Technical Standard

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Document Purpose

The purpose of the Electrical Safety Standard is to specify the corporate governance and requirements of Husky's Electrical Safety Program to minimize the exposure of personnel to electrical hazards.
Where conflicts exist between requirements specified in this standard and other regulation (e.g. federal, provincial, state or local authorities), the more stringent requirement shall apply.

Document Scope

This standard applies to:

- All Business Units and Departments within Husky
- Husky and non-Husky employees
- The hazards of electric shock and arc flash.

The standard does not apply to:

- Husky retail sites (Corporate owned stores)
- Hazards other than shock and arc flash that may result from the use and misuse of electricity and electrical equipment
- Motor vehicles
- 12 V systems supplied by a single battery rated 1000 cranking amps or less.

Document User Profile

The intended users of this standards are:

- Electrical workers
- Workers directing electrical work
- Other personnel who are trained and certified to work on or operate electrical equipment.

Technical Standard Requirements

1.0 Hazards

1.1. General

Electrical Hazards	Hazards of electricity include: • Electric shock • Arc flash • Arc blast.
Avoiding Electrical Hazards	The best way to avoid electrical hazards is to work with deenergized electrical equipment and circuits as much as is practicable.
Energized Electrical Work	When energized electrical work is necessary, the following methods shall be used to minimize the risks to workers: • Planning • Hazards mitigation • Appropriate tools and equipment • Use of written procedures • Electrical specific personal protective equipment.

1.2. Shock Hazard

Electric Shock	Electrical shock is the result of electrical current passing through the body.
Short Term Effects	Short term effects of electric shock include: • Slight to severe pain • Internal and external burns • Cessation of breathing • Ventricular fibrillation • Cardiac arrest • On-set of symptoms can be delayed.

Long Term Effects	Long term effects of electric shock include: • Damage to internal organs • Central nervous system disorders • Loss of memory. **WARNING**: Voltages over 30 V can be fatal.

1.3. Arc Flash and Arc Blast Hazard

Arc Flash and Arc Blast Events	• Arc flash and arc blast events are the results of a rapid release of energy due to an arcing fault between two or more electrical conductors. • Arc flash events release large amounts of energy due to rapid vapourization of metal bus bars and other conductors. • Arc flash events shall be considered possible at voltages as low as 120 V.
Impact to Workers	Arc flash events may injure workers through exposure to heat, pressure waves, noise, light (including ultraviolet and infrared wavelengths), toxic vapours, projectiles and other means.
Incident Energy	The amount of incident energy a worker may be exposed to due to an arc flash event will be primarily influenced by three factors: • The amount of current in the arc • The duration of the arc flash incident • The distance from the arc to the worker. NOTE: The higher the current in the arc and the greater duration of time before the arc is cleared, the greater the incident energy that the worker will be exposed to. The greater the distance the worker is away from the arc, the less incident energy that the worker could be exposed to during an arc flash event.
Arc Flash and Arc Blast Risks	If energized work is necessary, lower the risks of arc flash and arc blast to personnel and equipment by: • Ensuring that protective relays are set correctly • Temporarily reducing trip settings during energized work using installed “maintenance bypass” switches or settings • Using electrical specific PPE with the appropriate arc rating for the work involved • Increasing the distance from the potential arc source to the worker if possible • Using guards and shields to protect workers from potential arc sources. **CAUTION**: Currently available electrical specific PPE protects against the thermal component of arc flash per its arc rating but does not protect against other injuries (e.g. shrapnel, projectiles, etc.)

2.0 People and Training

2.1. General

All Workers	All workers shall receive training on electrical safety. The training shall be appropriate for the roles, responsibilities and expected activities of the worker.
All Workers Training Requirements	The training requirements for all workers shall include: • Safety related work practices and procedural requirements necessary to provide protection from the electrical hazards associated with their job or task assignment • Ability to identify and understand the relationship between electrical hazards and possible injury.
Documentation and Recordkeeping	• Worker training shall be documented and include the worker's name, date of attendance and the content of the training. • Records of worker training shall be maintained for the duration of the worker's employment.
Lockout Training	• All affected workers shall be trained and shall demonstrate proficiency in the lockout procedures that are used at the facility. • Worker training shall be documented and include the worker's name, date of attendance and the content of the training. Records of worker training shall be maintained for the duration of the worker's employment.

2.2. Qualified Electrical Workers (QEWs)

Qualified Electrical Workers	Only qualified electrical workers (QEWs) shall perform electrical work.
Qualified Electrical Worker (QEW) Criteria	A QEW meets all the following criteria: • Holds a certificate in the electrical trade or other certification that is acceptable to the local authority having jurisdiction with respect to the task being performed NOTE: the definition of a QEW is in addition to all applicable federal, provincial/state, local and site-specific requirements, and is intended to further define the required traits, training, skills, and experience of the electrical worker to ensure they are competent for the specific tasks they are required to perform. • Is authorized by someone in Husky to work on electrical equipment • Can identify the hazards involved in the task being performed • Has demonstrated skills and knowledge related to the construction and operation of the electrical equipment and installations involved in the task being performed • Has received safety training to identify and avoid the hazards involved.
QEW Training	• All electrical workers shall attend a minimum of 8 hours of electrical safety training per year. • Training shall include: ○ Requirements contained in CSA Z462 *Workplace Electrical Safety* or NFPA 70E *Standard for Electrical Safety in the Workplace* ○ Husky's Electrical Safety Standard ○ Electric shock ○ Arc Flash ○ Lockout procedures ○ Rotating equipment hazards ○ Methods of safe release of victims from contact with exposed energized electrical equipment.
Retraining Requirements	• Retraining of all electrical safety courses, policies, and practices shall be performed at intervals that do not exceed three years. • When revised or new electrical safety courses, policies, and practices are issued, it is preferred that retraining be completed by QEWs within six months.

Documentation and Recordkeeping	• Records shall be kept for electrical worker training.
	• The records shall indicate:
	  ○ Title of the training received
	  ○ Outline of the contents
	  ○ Location of the training
	  ○ Instructor's name
	  ○ Participant's name and the date.
	• The records and documentation shall be:
	  ○ Made when the worker demonstrates proficiency in the work practices involved
	  ○ Maintained for the duration of the worker's employment.

2.3. Contract Workers

Husky's Responsibilities	Husky is responsible to provide: • Information to contract workers about known risks that might not be recognized by the contract employer or its workers • Information that will enable the contract employer or workers to perform all necessary risk evaluations for the work they are undertaking.

2.4. Roles and Responsibilities

The following table highlights the expected responsibilities in terms of this standard.

Role	Responsibilities
Vice Presidents of Operating Areas	• Ensure this Standard is followed. • Provide sufficient resources to enable Business Units to implement the requirements of this Standard.
Corporate Process & Occupational Safety Manager	• Actively promote electrical safety concepts. • Ensure that the overall HSE management system incorporates and utilizes appropriate electrical hazard requirements as outlined in this Standard. • Ensure this Standard is assessed on a regular basis.

Role	Responsibilities
General Managers	• Ensure this Standard is followed in all areas under your authority and provide sufficient resources to allow personnel to implement the requirements of this Standard.
Managers / Superintendents / Foremen / Coordinators and equivalent supervisory positions (of operating areas and facilities)	• Ensure this Standard is followed in all areas under your authority. • Provide sufficient resources when required to enable personnel to implement the requirements of this Standard. • Enrol and be trained in electrical safety appropriate for Operations personnel. • Allow and encourage de-energization of equipment whenever feasible before electrical work is started. • Do not sign off on Energized Electrical Work Permits unless all required risk assessments have been completed and you are certain that it is not feasible to de-energize the equipment prior to the start of the work.
District or Site Process & Occupational Safety Staff	• Ensure this Standard is implemented and assessed. • Actively promote electrical safety concepts, and ensure appropriate training is available and taken by all employees. • Ensure that the overall occupational integrity management system incorporates and utilizes appropriate electrical hazard requirements as outlined in this Standard. • Do not sign off on Energized Electrical Work Permits unless all required risk assessments have been completed.
Electrical Workers	• Enrol and attend electrical safety training sessions for electrical workers. • Strive to increase understanding of electrical hazards. • Do not work on energized equipment unless de-energization is not feasible or is impractical. • Electrical workers shall not perform work unless they are “qualified” (see section 2.2) and competent for the particular task they are to perform. • Do not sign off on Energized Electrical Work Permits unless the electrical (and other) risks have been identified and removed or mitigated, and you are certain that the work can be performed safely.
Electrical Engineers and Technologists	• Encourage “safety by design” concepts. • Attend electrical safety training sessions for electrical workers. • Strive to increase understanding of electrical hazards and determination of arc flash and shock hazards. • Understand the limitations of your knowledge and competency level. • Do not sign off on Energized Electrical Work Permits unless you are sure that it can be performed safely.

Role	Responsibilities
Operations Staff	• Enrol and be trained in electrical safety subject matter that is appropriate for Operations personnel. • Assist electrical workers by allowing de-energization of equipment whenever feasible before electrical work is started. • Ensure that an Energized Electrical Work Permit is executed where and when required before a Safe Work Permit is issued.
All Husky Personnel	• Enrol and be trained in electrical safety subject matter that is appropriate for your job. • A basic electrical safety course shall be provided by Husky.

