

## STANDARD PROCEDURE INSTRUCTION

Title		SPI
Energized Electrical Work		32-4
Department	Supersedes SPI Dated	Effective Date
Manitoba Operations	N/A	MAR 30, 2012

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### Energized Electrical Work

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# STANDARD PROCEDURE INSTRUCTION

## 1. PURPOSE:

To establish standard practices and procedures for defining what is energized electrical work and guidelines around performing energized electrical work for electrical personnel working within operating plants and mines.

## 2. Scope

### 2.1 Subjects and workplaces included

This policy applies to all people working for Vale's Manitoba Operations, including contractors. This policy applies at all Vale Manitoba Operation properties and where work is being conducted under the authority of Vale's Manitoba Operations, Including work done for Vale Technology Development (Canada) Limited in Manitoba.

### 2.2 Workplaces excluded

This standard does not cover the following:

- (a) Working on electric arc furnaces
- (b) Working on plating cells and associated equipment
- (c) 3600 level Trolley line

## 3. Administration

Revisions to this SPI shall be reviewed by the Vale Manitoba Electrical Standard Practices Committee and approved by Manitoba Operations General Manager prior to implementation.

## 4. Definitions

- **Area Electrical Supervisor** – Is the licensed journeyman electrician accountable for the electrical system to be worked on and is familiar with the hazards associated with the system.
- **Arc flash hazard** – a dangerous condition associated with the possible release of energy caused by an electric arc.

**Note:** An arc flash hazard can exist when energized electrical conductors or circuit parts are exposed or are within equipment in a guarded or enclosed condition, if a person is interacting with the equipment in a manner that could cause an electric arc. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard.

- **Arc flash hazard analysis** – a study investigating a workers potential exposure to arc flash energy, conducted for the purpose of injury prevention and the

determination of safe work practices, arc flash protection boundary, and the appropriate levels of personal protective equipment.

- **Authorized Electrical Engineer** – a professional electrical senior engineer (More than 10 years experience) licensed to work in the Province of Manitoba.
- **Bare-hand work** – a technique of performing work on energized electrical conductors or circuit parts, after the worker has been raised to the potential of the conductor or circuit part.
- **Boundary, arc flash protection** – when an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electric arc flash were to occur.
- **Boundary, limited approach** – an approach boundary limit at a distance from an exposed energized conductor or circuit part within which a shock hazard exists.
- **Boundary, prohibited approach** – an approach limit at a distance from an exposed energized electrical conductor or circuit part within in which work is considered the same as making contact with the electrical conductor or circuit part.
- **Boundary, restricted approach** – an approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part.
- **Conductor** – a wire, cable, or other form of metal installed for the purpose of conveying electric current from one piece of electrical equipment to another or to ground.
- **Conductor, bare** – a conductor having no covering or electrical insulation.
- **Conductor, insulated** – a conductor encased within material of a composition and thickness that is recognized as electrical insulation.
- **De-energized** – free from an electrical connection to a source of potential difference and from electrical charge, i.e., not having a potential difference from that of earth.
- **Electrical equipment** – any apparatus, appliance, device, instrument, fitting, fixture, machinery, material. Or thing used in or for, or capable of being used in or for, the generation, transformation, transmission, distribution, supply, or utilization of electric power or energy, including, e.g., any assemblage or combination of materials or things that is used, or is capable of being used or adapted, to serve or perform any particular purpose or function when connected to an electrical installation, even if part or all of such materials or things are mechanical, metallic, or non-electric in origin.
- **Electrical hazard** – a dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

