Group Primary will remove all locks and tags placed on the energy isolation device(s).



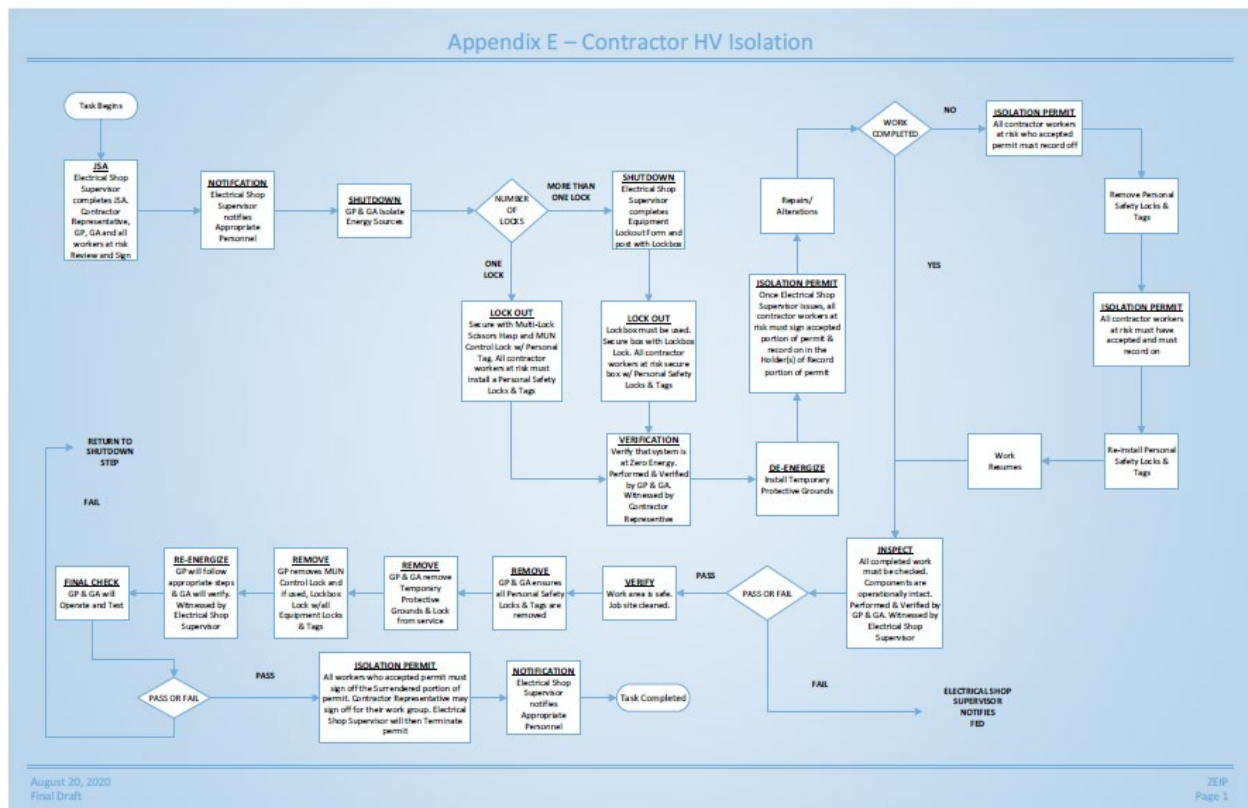
Workers must ensure all Temporary protective grounds are removed from service and grounds ID tag has also been removed from the energy isolation device.

11. Re-energize: Follow the appropriate steps for re-energizing the equipment. All steps should be documented on your JSA and or Equipment Lockout Form (Appendix I).

12. Isolation Permit: Group Primary and Group Alternate and any other worker who accepted the Isolation Permit (Appendix F) must sign off on the surrendered portion of the document and the Isolation Permit must be filed away for auditing purposes.

13. Final Check: The Group Primary will confirm the isolation device is back to a closed position and must ensure phase rotation is correct if there was cable or equipment replacement.

14. Notification: The Group Primary's Supervisor notifies the appropriate personnel when service or maintenance has been completed and the equipment is returned to service.