3.0 Operating Electrical Equipment

3.1. Normal Operation

Operating Electrical Equipment that is in Normal Condition

- Electrical equipment shall not be operated with doors open, covers off or latching hardware not in place unless the worker operating the equipment is a QEW who is wearing electrical specific PPE suitable for the hazards. Hazards may include arc flash and electric shock.
- Electrical equipment shall only be operated when all the following conditions are satisfied:

Condition	Definition
The equipment is properly installed.	Properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations.
The equipment is properly maintained.	Properly maintained means that the equipment has been maintained according to the manufacturer's recommendations and applicable industry codes and standards.
The equipment doors are closed and secured.	
The equipment covers are in place and secured.	
There is no evidence of impending failure.	Evidence of impending failure means that there are signs of arcing, overheating, loose or bound parts, physical damage, deterioration, or excessive corrosion on the equipment.

Body Position and Operating Techniques

- Proper operating techniques shall be used when operating switches to minimize risks due to arc flash.
- The worker shall stand to the side of the equipment being operated and preferably on the same side as the switch to avoid reaching across the door or cover of the equipment that is being operated.

3.2. Resetting Protective Devices

Resetting Protective Device Requirements

- No electrical device, including circuit breakers, protection relays and similar devices shall be reset from a tripped condition until a QEW has determined that it is safe to do so.
- Personnel who are not QEWs may reset overload relays if all the following requirements are met:
  - this may be done without opening doors or panels that would expose energized electrical conductors or circuit parts
  - electrically knowledgeable personnel deem the risk level to be low for resetting the specific device in its specific application
  - an approved, documented procedure for resetting the device has been developed in accordance with Appendix – B *Procedures for Resetting Protective Devices by Non-Electrical Personnel* and is followed by the worker resetting the device
  - the procedure is less than 5 years old
  - the worker has been trained and has an appropriate level of knowledge regarding the correct operation of the equipment, the consequences of operating the equipment, and the hazards associated with operating the equipment.

3.3. Operating Equipment Over 1000 V

Switchgear Equipment and Motor Disconnect Switches

The following equipment shall only be operated by a QEW, or an authorized operator who has been trained to understand the equipment and the potential hazards associated with the equipment and its operation:

- Switchgear equipment rated above 1000 V, including main breakers on motor control centres
- Disconnect switches for motors rated above 1000 V.

3.4. Racking

Requirements for Racking	Racking, either in or out, of circuit breakers and contactors on equipment rated 480 V or higher has the following requirements: • Shall be performed with the doors of the equipment closed if possible • Shall be performed by a QEW • Requires special preparations including the development of an emergency response plan prior to attempting this operation • A second person, preferably a QEW, shall be present during this operation, but shall position themselves outside of the arc flash boundary • Where the second person is a QEW, the two workers shall agree on the emergency response plan prior to beginning the racking operation • Where the second person is not a QEW, the QEW shall provide specific, detailed instructions to the second person, including an emergency response plan, on what actions shall be taken if the QEW is injured or incapacitated by an electrical incident such as electric shock or arc flash during this operation. ○ The QEW shall ensure that the second person fully understands the instructions before the racking operation begins.

4.0 Doors and Covers

4.1. Opening/Closing Doors and Covers

QEWs Only	Only QEWs shall open and or close doors or remove and or reinstall panels where these doors or panels act as barriers to energized electrical circuit parts or conductors.

5.0 Work Planning

5.1. Work Planning

Electrical Work	All electrical work shall be planned.
Safe Work Practices and Procedures	When exposed to electrical hazards while working on electrical equipment that is or can become energized, safe work practices and procedures shall be: • Used as a means of safeguarding workers from injury • Consistent with the nature and extent of electrical hazards.
Condition and Maintenance of Electrical System	• The overall condition and maintenance of electrical systems shall be evaluated before any operation and or work is to be performed. • There is an increased risk of malfunction, electric shock, arc flash and increased arc flash incident energy when equipment is not installed properly or adequately maintained. • Additional precautions beyond the minimum requirements of this Standard may be necessary and shall be used when appropriate.

5.2. Job Briefing

Job Briefing Requirements	• A job briefing shall be conducted prior to all work. • The length and format for the briefing shall be tailored to match the complexity, duration and risk level of the work. • The briefing shall include the workers involved in the work as a minimum; but, consideration shall also be given to involving Operations personnel and other workers who may be in the area.

5.3. Procedures

Procedures for Routine Work

- Safe work procedures for routine tasks, routine work and for routine preventive maintenance work (where similar work is carried out in a district/area/facility more than once per year) shall be developed and maintained.
- The procedures shall state the risks that may be encountered while performing the task as well as the methods (including but not limited to PPE) that shall be employed to mitigate these risks.

NOTE: It is highly recommended that procedures are also developed when performing other electrical tasks to help ensure worker safety.

5.4. Higher Risk Operations

Higher Risk Operations

Higher risk operations include:

- racking (in or out) of circuit breakers and contactors
- removing or inserting motor starter buckets in energized motor control centres
- operating electrical equipment with doors open or covers removed
- any other operation that is deemed to have a higher risk of an arc flash incident.

Higher Risk Operations Requirements

A second worker shall be present during the performance of high-risk operations. It is recommended that the second worker is a QEW. The second worker shall remain outside the arc flash boundary during higher risk operations of electrical equipment or for any electrical work on energized electrical equipment above 30 V.

If	Then
If the second worker is a QEW:	It is recommended that an emergency response plan be developed.
If the second worker is not a QEW:	The QEW performing the task shall ensure that: • a detailed and specific emergency response plan is developed • the second worker has suitable training and is instructed on the appropriate emergency response actions to be taken if an incident occurs. It is recommended that the second worker have Standard First Aid training; however, this may not be necessary if personnel with this training can be summoned and reach the location in less than four minutes.

Emergency Response Plan Requirements	When required, an emergency response plan for an electrical incident shall contain all the following information at a minimum: • location of isolation switch that can be used to de-energize equipment if necessary • the potential severity of injuries to personnel. For all electrical hazards, it shall be expected that injuries could be very severe (e.g. cardiac arrest/fibrillation, internal and external burns, broken bones, etc.) and death is possible • how medical aid or emergency help will be summoned if required • how fast medical aid can be obtained • location of fire extinguishers suitable for electrical fires; • location of medical aid and method to transport personnel to medical aid if required • confirmation that the assisting person has CPR training and able to administer CPR if necessary, or that a person with CPR training can reach the location in less than four minutes • how a person receiving an electric shock and cannot let go or who is hung up on energized conductors will be removed from the energized conductors.

5.5. Plan-Do-Check-Act

Electrical Work	Electrical work shall be done with a “Plan, Do, Check, Act” system. • Plan - all electrical work shall be planned; the risks shall be assessed and the results of both shall be documented. It is recommended that each time a new task is to be done, a written procedure should be developed • Do - the work shall then be completed to the plan • Check - once the work is completed, the plan shall be reviewed to check if improvements can be made • Act – make changes to the plan as per the recommendations of the “Check” step. The plan shall then be filed so that it can be easily accessed the next time it is required.

6.0 Risk Identification and Assessment

6.1. Risk Identification and Assessment

Risk Identification and Assessment	• Risks, including human factors, shall be identified and evaluated during planning and prior to commencing work. • Users of this Standard shall also refer to Husky's Corporate standards and procedures on risk assessment for further information.

QEW Responsibilities for Risk Assessment	• Risk identifications and assessments shall be completed by a QEW who has knowledge of all the following:
	  ○ The task to be performed
	  ○ The risks
	  ○ The system and its interconnected equipment
	  ○ Any other work being performed in the area.
	• The QEW shall understand:
	  ○ The Electrical Single Line Diagram for the site and how the electrical distribution system operates
	  ○ How all affected equipment operates
	  ○ The environment that the work is being done in (weather, any other work going on, etc.)
	  ○ The condition of the equipment (dirty, level of maintenance over its history, level of testing over its lifetime, etc.)

6.2. Risk Management

Risk Management	• Plans shall eliminate or reduce the risks when practicable and include steps to mitigate remaining risks. • Where practical, hazards shall be removed; de-energization is always the first choice if feasible. • The risk from remaining hazards shall be controlled using procedures and PPE (including but not limited to electrical specific PPE). Engineered solutions, equipment substitutions, warning signs, training and other methods shall also be considered.

7.0 Assessing Shock and Arc Flash Hazards

7.1. Assessing Shock Hazards

Voltage Levels	Voltage levels referenced in this technical standard shall be the highest available voltage at the location under consideration.
Shock Hazards	• QEWs who place their hands or tools within the Restricted Approach Boundary of circuit parts or conductors operating above 30 V are exposed to shock hazards. • Other circumstances may also expose workers to shock hazards

Shock Risk Assessment	• A shock risk assessment shall be conducted for all energized electrical work.
	• The shock risk assessment shall determine:
	  ○ the voltage(s) to which personnel will be exposed
	  ○ the shock hazard boundary requirements
	  ○ the required personal protective equipment necessary to minimize the possibility of electric shock.
	• Shock hazards shall be evaluated as part of the risk assessment and shall be documented.

Approach Boundaries	Approach boundaries are defined in CSA Z462 for shock protection for ac systems and dc systems. A Limited Approach Boundary and a Restricted Approach Boundary should be determined based on the tables provided in Appendix - A *Approach Boundary Tables*.