- **Electrically safe work condition** – a state in which an electrical conductor or circuit part has been disconnected from energized parts, locked out in accordance with established standards, tested to ensure the absence of voltage, and grounded (if grounding is determined to be necessary).
- **Electrical safety** – recognizing hazards associated with the use of electrical energy and taking precautions so that such hazards do not cause injury or death.
- **Energized** – electrically connected to or having a source of voltage.
- **Energized parts** – electrically energized conductive components.
- **Equipment** – material, fittings, devices, appliances, luminaires, apparatus, etc. used as part of, or in connection with, an electrical installation.
- **Exposed** (as applied to energized electrical conductors or circuit parts) – capable of being inadvertently touched or approached nearer than a safe distance by a person. This term is applied to electrical conductors or circuit parts that are not suitably guarded, isolated, or insulated.
- **Exposed** (as applied to wiring methods) – not concealed.
- **Ground** – a connection to earth obtained by a grounding electrode.
- **Guarded** – covered, shielded, fenced, enclosed, or otherwise protected by suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger.
- **Insulated** – separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.
- **Insulating** (as applied to non-conducting substances) – capable of bringing about the condition defined as insulated.
- **Overcurrent** – a current in excess of the rated current of equipment or the ampacity of a conductor. It can result from an overload, short circuit, or ground fault.
- **Qualified person (worker)** – one who has skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.
- **Safeguarding** – the consistent administrative enforcement of safe work practices.
- **Shock hazard** – a dangerous condition associated with the possible release of energy caused by contact with or approach to energized electrical conductors or circuit parts.

## 5. Justification for work

### a. Electrically safe work condition

Energized electrical conductors and circuit parts to which a worker might be exposed shall be put into an electrically safe work condition before a worker works within the limited approach boundary of those conductors or parts.

### b. Greater hazard

Energized work may be performed when the Area Electrical Supervisor or Authorized Electrical Engineer can demonstrate that de-energizing introduces additional or increased hazards.

### c. Infeasibility

Energized work may be performed when the Area Electrical Supervisor or Authorized Electrical Engineer can demonstrate that the task to be performed is infeasible in a de-energized state because of equipment design or operational limitations.

### d. Operation 240 volts or less

Energized electrical conductors and circuit parts that operate at 240 volts or less 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 any increased exposure to electric shock, electrical burns or to explosion due to electric arcs will be managed.

## 6. Energized electrical work permit

### 6.1 General

For work on energized electrical conductors or circuit parts that are not placed in an electrically safe work condition as permitted by clause 5, shall be considered energized electrical work and shall be performed only after a written permit specific to the work has been obtained by the worker(s).

### 6.2 Elements of work permit

The Energized Electrical Work Permit shall include, but not be limited to, the following:

- (a) a description of the circuit and equipment to be worked on and their location;
- (b) a justification for why the work needs to be performed in an energized condition;
- (c) a description of the safe work practices to be employed;
- (d) the results of a shock hazard analysis;
- (e) The limited approach boundary;
- (f) The restricted approach boundary;
- (g) The prohibited approach boundary;
- (h) The necessary arc flash/shock protection PPE and other protective equipment to safely perform the assigned task;

- (i) the results of the arc flash hazard analysis and the date it was completed;
- (j) The available incident energy or Hazard/Risk Category (HRC);
- (k) The arc flash protection boundary;
- (l) The specifications for the overcurrent protection in place for the circuit to be worked on and their location;
- (m) Current drawings that have been field verified to be correct (sketches may be acceptable);
- (n) a description of the means employed to restrict the access of unqualified persons to the work area;
- (o) evidence of completion of a job safety analysis (JSA), including a discussion of any job specific hazards;
- (p) evidence of completion of an electrical rescue plan, including a discussion of any job specific requirements;
- (q) the Qualified persons performing the work will sign the permit stating that they agree that the work can be done safely; and
- (r) Energized work approval signatures by the area Manager or Acting Manager and either the Area Electrical Supervisor or Authorized Electrical Engineer.

### **6.3 Exemptions to work permit**

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 personal protective equipment in accordance with CSA-Z462 are used.

### **6.4 Completion of work**

Upon completion of the energized electrical work, the completed permit will be sent to the site Electrical Safety Specialist for audit and retention.

## **7. Approach boundaries to energized electrical conductors and circuit parts**

### **7.1 Shock hazard analysis**

A shock hazard analysis shall determine

- (a) The voltage to which personnel will be exposed;
- (b) Boundary and requirements; and
- (c) The personal protective equipment necessary to minimize the possibility of electric shock to personnel.

### **7.2 Shock protection boundary**

The shock protection boundaries identified as limited, restricted, and prohibited approach boundaries are applicable to the situation in which approaching personnel

are exposed to energized electrical conductors or circuit parts. See Appendix 1 for the distances associated with various system voltages.