## Appendix F – Isolation Permit

### Memorial University ISOLATION PERMIT

Issued Date: _____	Issued By: _____
Terminated Date: _____	Terminated By: _____
WO #: _____	Group Primary: _____
Lockbox #: _____	Group Alternate: _____
Equipment ID: _____	Contractor Representative: _____

DESCRIPTION OF WORK:

NOTES:




## Memorial University ISOLATION PERMIT

<b>ACCEPTED BY:</b>			
<b>WORKER NAME (PRINT &amp; INITIAL)</b>		<b>WORK GROUP</b>	<b>DATE</b>
<b>HOLDER(S) OF RECORD</b>			
<b>RECORD ON NAME-DATE</b>	<b>RECORD OFF NAME-DATE</b>	<b>RECORD ON NAME-DATE</b>	<b>RECORD OFF NAME-DATE</b>
<b>SURRENDERED BY:</b>			
<b>WORKER NAME (PRINT &amp; INITIAL)</b>		<b>WORK GROUP</b>	<b>DATE</b>

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## Appendix G – Emergency Lock Removal Form

 APPENDIX G  
**EMERGENCY LOCK REMOVAL FORM**

Date: \_\_\_\_\_

Lock to be removed:

Employee's Name on Lock & Tag:	
Employee's Department:	
Work Order No. on Tag:	

Employee's Department Supervisor must verify the Employee's Name on the Lock & Tag.

Reason for Removing the Lock-out Device:

Mandatory- actions to be taken:	YES	NO
Mandatory- Employee called at home but could not be contacted		
Employee was contacted but unable to return to work		
Mandatory- Supervisor has conducted a thorough worksite inspection to verify that the equipment locked out is clear of all personnel		

\_\_\_\_\_

**Departmental Supervisor                      Departmental Director                      Employee**

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## Appendix H – Authorized Isolation Authorities

### APPENDIX H ISOLATION AUTHORITIES

Occupation/ Trade	Mechanical Isolation (Under Ground Water Mains)	Mechanical Isolation (High Pressure Steam Lines)	Mechanical Isolation (Chemical/Hydronic Heating & Domestic Water Lines)	Mechanical Isolation (Gas Lines)	Mechanical Isolation (Fuel Lines)	Electrical Isolation	Tag Out of Service
<b>FACILITIES MANAGEMENT</b>							
Manager, Energy Systems & Controls							✓
Carpentry Shop Supervisor						Up to 600V***	✓
Carpentry Lead Hand						Up to 600V***	✓
Carpenters						Up to 600V***	✓
Building Technician						Up to 120V*	✓
Carpenter Apprentice							✓
Locksmith Lead Hand						Up to 120V	✓
Locksmith						Up to 120V	✓
Mechanical & Plumbing	✓		✓	✓	✓	Up to 600V	✓

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Systems Supervisor							
Mechanical Systems Lead Hand			✓	✓	✓	Up to 600V	✓
Maintenance Repairperson			✓	✓	✓	Up to 600V	✓
Millwright Apprentice							✓
Plumbing Lead Hand	✓		✓			Up to 600V	✓
Maintenance Plumber	✓		✓			Up to 600V	✓
Plumbing Apprentice							✓
Manager, Electrical Systems							✓
Electrical Shop Supervisor						Up to 12.5kV	✓
Electrical Lead Hand						Up to 12.5kV	✓
Power & Controls Electrical Technologist						Up to 12.5kV	✓
Industrial Electrician						Up to 12.5kV	✓
Electrical Apprentice							✓
Manager, Central Utilities							✓

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Supervisor, Plant Maintenance		✓	✓	✓	✓	Up to 4160V	✓
Supervisor, External Plants		✓	✓	✓	✓	Up to 4160V	✓
Power Engineer 2nd Class		✓	✓	✓	✓	Up to 4160V	✓
Power Engineer 3rd Class		✓	✓	✓	✓	Up to 4160V	✓
Mechanical Patrolperson		✓	✓	✓	✓	Up to 600V	✓
Manager, Environmental Services							✓
Supervisor, Custodian							✓
Custodian							✓
Equipment Operators	✓						✓
Foreperson	✓						✓
Horticulturalist	✓						✓
Landscape Technician	✓					Up to 120V**	✓
TMA Coordinator							✓
Planner Estimator							✓
FED							✓
Plant Stores Clerk							✓
Sign Technician							✓
Storekeeper							✓

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TECHNICAL SERVICES							
Electronics			Only Domestic Water Lines	✓		Up to 600V	✓
Mechanical		✓	Only Domestic Water Lines	✓		Up to 600V	✓
Refrigeration			Only Domestic Water Lines	✓		Up to 600V	✓

- \*For the purpose of re-lamping fixtures only.
- \*\* For the purpose of watering Arts atrium plants only.
- \*\*\* For the purpose of maintaining Shop tools only. 120V Campus wide.