7.2. Assessing Arc Flash Hazards

Situations Where Arc Flash Hazards May Exist

Situations Where an Arc Flash Hazard May Exist	
An arc flash hazard may exist:	**Notes**
When energized electrical conductors or circuit parts are exposed or when they are within equipment in a guarded or enclosed condition, provided a person is interacting with the equipment in such 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.
When work is performed on energized alternating current (ac) systems rated greater than 150 Vac.	For ac systems, the arc flash hazard is considered to be very low for systems rated 150 V or less. In determining whether the circuit is 150 V or less, the maximum line-to-line voltage at the location of work shall be considered (e.g. 208 V line-to-line or 240 V line-to-line may exist where a worker is working on a 120 V line-to-neutral circuit).
On some direct current (dc) systems rated 100 Vdc or higher.	Systems rated over 100 V dc shall be evaluated to determine if there is an arc flash hazard. Incident energy calculations shall be performed if necessary.
When abnormal conditions exist in ac systems rated greater than 150 Vac or for dc systems rated greater than 100 Vdc.	Abnormal conditions include, but are not limited to: • abnormal operation (including, but not limited to, operation with doors or covers open • poor equipment condition and environmental factors (e.g. exposure to excessive moisture or other contaminants)

Arc Flash Risk Assessment	• All systems requiring energized electrical work or where circuit breakers and contactors may be racked out require the completion of an arc flash risk assessment.
	• One of two methods shall be used to determine the required electrical specific PPE to be worn by workers that may be exposed to arc flash hazards.
	  ○ For larger systems (typically 300 kVA and larger), detailed incident energy analysis shall be performed.
	  ○ In the absence of a valid incident energy analysis, the Table Method shall be used to select appropriate arc flash PPE
	• Direct current (dc) systems rated over 100 V, including but not limited to batteries and battery-supplied uninterruptible power supplies, shall be evaluated to determine if there is an arc flash hazard.
	• The arc flash risk assessment shall determine the arc flash boundary and the incident energy level or the required electrical specific PPE.
	• Incident energy calculations shall be performed if necessary.
	• Arc flash hazards shall be evaluated as part of the risk assessment and the results shall be documented.

Arc Flash Hazard Analysis	• Arc Flash Hazard Analysis may consist of either of the following two methods:
	  ○ a detailed incident energy analysis utilizing the calculation methods of either CSA Z462 (or NFPA 70E) or IEEE 1584 or both (i.e. “Incident energy analysis method” from CSA Z462 *Workplace Electrical Safety*), or
	  ○ the Table Method from CSA Z462 or NFPA 70E (i.e. “Arc Flash PPE Category method” from CSA Z462 *Workplace Electrical Safety*) may be used for selection of electrical specific PPE for arc flash hazards.
	  ▪ NOTE: If this method is used, it is imperative that the short circuit currents and clearing times be applicable (see the notes on Tables 6A and 6B of CSA Z462 or Tables 130.7(C)(15)(a) and 130.7(C)(15)(b) of NFPA 70E).
	  ○ Clearing times greater than the times listed in the notes of Tables 4B and 4C will increase available incident energy and therefore the required level of electrical specific PPE.
	  ○ Lower or higher short circuit levels than the listed levels could also increase the available incident energy and therefore the required level of electrical specific PPE.
	  ○ Lower short circuit levels could drastically increase the clearing time for a fault which will increase the incident energy levels.
	  ○ Higher short circuit currents will also increase the incident energy levels if clearing times are not reduced.

Arc Flash Hazards Over 40 cal/cm^2	• Work in situations where the arc flash hazard exceeds 40 cal/cm^2 is discouraged; the increased risk cannot be quantified, nor can workers be easily protected. These increased risks to personnel could include blast pressure, projectiles, molten metals, higher noise and light hazards (including ultraviolet and infrared wavelengths). • If the arc flash hazard is determined to be greater than 40 cal/cm^2, or is unknown, preference shall be given to establishing an electrically safe work condition instead of energized work being performed. If there is no apparent alternative to energized electrical work where the arc flash hazard is greater than 40 cal/cm^2 or is unknown, then Husky electrical engineering personnel shall be contacted, and an engineering-based study shall be conducted to determine how the risk will be reduced. • The electrical engineer and/or the QEWs involved may determine that an alternative to energized work is required due to the arc flash/arc blast risk and/or other risks.

8.0 Personal Protective Equipment – Selection, Specifications and Care

8.1. General

General PPE Requirements	Refer to Husky Corporate practices and procedures regarding personal protective equipment (PPE) for minimum standards regarding general PPE for all Husky workers.

PPE Requirements for Electrical Workers

- Increased electrical specific PPE requirements may be required for workers operating or working on or near energized electrical conductors or circuit parts depending on several factors including:
  - type of operation or work being performed
  - type of equipment involved
  - voltage of equipment involved
  - results of shock and arc flash risk assessments, and
  - condition of equipment.

PPE	Description
Footwear	It is recommended that QEWs wear electric-shock-resistant footwear as defined in CSA Z195 Protective footwear or dielectric footwear as defined in ASTM F 1117 *Standard Specification for Dielectric Footwear*.
Safety Glasses or Goggles	Safety glasses or goggles that meet Husky's standards shall be worn under arc rated face shields and arc flash hoods.

- All electrical specific PPE shall be tested and approved to the standards listed in Appendix - D *Approved Standards for Electrical Specific PPE*. The latest versions of the standards shall be used when purchasing new PPE or equipment.
- Conductive articles of jewellery and clothing (e.g., watchbands, bracelets, rings, key chains, necklaces, metallized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn within the restricted approach boundary or where they present an electrical contact hazard with exposed energized electrical conductors or circuit parts.

8.2. PPE Selection – Shock

PPE Requirements for Shock	• QEWs who may be exposed to shock hazards on voltages above 30 V shall wear rubber insulating gloves appropriate for the voltage level that may be encountered.
	• Leather protectors over the rubber insulating portion of the gloves are required to protect the rubber material from damage. The leather protector also provides limited arc flash protection for the hands.
	• Rubber insulating gloves are not required when performing voltage or current measurements on circuits rated 150 V and less, provided that the QEW:
	  ○ uses approved test equipment with insulated parts
	  ○ is not likely to contact energized wires or circuit parts other than the targets with the test probes
	  ○ is not likely to contact any energized wires or circuit parts with hands or other parts of the body.

8.3. PPE Selection – Arc Flash

General Arc Flash PPE Requirements	• All workers within the Arc Flash Boundary are exposed to arc flash hazards and shall wear electrical specific PPE.
	• The arc rating of the PPE shall be equal to or greater than the arc flash hazard level that may be encountered at the assumed working distance.
	• A low-level arc flash hazard may exist on low capacity systems. These low capacity systems include:
	  ○ Alternating current (ac) - below 150 Vac
	  ○ Direct current (dc) – below 100 Vdc.
	  It is recommended that AFC 2 PPE be worn when work is performed at these locations.
	• Arc rated clothing shall cover all ignitable clothing.
	• Where a detailed incident energy analysis (i.e. an “arc flash study”) has not been performed, it may be possible to use the “Table Method” (i.e. clauses 4.3.7.3. and Tables 6A, 6B and 6C from CSA Z462) to establish the Arc Flash PPE Categories and the electrical specific PPE for a specific task.
	• If the “Table Method” is used, caution shall be exercised to ensure that this method is appropriate for the specifics of the task and installation in question (for example, that the fault currents and clearing times are within the required ranges stated in the “Notes” section of the Tables).
	  ○ In addition, the Table Method may be used in all cases where all the following criteria are met:
	  ▪ the voltage is 1000 V or less
	  ▪ there is a single source of supply

  - the upstream protective device is rated 250 A or lower
  - there are no transformers installed between the protective device and the work location.

- Clothing intended to provide arc flash protection should be loose fitting as the air spaces created add an additional thermal insulation value and thus provide added safety. However, clothing should not be so loose as to increase risks to workers from clothing getting caught in rotating equipment or increase the chance of inadvertently contacting energized electrical conductors or circuit parts
- Additional electrical specific PPE should be considered for use on parts of the body that are closer to the energized conductors or circuit parts than the assumed working distance used in the calculation of the incident energy.
  - For example, arms and hands are often closer to the energized conductors than the assumed working distance that is used in the incident energy calculation. It may not be practical to wear additional PPE on the hands as this would adversely affect dexterity, creating a higher risk. However, it may be possible to wear an additional arc rated shirt or light jacket to better protect the arms from a potential arc flash incident.
  - Care must be taken when layering arc rated garments as it has been observed in laboratory tests that certain combinations of garments may result in an arc rating for the combination that is less than the sum of the individual arc ratings of the two garments. Before wearing any layered system, always consult the garment manufacturer's published data to determine whether the layered system provides the desired level of protection. Refer to CSA Z462 Annex M for information.

Face and Head Protection

PPE	Description
Face Shields and Balaclavas	• Arc rated face shields shall have wrap-around guarding to protect the face, chin, forehead, ears and neck area. • Arc rated face shields and balaclavas may be worn where the calculated incident energy level is 12.0 cal/cm^2 or lower and for tasks rated AFC 1 or 2.
Arc Rated Hoods	• An appropriately rated hood shall be worn where the calculated incident energy level is above 12.0 cal/cm^2 and for tasks rated AFC 3 or AFC 4. • Hood ventilation systems - when exterior air is supplied into an arc rated hood, the hood ventilation system shall be covered by arc-rated materials with an arc rating equivalent to the hood or shall be constructed of non-melting, non-flammable materials.