### **7.3 Approach to exposed energized electrical conductors or circuit parts operating at greater than 240 volts**

For the restricted approach boundary specified in appendix 1 qualified persons shall not approach or bring conductive objects closer to exposed energized electrical conductors or circuit parts operating at greater than 240 volts unless at least one of the following applies:

- (a) The qualified person is insulated or guarded from energized electrical conductors or circuit parts operating at greater than 240 volts and no uninsulated part of the qualified person's body crosses the prohibited approach boundary specified in appendix 1. Insulating gloves or insulating gloves and sleeves shall be considered insulation only with regard to the energized parts on which work is being performed.
- (b) The energized electrical conductors or circuit parts operating at greater than 240 volts are insulated from the qualified person and from any other conductive object at a different potential.
- (c) The qualified person is insulated from any other conductive object in the same manner as during live-line bare-hand work.

If there is a need for an uninsulated part of the qualified person's body to cross the restricted approach boundary, a combination of the precautions specified in items (a) to (c) shall be used to protect the uninsulated body parts.

## **8. Approach by unqualified persons**

### **8.1 General**

Unqualified persons shall not enter spaces in which energized electrical conductors or circuit parts operating at 30 volts or more are not suitably guarded, unless the electrical conductors and equipment are in an electrically safe work condition.

### **8.2 Working at or close to the limited approach boundary**

When one or more unqualified persons are working at or close to the limited approach boundary, the designated person in charge of the workspace where the electrical hazard exists shall advise the unqualified person(s) of the electrical hazard and warn them to stay outside the limited approach boundary.

### **8.3 Entering the limited approach boundary**

When there is a need for an unqualified person to cross the limited approach boundary, a qualified person shall advise him or her of the possible hazards and continuously escort the unqualified person while he or she is inside the limited approach boundary. The unqualified person shall not be allowed to cross the restricted approach boundary.

**Appendix 1****CSA-Z462 Table 1****Approach boundaries to energized electrical conductors or circuit parts for shock protection**

<b>Nominal system voltage range, phase to phase</b>	<b>Limited approach boundary, exposed movable conductors</b>	<b>Limited approach boundary, exposed fixed circuit parts</b>	<b>Restricted approach boundary</b>	<b>Prohibited approach boundary</b>
Less than 50 V	Not specified	Not specified	Not specified	Not specified
50-300 V	3.05m ( 10'0" )	1.07m ( 3' 6" )	Avoid contact	Avoid contact
301-750 V	3.05m ( 10'0" )	1.07m ( 3' 6" )	304.8mm ( 1' 0" )	25.4mm ( 0' 1" )
751 V – 15 kV	3.05m ( 10'0" )	1.53m ( 5' 0" )	660.4mm ( 2' 2" )	177.8mm ( 0' 7" )
15.1 – 36 kV	3.05m ( 10'0" )	1.83m ( 6' 0" )	787.4mm ( 2' 7" )	254mm ( 0' 10" )
36.1 – 46 kV	3.05m ( 10'0" )	2.44m ( 8' 0" )	838.2mm ( 2' 9" )	431.8mm ( 1' 5" )
46.1 – 72.5 kV	3.05m ( 10'0" )	2.44m ( 8' 0" )	991mm ( 3' 3" )	660mm ( 2' 2" )
72.6 – 121 kV	3.25m ( 10' 8" )	2.44m ( 8' 0" )	1.02m ( 3' 4" )	838mm ( 2' 9" )
138 – 145 kV	3.36m ( 11' 0" )	3.05m ( 10'0" )	1.17m ( 3' 10" )	1.02m ( 3' 4" )
161 – 169 kV	3.56m ( 11' 8" )	3.56m ( 11' 8" )	1.29m ( 4' 3" )	1.14m ( 3' 9" )
230 – 242 kV	3.97m ( 13' 0" )	3.97m ( 13' 0" )	1.73m ( 5' 8" )	1.57m ( 5' 2" )
345 – 362 kV	4.68m ( 15' 4" )	4.68m ( 15' 4" )	2.79m ( 9' 2" )	2.64m ( 8' 8" )
500 – 550 kV	5.8m ( 19' 0" )	5.8m ( 19' 0" )	3.61m ( 11' 10" )	3.45m ( 11' 4" )
765 – 800 kV	7.24m ( 23' 9" )	7.24m ( 23' 9" )	4.85m ( 15' 11" )	4.7m ( 15' 5" )



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**Date**