## Appendix I – Equipment Lock-out Form





## Appendix J – Training Matrix

## ZERO ENERGY ISOLATION PROGRAM

### TRAINING MATRIX

APPENDIX J

Zero Energy Isolation Program Training Matrix

EMPLOYEE BY CATEGORY	EST. TIME	MODULE 1	MODULE 2	MODULE 3	MODULE 4	TOS
<b>FACILITIES MANAGEMENT</b>						
Manager, Energy Systems & Controls		X	X			
Supervisor, Carpentry Shop		X	X			
Carpentry Lead Hand		X	X			
Carpenters		X	X			
Building Technician		X	X			
Carpenter Apprentice		X	X			
Locksmith Lead Hand		X	X			
Locksmith		X	X			
Supervisor, Mechanical & Plumbing Systems		X	X			
Mechanical Systems Lead Hand		X	X			
Maintenance Repairperson		X	X			
Millwright Apprentice		X	X			
Plumbing Lead Hand		X	X			
Maintenance Plumber		X	X			
Plumbing Apprentice		X	X			
Manager, Electrical Systems		X	X	X		
Supervisor, Electrical Shop		X	X	X		
Electrical Lead Hand		X	X	X		
Power & Controls Electrical Technologist		X	X	X		
Industrial Electrician		X	X	X		
Electrical Apprentice		X	X	X		
Manager, Central Utilities		X	X	X		
Supervisor, Plant Maintenance		X	X	X		
Supervisor, External Plants		X	X	X		
Power Engineer 2nd Class		X	X	X		
Power Engineer 3rd Class		X	X	X		
Mechanical Patrolperson		X	X			
Manger, Environmental Services		X	X			
Supervisor, Custodian						X
Custodian						X
Equipment Operator		X	X			
Foreperson		X	X			
Horticulturalist		X	X			
Landscape Technician		X	X			
TMA Coordinator		X				
Planner Estimator		X				
FED		X				
Plant Stores Clerk		X				
Sign Technician		X				
Storekeeper		X				

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## ZERO ENERGY ISOLATION PROGRAM TRAINING MATRIX

Contractor Electrical Worker						X	
Contractor Mechanical Workers						X	
<b>TECHNICAL SERVICES</b>							
Electronic Shops		X	X				
Mechanic Shops		X	X				
Refrigeration Shops		X	X				
<b>ENVIROMENTAL HEALTH &amp; SAFETY</b>							
EHS (AS REQUIRED)		X	X	X	X	X	X

<b>MODULE 1</b>	<ul style="list-style-type: none"> <li>• Purpose</li> <li>• Scope</li> <li>• References/ Guidelines</li> <li>• Responsibilities</li> <li>• Education &amp; Training</li> <li>• Locking &amp; Tagging Supplies</li> <li>• Isolation Authorities- Appendix H</li> <li>• Safe Work Practice- Tagging Equipment "Out of Service"</li> </ul>
<b>MODULE 2</b>	<ul style="list-style-type: none"> <li>• Safe Work Practice- Render Inoperative &amp; Mechanical Patrol Person</li> <li>• Definitions- Con't in Program</li> <li>• Safe Work Procedures- Appendix A, B, C</li> <li>• Emergency Lock Removal- Appendix G</li> <li>• Isolation Permit- Appendix F</li> <li>• Equipment Lock-out Form- Appendix I</li> </ul>
<b>MODULE 3</b>	<ul style="list-style-type: none"> <li>• Safe Work Procedures- Appendix D &amp; E</li> <li>• Non-Zero Energy Methods</li> <li>• Energized Electrical Work Permit</li> </ul>
<b>MODULE 4</b>	<ul style="list-style-type: none"> <li>• Purpose</li> <li>• Scope</li> <li>• References/ Guidelines</li> <li>• Responsibilities</li> <li>• Education &amp; Training</li> <li>• Locking &amp; Tagging Supplies</li> <li>• Isolation Authorities- Appendix H</li> <li>• Definitions- Con't in Program</li> <li>• Safe Work Procedure- Appendix C &amp; E if required</li> </ul>

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