Arc Flash PPE Selection Based on Calculated Incident Energy

Calculated Arc Flash Incident Energy	PPE Requirements
0.1 – 12.0 cal/cm^2	• hard hat • safety glasses or safety goggles • insert type hearing protection • safety footwear • long sleeve arc rated shirt and arc rated pants, or, arc rated coveralls with an arc rating that meets or exceeds the incident energy at the assumed working distance (the minimum arc rating for these garments is 8 cal/cm^2 when the calculated incident energy is below 8 cal/cm^2) • arc rated face shield and arc rated balaclava, or arc rated arc flash suit hood with an arc rating that meets or exceeds the incident energy at the assumed working distance • heavy duty leather gloves, or where a shock hazard exists, rubber insulating gloves rated for the shock hazard complete with leather outer protectors
12.1 – 40.0 cal/cm^2	• hard hat • safety glasses or safety goggles • insert type hearing protection • safety footwear • long sleeve arc rated shirt and arc rated pants, or, arc rated coveralls with an arc rating that meets or exceeds the incident energy at the assumed working distance • arc rated arc flash suit hood • arc rated gloves, or where a shock hazard exists, rubber insulating gloves rated for the shock hazard complete with leather outer protectors

Arc Flash PPE Selection Based on the Table Method

- Use the Table below to select PPE when the Table Method is used to determine the required arc flash PPE.
  - the "Table Method" is the use of Table 6A or 6B of CSA Z462 or Table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) of NFPA 70E.
- Husky uses a two-category PPE system.
  - AFC 2 PPE is used when performing tasks determined to be Arc Flash PPE Category 1 (AFC 1) or Arc Flash PPE Category 2 (AFC 2) in the Table Method
  - AFC 4 PPE is used when performing tasks identified as Arc Flash PPE Category 3 (AFC 3) or Arc Flash PPE Category 4 (AFC 4) in the Table Method.

AFC PPE Category	Required PPE
AFC 1 or AFC 2 PPE	Arc Flash PPE Category 2 personal protective equipment. Use of the following PPE shall be considered the minimum for AFC 2 PPE: • arc rated long sleeve shirt and arc rated pants or arc rated coveralls (minimum arc rating of these garments shall be 8.0 cal/cm^2) • hard hat • arc rated face shield (minimum arc rating shall be 10.0 cal/cm^2) • arc rated balaclava (minimum arc rating shall be 8.0 cal/cm^2 • safety glasses or safety goggles • safety footwear • heavy duty leather gloves • insert-type hearing protection.
AFC 3 or AFC 4 PPE	Arc Flash PPE Category 4 personal protective equipment. Use of the following PPE shall be considered the minimum for AFC 4 PPE: • arc rated jacket and arc rated pants (or garments providing equivalent coverage and protection). Minimum arc rating shall be 40.0 cal/cm^2 • hard hat • arc rated arc flash suit hood. Minimum arc rating shall be 40.0 cal/cm^2 • safety glasses or safety goggles • safety footwear • heavy duty leather gloves • insert-type hearing protection.

8.4. PPE Requirements for Specific Tasks

PPE for Removing or Re-Installing Unhinged Covers	• QEWs who remove unhinged bolted covers or any other panel that could inadvertently contact energized electrical conductors shall wear:
	  ○ rubber insulating gloves appropriate for the voltage level that may be encountered
	  ○ Leather protectors shall be worn over the rubber insulating gloves to protect the rubber material from damage
	  ○ Arc rated PPE appropriate for the arc flash hazard at the location.

PPE for Operating Equipment Over 1000 V	• Any person operating switchgear equipment rated above 1000 V shall wear a minimum of AFC 2 PPE. • Any person operating disconnect switches for motors rated above 1000 V shall wear a minimum of AFC 2 PPE.
PPE for Racking	A QEW who is racking in or racking out any circuit breaker or contactor shall wear AFC 4 PPE unless either of the following apply: • When an arc flash study has been completed for the system in question, the QEW may wear electrical specific PPE that is suitable for the calculated incident energy level at the line-side of the circuit breaker that is being racked • When remote racking devices are used, and the QEW is outside of the arc flash boundary (that has been established by an arc flash study) for the line-side of the breaker that is being racked, the QEW is not required to wear AFC 4 PPE. NOTE: If an incident energy analysis has been performed and the incident energy is greater than 40 cal/cm^2 at the line side of the circuit breaker or contactor to be racked, the line side energy supply shall be de-energized prior to racking.
PPE for Opening Doors	QEWs shall wear a minimum of AFC 2 PPE when opening or closing hinged doors on equipment operating at voltages greater than 150 V. If the equipment has an increased probability of an arc flash developing while opening or closing the doors, then the arc flash hazard shall be evaluated, and the worker shall wear the appropriate PPE for the arc flash hazard. NOTE: the probability of an arc flash may be increased due to specific installation factors (e.g., due to congestion of wires, or poor equipment condition) or environmental factors (e.g. wind, rain, snow, dust, condensation/frost/ice or other factors).

PPE for Removing Covers	When removing or re-installing unhinged panels on equipment operating at voltages greater than 150 V: • The arc flash and electric shock hazards shall be identified • The QEW performing this task shall wear PPE that is rated for these hazards.
Safety Requirements for Visual Inspections	• Workers shall wear minimum AFC 2 PPE while performing visual inspections, infrared thermography, or other image capturing tasks on energized equipment with doors open or covers removed when the equipment is rated greater than 150 Vac or 100 Vdc.
PPE for Working on Batteries	• Appropriate chemical hazard PPE shall be provided to and worn by all workers performing battery maintenance including: ○ goggles ○ face shields ○ chemical resistant gloves ○ protective aprons ○ protective overshoes ○ eye and skin wash facilities in case of electrolyte spillage or splashing. • A minimum of AFC 2 PPE shall be worn while working on battery banks or energized UPS systems. • When working on batteries, there may be cases where the worker must choose either chemical or electrical PPE. In those cases, the worker should select the specific PPE to protect themselves from the highest risk (either chemical or electrical) for the task being performed.

8.5. PPE Care and Storage

Visual Inspection and Care	• All electrical specific PPE shall be visually inspected for defects prior to use. If any piece of electrical specific PPE is suspected or found to have defects, it shall not be used until it has been repaired or proven to be in good condition. • General and electrical specific PPE shall be: ○ cared for as per the manufacturer's directions ○ kept clean and in good working condition.

PPE Repairs	• Holes in garments shall be repaired with materials that meet or exceed the original garment specifications and are approved by the garment manufacturer.

Electrical PPE Storage	• Electrical specific PPE shall be stored in a clean, dry environment.
	• It is recommended that this equipment:
	  ○ be purchased complete with storage bags or protective cases from the original manufacturer
	  ○ that electrical specific PPE be stored in marked or tagged lockers or cabinets.

PPE Tagging Requirements	• Any electrical specific PPE requiring periodic testing shall have unique identification tags or markings for inventory management. ○ It is also recommended to uniquely tag other electrical specific PPE and equipment that may be referenced in electrical safe work procedures to more clearly identify the correct item.

8.6. Rubber Insulated Gloves Testing Requirements

Testing Requirements	• Rubber insulating gloves and live-line tools (hot sticks) shall be tested by a certified testing company at intervals that do not exceed the applicable ASTM or IEEE standards or the manufacturer's guidelines. • Rubber insulated gloves shall be tested at intervals that do not exceed six months.

8.7. Clothing Under PPE

Clothing Under PPE	• If undergarments are worn under arc rated garments, it is recommended that these undergarments are made of untreated natural fibres that will not melt when exposed to heat (e.g. cotton or wool). • Synthetic clothing shall not be worn under arc rated garments unless these synthetic undergarments are flame resistant (FR) or arc rated.

9.0 Tools, Meters and Cords

9.1. Handheld Electrical Meters

Test and Measurement Equipment

- Workers shall ensure that their electrical test and measurement equipment is rated for the voltage levels to which it is exposed.
- Test instruments include:
  - Voltage meters
  - Voltage detectors
  - Multimeters
  - And similar devices.

Intended for Use on Circuits	Requirements
Operating at 600 V or below	Shall comply with ANSI/ISA S82.02.01 *Electric and Electronic Test, Measuring, Controlling, and Related Equipment: General Requirements* or IEC 61010 *Safety requirements for electrical equipment for measurement, control, and laboratory use* and be rated as 1000 V Category III or 600 V Category IV devices at a minimum.
Operating at 601 V to 1000 V	Shall comply with ANSI/ISA S82.02.01 or IEC 61010 and be rated as 1000 V Category III at a minimum.
Operating at voltages above 1000 V	Shall comply with the requirements of IEC 61243-1 *Live working - Voltage detectors - Part 1: Capacitive type to be used for voltages exceeding 1 kV AC.*

Pre-Use Examination

- Personnel shall visually examine test and measurement equipment prior to its use.
  - If a defect is found or if there is evidence of damage, the device shall not be used until it has been repaired or proven safe through reliable testing means.

9.2. Live-Line Tools

Testing Requirements

- Live-line tools (hot sticks) shall be tested at intervals that do not exceed 24 months.
- Testing records shall be kept for all live-line tools.

9.3. Insulated Tools

Restricted Approach Boundary	• When using hand tools inside the Restricted Approach Boundary of circuits rated 1000 V and below that have not been put into an electrically safe work condition, the hand tools shall be insulated, manufactured and tested to ASTM F 1505 *Standard Specification for Insulated and Insulating Hand Tools*.
	  ○ The insulation level of the hand tools shall be adequate for the highest voltage they may be exposed to.
	• When working inside the Restricted Approach Boundary of energized conductors with voltages above 1000 V, all testing equipment and live-line tools shall be rated for the highest voltage they may be exposed to.
	  ○ Live-line tools shall be manufactured and tested to the requirements of ASTM F 711 *Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live-Line Tools*.

Inspection Requirements	Insulated hand tools shall be inspected before they are used to ensure the insulation has not been damaged and no other condition or defect exists that could prevent the tool from performing its intended function.
Maximum Voltage Level	All tools that are not insulated for the maximum voltage level they may be exposed to shall be considered conductive.

9.4. Corded Tools and Extension Cords

Portable Power Tools	• Portable power tools used by any worker shall bear CSA (or equivalent) approval markings and shall be grounded or double insulated. • Portable power tools shall be inspected before each shift in which they will be used. If any damage is found on the tool or the cord, the tool shall not be used until it is repaired.
GFCI Protection	• Where portable power tools are used in outdoor or wet locations, the tools shall be plugged into an appropriately rated, permanently installed GFCI receptacle or a portable in-line GFCI receptacle. • Class A GFCI protection shall be required when a worker is operating or using cord and plug connected tools related to maintenance and construction activity supplied by 125 V, 15, 20, or 30 A circuits.

Extension Cords	• In classified hazardous areas, only cords and connectors approved for the hazardous location shall be used. • All extension cords shall be checked for damage prior to use. • Flexible cords, cables and plugs shall be maintained to avoid strain or damage and shall be visually inspected for damage on a regular basis.

10.0 De-Energized Work

10.1. Electrically Safe Work Conditions

Establishing an Electrically Safe Work Condition	Electrical work shall be considered to be energized electrical work unless an electrically safe work condition has been established. The steps to establish an electrically safe work condition are: 1. Determine all possible sources of electrical energy supply. 2. Properly interrupt the load current and turn off the electrical equipment. 3. Disconnect the electrical equipment from energized parts by operating the appropriate switch(es) or breaker(s). Visually verify, where possible, that all blades are disconnected, or that draw-out circuit breakers are withdrawn. 4. Lock out all switches, breakers and other disconnect devices that could provide voltage to the electrical equipment according to the lockout requirements. 5. Test all electrical equipment to verify zero voltage. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source. 6. Ground the electrical equipment using temporary protective grounding conductors or other devices specifically manufactured and approved for this use, if grounding has been determined to be necessary during the risk assessment.
Remain Alert for Changes	Workers shall remain alert for changes to the job or task that may lead them outside of the electrically safe work condition or expose them to additional hazards not in the original job plan.

10.2. Lockout Requirements

Lockout Requirements

- All lock-out procedures shall comply with Husky corporate practices and procedures regarding requirements for lockout and lockout/tagout.
- Each facility and/or district should develop electrical lockout procedures in a standard format to address local conditions in accordance with Husky requirements and/or CSA Z460 *Control of Hazardous Energy – Lockout and other methods*.
- The lockout process shall involve all persons who could be exposed to a source of electrical energy.
- Each electrical lockout shall have a designated person in charge and it is recommended that this person be a QEW. This person shall be the first person to put their lock(s) on the lockout device(s) and shall be the last person to take their lock(s) off the lockout device(s).

NOTE: In some facilities or districts, there may be a requirement for an operator to place their lock on first and remove it last. In these areas, the designated person in charge will place their lock on second and will remove their lock second last.

- Locks and other devices used for lockout purposes shall be unique and readily identifiable as lockout equipment and shall not be used for any other purpose.
- When equipment is not lockable, special procedures shall be developed to ensure an equivalent level of safety for workers.
- At each lockout device, a tag shall also be applied that includes markings such as “DO NOT START”, “DO NOT OPERATE” or a similar directive to help provide protection to personnel. The name of the designated person in charge of the lockout, the date, and a brief description of the purpose of the lockout shall be included on the tag.
- Procedures shall be developed and followed by each operating area in case a worker’s lock needs to be removed and the worker cannot be found. In no case shall anyone other than the designated person in charge of the lockout be authorized to remove a worker’s lock.

10.3. Lockout Procedures

Individual and Group Lockout Procedure for Electrical Equipment

Individual Lockout Procedure applies when the number of workers involved with a lockout procedure is low enough to allow each worker to apply their personal lock to the disconnecting device and the lockout requirements are not complex:

1. Designate a person in charge of the lockout.
2. Ensure that all personnel affected by the lockout are notified and involved with the lockout process.
3. Determine all sources of electrical supply to the equipment, including “normal” and “alternate” sources or supplies (e.g. utility, emergency generators, temporary power sources and connections, uninterruptible power supplies (UPS), capacitors, etc.).
4. Properly interrupt the load current. Open the disconnecting device(s) for each source of electrical supply to the equipment.
5. Visually verify that all blades of the disconnecting devices are fully open, or that draw-out-type circuit breakers are withdrawn to the fully disconnected position.
6. Individual Lockouts:
   The designated person in charge of the lockout shall put their lock(s) on all disconnecting devices first. All involved workers shall then put their locks on the disconnecting devices.

NOTE: In some facilities or districts, there may be a requirement for an operator to place their lock on first and remove it last. In these areas, the designated person in charge will place their lock on second and will remove their lock second last.

Group Lockouts:
The designated person in charge of the lockout shall put the group lock(s) on all disconnecting devices. The designated person in charge shall then put the key for the group lock in the lockbox and put their lock on the lockout box so that the key for the group lock cannot be accessed. All involved workers shall then put their locks on the lockout box.

7. Proper Test Before Touch procedures shall be used to verify the absence of voltage on all electrical supply conductors to the equipment to ensure that the equipment has been de-energized. All QEWs involved with the work should verify the absence of voltage for themselves or witness the verification of absence of voltage by the designated person in charge.
8. If applicable, apply ground connecting devices (e.g. temporary protective grounds or ground truck devices rated for the available fault duty (both assumed clearing time and available fault current).
9. Once work has been completed on the equipment, each worker shall ensure that they have removed all tools and all

	non-essential items from the work site. When they have determined that there is no reason for them to return to the work area, they may remove their personal lock from the disconnect device (Individual Lockout) or the lockout box (Group Lockout). 10. When work is complete, and all workers are clear of the work site/equipment, remove all temporary protective grounds installed as part of that work. 11. The designated person in charge of the lockout shall ensure all workers are clear of the work site, visually inspect the electrical equipment and work area and ensure all non-essential items have been removed, and all components are operationally intact before removing their lock from the disconnect device (Individual Lockout) or from the lockout box and in turn removing the group lock (Group Lockout).
Complex Lockout Procedure for Electrical Equipment	Complex lockout situations occur when it is not possible to directly comply with the individual or group lockout approaches due to one or more of the following: • physical size and extent of the equipment • inaccessibility of energy isolating devices • number of workers involved • number of energy isolating devices require, • length of time for the work • other factors. In such cases, an equivalent level of safety to the individual or group lockout approach shall be achieved through other means. CSA Z460 *Control of hazardous energy – Lockout and other methods* shall be used and followed.

10.4. Grounding

Temporary Protective Grounds and Similar Devices

- Temporary protective grounds shall be adequately rated (both current rating and assumed clearing time) for the maximum fault current that could occur if the conductor or circuit being worked on is accidentally energized. These ratings shall be marked on the temporary protective grounds with a non-conductive sticker/tag.
- Temporary grounds shall have an impedance low enough to cause the intended operation of the protective devices in case of accidental energization of the electrical equipment.
- Clamps on temporary grounds shall be suitable for the types of conductors they are connected to and shall be adequately tightened to ensure they remain in good contact with all conductors.
    - Clamps shall not be hand tightened unless the clamp is the appropriate type (i.e. ASTM F855-04 Type III) and adequate working space is not available to utilize a live-line tool (“hot stick”) for the application of the clamp.
- Rubber insulating gloves, with protective leather outers, of the appropriate class shall be used when applying temporary protective grounds.
- Each set of temporary protective grounds shall have a unique identifying tag applied with a non-conductive sticker/tag. This tag can be called up in inventory lists, procedures, and in periodic preventative maintenance tasks.
- Temporary protective grounds shall be tested to the requirements of ASTM F2249 *Standard Specification for In-Service Test Methods for Temporary Grounding Jumper Assemblies Used on De-Energized Electric Power Lines and Equipment*.
    - The recommended interval for testing the operation of temporary protective grounds is three years, but in no case shall the interval exceed five years.
- Grounding trucks shall be inspected and tested in accordance with the manufacturer’s recommendations.
    - The recommended interval for testing the operation of grounding trucks is three years, but in no case shall the interval exceed five years.

10.5. Test Before Touch

Test Before Touch

- All electrical equipment shall be considered energized unless proven otherwise by the Test Before Touch procedure. The Test Before Touch procedure provides the specific steps that QEWs shall follow to ensure that the electrical equipment is de-energized prior to making contact. Test Before Touch procedures shall include all the following:
    - Checking the voltage detection instrument(s) to ensure it is rated for the voltage levels that could be encountered during the test and to ensure it is in good working condition
    - Selection of appropriate electrical specific PPE to protect the QEW(s) from the electric shock and arc flash hazards that may be present during the work/checks
    - Establishing an electrically safe work condition to achieve a de-energized state and appropriate lockout procedures used
    - Testing the voltage detection instrument on a known voltage source prior to testing the electrical equipment to be worked on.
    - Measuring the exposed electrical equipment that is to be worked on (or is near the electrical equipment to be worked on) to ensure it is de-energized
        - Voltage checks shall include ground to phase, neutral to phase, and phase to phase checks of all conductors and circuit parts at all locations
    - Re-testing the voltage detection instrument on a known voltage source to confirm that it did not experience a failure during any point during the voltage tests
- After any work stoppage, any change to the scope of work, or any change to the configuration of the electrical system all electrical equipment shall be re-tested using the Test Before Touch procedure to confirm it is still de-energized
- Test Before Touch may be performed by QEWs on systems where the incident energy is above 40 cal/cm^2 provided that:
    - the system can be reasonably assumed to be in a de-energized state due to the operation and lockout of disconnect devices
    - the QEW performing the work wears AFC 4 PPE and rubber insulating gloves rated for the voltage complete with leather outer
    - for equipment rated greater than 1000 V, the QEW uses an appropriately rated test instrument to perform the test before touch procedure
    - for equipment rated less than 1000 V, the QEW uses an appropriately rated proximity detector to perform an

initial check for voltage (if the system is an ac system). If the proximity detector detects no voltage, the QEW shall then proceed to use an approved test instrument and proper Test Before Touch procedures to establish that there is no voltage on the equipment.

- When Test Before Touch is to be performed on systems where the incident energy is unknown, it is recommended that either the incident energy be determined by completing an incident energy analysis or the Arc Flash PPE Category is determined using the Table Method. The appropriate electrical specific PPE can then be selected by the QEW. If it is impractical to calculate the incident energy or use the Table Method, the QEW shall use the Test Before Touch procedures for systems where the incident energy is above 40 cal/cm^2 as described in the preceding clause.

11.0 Energized Work

11.1. General

General

- Only QEWs may work on electrical conductors or circuit parts that have not been put into an electrically safe work condition.
- Workers shall not cross the Restricted Approach Boundary of any energized circuit part or conductor either with their body or any object unless they intend to work on the associated circuit parts or conductors.
- Workers shall remain alert when working within the Limited Approach Boundary of energized electrical conductors or circuit parts operating at more than 30 V.
- Workers shall not reach into any space inside energized electrical equipment that they cannot see due to barriers, lighting conditions or other factors.
- Unqualified persons within a Limited Approach Boundary shall be escorted by QEWs at all times and shall wear appropriate PPE. Unqualified persons shall not cross the Restricted Approach Boundary. A Safety Watch may also be used as required to keep unauthorized personnel out of the work area.

11.2. Justification

Justification for Energized Work

- Energized work may be allowed only if any of the following apply:
  - The task to be performed is infeasible in the de-energized state due to equipment design or operational limitations.
    - It is infeasible to perform voltage testing and some troubleshooting tasks while de-energized.
    - An example of an operational limitation would be if the electrical circuit or associated equipment is part of a continuous process that would otherwise need to be completely shut down. However, using operational limitations to justify energized electrical work shall be done with extreme care and caution. The consideration or determination of production losses alone as justification for energized electrical work is not sufficient. As a minimum, the degree of hazard and potential consequences of working on energized electrical equipment shall be identified and considered as part of the justification.
  - De-energization introduces additional or increased hazards.
    - De-energization of gas detection or emergency alarm systems could be examples of situations where de-energization introduces increased hazards to personnel.

- De-energization of ventilation systems in buildings that require ventilation to ensure dangerous levels of flammable or toxic gases do not develop is another example.
- The energized electrical conductors or circuit parts operate at 30 V or less and the capacity of the circuit is 100 A or less.

11.3. Work Area Access

Access to Work Area

- Access to the work zone/area, when energized electrical work is performed, shall be restricted to authorized personnel only.
  - The means of restricting access to authorized personnel shall be appropriate to the work location and task and may include:
    - use of warning tape,
    - barricades,
    - a Safety Watch person, or
    - a similar means.
  - Restricted access limits shall not be closer than the greater of either the limited approach boundary or the arc flash boundary.
- No person shall cross the arc flash boundary during energized electrical work unless this action is deemed necessary by the QEW(s) performing the work.
- Unqualified persons shall not cross the Restricted Approach Boundary unless escorted by QEWs at all times.

11.4. Energized Electrical Work Permits (EEWPs)

Energized Electrical Work Permits

- All energized electrical work requires an Energized Electrical Work Permit to be completed, with the following exceptions:
  - Work performed within the Limited Approach Boundary of energized electrical conductors or circuit parts rated less than 1000 V related to tasks such as testing, troubleshooting, voltage measuring, etc. Where such work could cause a voltage greater than 1000 V to be generated (e.g. when testing the low voltage side of a transformer, the high side may become energized at greater than the 1000 V limit) an Energized Electrical Work Permit is required.
  - If the purpose of crossing the Limited Approach Boundary is for visual inspection only, and the Restricted Approach Boundary will not be crossed. Infrared scans may fit this description.
  - Work on energized conductors less than 30 V.

	○ Replacement of fuses by a QEW in panels containing circuits that do not exceed 150 V using appropriate safe work practices and PPE that is appropriate for the shock and arc flash hazard. Fuse-handling and fuse-holder-handling equipment that is insulated for the circuit voltage shall be used to remove or install a fuse if energized circuit parts are in the vicinity of the work. ○ Insulation testing (i.e. “meggering” and “hi-potting”). ○ Voltage measuring on circuits rated above 1000 V when all the following requirements are met: ▪ the circuit being tested and any other circuit within the Limited Approach Boundary of the work being performed can be reasonably assumed to be in a de-energized state due to the operation of disconnect devices and the application of locks to these disconnect devices, or the completion of similar actions ▪ the QEW performing the work wears suitable electrical specific PPE for the arc flash and electric shock hazards ▪ the QEW uses an appropriately rated test instrument to perform the test before touch procedure.
Energized Electrical Work Permit Requirements	The Energized Electrical Work Permit shall contain all the following elements: • a description of the circuit and equipment to be worked on and their location • a justification for why the work must be performed in an energized condition • a description of the safe work practices to be employed; • results of the shock risk assessment • determination of shock protection boundaries; • results of the arc flash risk assessment • the arc flash boundary • the required PPE (both electrical specific and general) to safely perform the assigned task • the methods used to restrict the access of unqualified persons from the work area • evidence of completion of a job briefing, including a discussion of any job-specific hazards • energized work approval signatures from a minimum of the following: ○ a Manager/ Superintendent/ Foreman/ Coordinator or other Husky employee with an equivalent level of authority for the facility, area or project ○ the Process & Occupational Safety staff member for the facility or project ○ the QEW doing the work ○ one other electrically knowledgeable person.

EEWP Sign-off

- All efforts shall be made to obtain signatures on the Energized Electrical Work Permit prior to the start of the work. Under certain conditions, for example at remote sites, it may be necessary to use electronic communications to obtain signatures in a timely manner. It is recognized, however, that in very rare situations, it may not be practical or feasible to obtain a physical signature prior to the start of work. Under these rare situations, and at the sole discretion of the affected signatory (i.e. the person who is unable to physically sign the Permit at the time), verbal approval to proceed may be granted in advance of a signature. Under such circumstances, all the following requirements shall be satisfied:
  - The Energized Electrical Work Permit shall be fully completed with the exception of any signatures that may not be readily available
  - Each person (or their approved designate) who would normally sign the Energized Electrical Work Permit shall be contacted.
  - The QEW and/or the Husky personnel directing the work shall ensure that a complete and accurate description of all information on the completed Energized Electrical Work Permit is provided to each person who is contacted
  - Each person who is contacted to approve the energized electrical work shall first be informed that they have the right to approve or not approve the energized electrical work and they shall not provide their approval until all the following requirements are met:
    - they agree that the proper procedures for completing the Energized Electrical Work Permit have been followed,
    - they agree that it is infeasible to perform the work with the equipment de-energized or that de-energization would introduce greater hazards
    - they believe the work can be done safely before they may give their approval.
  - Approval has been received from all necessary personnel. If any required signatory does not approve the energized electrical work, the work shall not proceed with the equipment in an energized state
  - Physical signatures on the Energized Electrical Work Permit for the work shall be obtained from all required signatories within five working days of the commencement of the work.

Annual EEWPs	• Annual Energized Electrical Work Permits may be used for specific routine, low risk, energized electrical work tasks.
	• Tasks that may be deemed as low risk include:
	  • tasks where the maximum voltage of all circuits exposed during the execution of the task does not exceed 240 V and the incident energy is 8 cal/cm^2 or less (or the PPE required is AFC 2 or less as determined by the Table Method)
	  • other tasks deemed to be low risk by an electrically knowledgeable person.
	• Annual Energized Electrical Work Permits shall state the conditions that must be met before they can be used, including but not limited to weather conditions, site operational conditions, lighting conditions, equipment condition, electrical distribution system scheme (such as tie-breakers open or closed), name(s) of personnel who may perform the work (if desired), etc. Each time an Annual Energized Electrical Work Permit is used, the worker executing the work shall ensure that all conditions listed on the Permit have been met and that no changes have occurred that could introduce additional hazards.
	• A copy of the Annual Energized Electrical Work Permits shall be signed and dated by the worker(s) performing the work each time the Permit is used.

11.5. EEWPs Required for Specific Tasks

Insertion or Removal of Starter Cell Buckets	An Energized Electrical Work Permit shall be completed when installing or removing cells (i.e. starter buckets or wrappers) in energized motor control centres
Unhinged Covers	An Energized Electrical Work Permit shall be completed when removing or reinstalling unhinged covers/panels on energized electrical equipment rated greater than 240 V or where the incident energy is greater than 8 cal/cm^2 (or the required level of PPE is AFC 3 or higher when the Table Method is used).
Voltage Testing Over 1000 V	All testing, troubleshooting and voltage measuring of circuits rated greater than 1000 V requires an Energized Electrical Work Permit (except where specifically exempted elsewhere in this document) and shall be performed by a QEW.

Racking of Switchgear	An Energized Electrical Work Permit is not required when racking in or racking out circuit breakers or medium voltage motor controllers that are designed for this operation if all the following conditions are satisfied: • the equipment is properly installed • the equipment is properly maintained • the equipment doors are closed and secured • the equipment covers are in place and secured • there is no evidence of impending failure. NOTES: “properly installed” means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer’s recommendations. “properly maintained” means that the equipment has been maintained according to the manufacturer’s recommendations and applicable industry codes and standards. “evidence of impending failure” means that there are signs of arcing, overheating, loose or bound parts, physical damage, deterioration, or excessive corrosion on the equipment.

12.0 Batteries and Battery Rooms

12.1. Access

Access to Battery Rooms and Battery Banks	Battery rooms and battery banks shall be: • Accessible to authorized personnel only • Provided with signs warning of shock, arc flash (if applicable), potential presence of explosive gases, and chemical hazards located in easily visible locations at all points of access to the room.

12.2. Tools and Maintenance

Tools and Equipment	Tools and equipment used for work on batteries shall be constructed to minimize the chance of creating sparks and shall be insulated for the maximum working voltage.

12.3. Testing and Maintenance

Battery Rooms Alarms Testing	Alarms, if provided, for overvoltage, undervoltage, overcurrent, ground fault and over-temperature shall be tested at an interval not to exceed twelve months.
Battery Cells	• Battery cell ventilation openings shall be unobstructed and cell flame arresters shall be maintained. • Battery cell flame arresters shall be inspected for proper installation and unobstructed ventilation.
Battery Rooms Ventilation	When forced or natural ventilation systems are required by the battery system design and are present, they shall be examined and maintained to prevent buildup of explosive mixtures. • This maintenance shall include a functional test of any associated detection and alarm systems.

13.0 Maintenance

13.1. Maintenance and Inspection Requirements

Maintenance of Electrical Equipment	• Only QEWs shall perform maintenance activities on electrical equipment. • Electrical equipment shall be maintained in accordance with the manufacturer's instructions or industry consensus standards to reduce the risk associated with failure. • Maintenance, tests and inspections shall be documented. • All electrical equipment shall be regularly maintained, inspected and tested in a manner that maintains or reduces the risks to personnel of electric shock or arc flash hazards. Regular maintenance will minimize risks due to equipment failure, electrical fires, shock hazards, arc flash hazards and all other hazards associated with electricity. • All working space and clearances for electrical equipment shall be maintained. • Enclosures shall be kept free of material that would create a hazard (e.g. dust, dirt, moisture, oil or grease build-up, etc.).
Inspection of Electrical Equipment	• An external visual inspection of electrical equipment shall be conducted at least once per year. • Deficiencies noted during inspections shall be reported immediately and fixed promptly. This includes missing covers, fasteners, excessive dirt/dust, indications of excessive heat and thermal damage, etc.

13.2. Testing Requirements

Testing Scope and Frequency	• The scope and frequency of testing of electrical equipment shall be done as per manufacturer's recommendations and/or the guidelines of NFPA 70B *Recommended Practice for Electrical Equipment Maintenance*, ANSI/NETA *Standard for Maintenance Testing Specifications*, or CSA Z463 *Maintenance of Workplace Electrical Systems*.
Testing Intervals	• The recommended interval for testing the operation of all 480 V and higher main breakers (including associated relays) and feeders to other electrical equipment in excess of 200 A is three years, but in no case shall the interval exceed five years. • Tests shall include timing tests to ensure correct breaker operation for both low level overloads and short circuit conditions, contact resistivity (i.e. "ducter") testing and insulation integrity (i.e. "megger" or "hi-pot") testing.

14.0 Electrical Rooms and Buildings

14.1. Access and Intended Use

Authorized Personnel	• Only authorized personnel, including but not limited to QEWs, operators and electrical engineers/technologists, shall enter electrical rooms or buildings. • Personnel shall only enter an electrical room or building when they are required to operate, maintain, repair, provide technical support or have similar valid reasons for entering these areas. • These personnel shall be trained to understand the electrical hazards around them while in the electrical room or building or be escorted by trained, authorized personnel.
Authorized Use	• Electrical rooms and buildings shall not be used for storage of any materials that are not associated with the maintenance or operation of the electrical equipment contained within that room or building. Drawings and manuals associated with electrical equipment may be stored in electrical rooms and buildings in a neat and orderly manner. • Electrical rooms and buildings shall not be used by personnel as coffee break rooms, lunch rooms or any other reason than for operating and maintaining the equipment contained within the room or building.

14.2. Posted Single Lines and Signage

Single Line Diagrams	• Up to date Single Line Diagrams or equivalent documentation shall be posted at all 480 V and above switchgear, motor control centers and other distribution equipment. ○ Posting of Single Line Diagrams or similar documentation is not required for very simple distribution systems such as those found at single well controllers.
Signage	Electrical buildings and rooms shall have visible signs at all points of entry that clearly state all the following: • There are electrical hazards present (e.g. WARNING: ELECTRIC SHOCK AND ARC FLASH HAZARD) • Only authorized personnel are allowed to enter (e.g. AUTHORIZED PERSONNEL ONLY) • The MCC building/room identification tag or number.

15.0 Electrical Panels

15.1. Panels and Panel Schedules

Panels and Panel Schedules	Required electrical safety practices include: • Taking care to not overload circuits and receptacles • Ensuring lighting panel schedules are as-built and legible.

16.0 Overhead Lines

16.1. Working Near Overhead Lines

Risk Assessment	• A risk assessment shall be performed where any work, including but not limited to electrical work, will be performed in locations containing overhead lines. • The work shall be planned and adequate safeguards applied to ensure that workers, conductive tools, materials, or equipment do not come within the applicable Limits of Approach of the energized power lines or other energized circuit parts (e.g. energized exposed transformer bushings) as identified in Provincial/State/Federal occupational health and safety regulations.
Work Near Overhead Lines	• Where overhead lines or other exposed parts of electrical systems are to be de-energized before the start of work, those lines or other exposed parts shall be visibly grounded at the location of the work. • Where overhead lines are owned by a Utility, the Utility shall be contacted to verify the voltage levels that may be present and to determine any other requirements that the Utility may have when work is performed near their overhead lines.

17.0 Construction and Turnarounds

17.1. General

Required Electrical Safety Practices	Required electrical safety practices on construction sites and at sites conducting turnaround or other maintenance activities include, but are not limited to: • Development and maintenance of single line diagrams to help ensure effective and safe lockouts, assist when modifications are necessary, and help prevent overloading of circuits • Ensuring that temporary power systems are designed, documented with drawings, installed and maintained to the Canadian Electrical Code or National Electrical Code as applicable.
Cutting or Drilling	Before cutting or drilling into equipment, floors, walls, or structural elements where a likelihood of contacting energized electrical lines or parts exists, Husky personnel shall ensure that: • the location of conductors, cables, raceways, or equipment is identified and marked; and • the safe work practices and personal protective equipment to be used are specified.
Conductors	When conductors are de-energized to cut, remove, or reroute them and conductor terminations are not within sight, additional steps to verify absence of voltage or identify the conductors shall be taken.

18.0 Designing for Electrical Safety

18.1. Risk Control Measures

Preventive and Protective Control Measures

Preventive and protective control measures for electrical risks can be categorized into six different methods listed from most effective to least effective:

1. elimination of the risk (e.g. de-energization)
2. substitution of equipment, procedures, etc. that are safer
3. engineering design and controls
4. warning signs and barricades
5. administrative controls, training and the use of procedures
6. personal protective equipment.

18.2. Safety by Design

Safety by Design

- An effective method to reduce electrical risks to personnel is to address safety in the design phase of new facilities or upgrades to existing facilities as the design of the system can affect all of these methods.
- Engineered solutions can often eliminate electrical hazards to personnel or at least reduce the risk to personnel by choosing the safest electrical equipment or design option.
- Safety by design may incorporate numerous features, however two principles are especially important:

Principles	Description
Ease of de-energization	If equipment can be de-energized without decreasing production throughput or effects on throughput are minimal, electrical equipment is much more likely to be well maintained which will result in greater levels of safety, more reliability and thus greater rates of throughput and equipment availability for the life of the facility.
Distance	Keeping personnel away from hazards, especially when the equipment is operating or changing state is a very effective means of reducing hazard risks to personnel. An example of this is a remote breaker operation panel instead of push buttons on the front of electrical switchgear.

New Construction and Upgrades	• All new construction and upgrades to existing facilities shall specifically address and consider electrical safety during the early stages of the project. • The amount of time and effort that is required will be different for each project. Some of the factors to be considered are: ○ type(s) of processes involved and ease of de-energization of all electrical equipment based on operational needs ○ frequency of maintenance ○ ease of maintenance and other electrical tasks required during the lifetime of the facility (e.g. is there adequate working space in front of and behind electrical distribution equipment that requires access for breaker racking or the application of temporary protective grounds) ○ incident energy levels at the assumed working distance (e.g. an engineering study shall be completed at the beginning and end of the design stage, as well as at the as-built stage) ○ shock hazards.
Identify Electrical Risks	• The electrical risks shall be identified for each type of equipment and means to reduce the risk to personnel shall be identified and considered for implementation. • For large projects, representatives from the Business Unit, Operations, Maintenance, and Engineering departments shall be involved in this process to ensure a reasonable balance of safety, operability, and maintainability is reached.

19.0 Detailed Arc Flash Incident Energy Analysis Studies

19.1. Frequency of Arc Flash Study Review

Review Intervals for Arc Flash Hazard Analysis

- The data used in the arc flash hazard analysis shall be reviewed for accuracy at intervals not to exceed five years.
- When the review of the data identifies a change that renders the arc flash hazard analysis inaccurate, the analysis shall be updated.
- An arc flash hazard analysis shall be updated when significant changes to the electrical distribution system at the facility or the Utility system supplying the facility occur.
- Changes requiring updates to the arc flash hazard analysis include:
    - Addition of removal of significant loads
    - Connected electrical generation is added or removed
    - Significant change to the short circuit levels supplied by the Utility.

19.2. Deliverables

Deliverables of Incident Energy Analysis

The minimum deliverables of a detailed incident energy analysis (i.e. “Incident energy analysis method” from CSA Z462), shall be:

- Incident energy levels at the assumed working distance and arc flash boundaries at each bus. Incident energy levels shall be provided for both the line and load side of each main protective device
- Incident energy levels at the assumed working distance and arc flash boundaries at the primary and secondary side of each transformer rated greater than 125 kVA. At the discretion of Husky’s Electrical Engineer, incident energy levels at smaller transformers may also be required
- An engineering power system electronic model of the electrical system for Husky’s future use. Husky shall specify the modelling software to be used by any external consultants to ensure that the model is supported by software used internally by Husky
- Recommendations on how any arc flash levels higher than 40 cal/cm^2 can be reduced below that level, if possible.

NOTE: Although not mandatory, it may also be desirable for the person or company responsible for the study to provide recommendations on reducing incident energy levels for any buses where incident energy levels are greater than 8 cal/cm^2.

Deliverables of Arc Flash Hazard Analysis	The minimum deliverables of an arc flash hazard analysis using the Table Method* from CSA Z462 (i.e. “Arc flash PPE category method”), shall include: • Confirmation that the available fault current and fault-clearing times are within the ranges noted in the Tables*. The available fault current and the fault-clearing times that have been determined shall be recorded in the analysis • A list of applicable sections in the Tables* should be noted or highlighted as many facilities will not have electrical equipment rated greater than 1 kV, many facilities do not have switchgear, etc. • The required minimum working distances as specified in the Tables* • The electrical specific PPE requirements for the applicable Arc Flash PPE Category that are identified by the analysis. * - “the Table Method” and “the Tables” refers to Tables 6A and 6B of CSA Z462 (or Tables 130.7(C)(15)(a) and 130.7(C)(15)(b) of NFPA 70E)
Documentation of Analysis	The analysis shall be made readily available to the workers at the site. • It is recommended that the study is filed, and a copy is left at site or in a nearby field office.

20.0 Labelling Equipment

20.1. Labelling Requirements

Labelling on Distribution Equipment

- In addition to the mandatory labelling requirements of the Canadian Electrical Code and/or other local regulations, all the following information shall be provided on all distribution equipment rated greater than 150 Vac or 100 Vdc:
  - Voltage Level (in volts or kilovolts)
  - Incident Energy Level (in cal/cm^2) at the assumed working distance
  - Assumed Working Distance (in meters, millimetres, inches or feet)
  - Arc Flash Boundary (in meters, millimetres, inches or feet)
  - Restricted Approach Boundary (in meters, millimetres, inches or feet)
  - Limited Approach Boundary (in meters, millimetres, inches or feet)
  - Date that the information required by this clause was analyzed or verified
  - Name of the person or organization who analyzed or verified the information required by this clause;
  - Rubber Insulating Glove Class Required
  - If there are alternative conditions besides normal supply source and/or distribution system configuration (i.e. standby generator power, tie breakers closed, etc.), the label shall indicate the conditions that apply.
- If an Engineer has determined that an arc flash study is not required for a particular piece of equipment it is acceptable to label the following fields as “Use the Table Method”:
  - Incident Energy Level
  - Arc Flash Boundary
  - Assumed Working Distance fields.
- For distribution equipment rated greater than 30 V but less than 150 Vac or 100 Vdc, or if Husky’s Electrical Engineer has determined that the above labelling requirements are not required, a generic warning label may be used. An example of an acceptable generic warning label is provided here: “WARNING: ARC FLASH AND SHOCK HAZARD”).

Labeling of Lighting and Distribution Panels	• Notwithstanding other requirements in this Standard, simplified labels for lighting and distribution panels rated 31-240 V need only state the following information:
	  ○ Voltage Level (in volts)
	  ○ Incident Energy Level (in cal/cm^2) at the assumed working distance or the Arc Flash PPE Category for the equipment
	  ○ Assumed working distance (in meters, millimetres, inches or feet)
	  ○ Arc Flash Boundary (in meters, millimetres, inches or feet).
	• For lighting and distribution panels rated 31-240 V, a generic warning label may be used when approved by Husky's Electrical Engineer. An example of an acceptable generic warning label is provided here: "WARNING: ARC FLASH AND SHOCK HAZARD").

Location of Labels	• When required, labels shall be located on the front of the electrical equipment and shall be visible to all workers without the need for opening doors or covers. • Where side or rear panels may also be removed for maintenance, infrared thermography or other reasons while the equipment is energized, labels shall also be placed on these panels.
Labelling Standards	• Labels shall conform to ANSI Z535.4 and CSA Z462 or NFPA 70E.

21.0 Incidents

21.1. Incidents and Reporting

An electrical incident is defined as any of the following:

Definition of Electrical Incident	• any incident where a person is injured or killed by an electric shock • any incident where a person is injured or killed by an arc flash or arc blast • any incident where electrical equipment fails in a manner that did or could have reasonably been expected to injure a person • fire suspected to be of an electrical origin • death to livestock from an electrical energy source • a near miss for any of the above.

Electrical Incident Reporting	• In addition to normal incident reporting requirements, all electrical incidents shall also be reported to the Engineering, Procurement & Project Management's Technical Services department. ○ The Technical Services department shall assist the department or Business Unit investigating the incident with examining the electrical incident, finding the root cause (if possible) and making recommendations to all appropriate Husky Business Units and Departments to avoid a similar incident in the future. • All required Provincial, Federal or State requirements for reporting on electrical incidents shall also be followed.

22.0 Audits

22.1. Annual Audit Requirements

Annual Comprehensive Audit	• Each year, one District or large facility shall be completely audited with respect to the contents and principles of this Standard. ○ The auditor shall strive to audit Districts or large facilities from different Business Units from year to year. • The purpose of the audit is to identify portions of the Electrical Safety Standard that are not being applied or are being applied incorrectly and to understand why they are not being applied correctly (e.g. lack of training, need to modify this Standard, etc.). • The audit shall include task-based observations of a QEW(s) performing work task(s) on electrical equipment. The purpose of these task-based observations shall be to determine if the worker(s) is (are) complying with the Electrical Safety Standard while performing the task(s).

Annual Audits in Each District or Major Facility	• An audit of at least one lockout in progress shall be conducted in each operating district at least annually.
	• Annual internal audits shall be performed in each District or major facility.
	• These annual internal audits shall assess the following requirements:
	  ○ Only QEWs are performing electrical work tasks
	  ○ All workers (electrical and non-electrical) are trained appropriately on electrical hazards and the requirements of this document
	  ○ Risk assessments are performed prior to the completion of tasks involving electrical hazards

	○ Electrical work is planned ○ The requirements for electrically safe work conditions are followed when tasks are to be performed on de-energized equipment ○ Appropriate electrical specific PPE is being chosen and used as per the requirements of this document ○ Electrical specific PPE, tools and meters are in good condition and are tested regularly where required by this document ○ Any required arc flash studies are available and up to date ○ Electrical equipment is adequately maintained as required by this document ○ Energized electrical work permits are used properly and when required ○ Electrical incidents are reported as required by this document.
Results of Audits	• The result of the audits shall include recommendations for corrections that should be made in the implementation of this Standard, or recommendations for modifications to this Standard, or both.

Document Accountability and Responsibility

Document Development

The BU Process Stewards, Corporate Process Steward and Corporate Process Owner participated in the development of this technical standard and must be consulted for any interpretation of requirements or application of the content of this document.

Implementation and Application

The Corporate Process Steward and Business Unit Process Stewards are responsible to administer and ensure the implementation of the technical standard requirements as described in this document.

Resolution of Interpretation and Applicability

Any issues that arise from implementation or application of this technical standard shall be brought to the attention of the BU Process Steward for review and resolution with the Corporate Process Steward and other Business Unit Process Stewards.
The Corporate Process Steward and Business Unit Process Stewards shall have sufficient qualifications, authority and organizational freedom to identify problems, report and investigate deficiencies, and issues relating to the implementation of this technical standard.

Document Updates and Sustainment

The Corporate Process Owner, Corporate Process Steward and Business Unit Process Stewards are responsible to ensure that this technical standard is reviewed within the required review cycle and kept in compliance with any Regulatory requirements that may apply.

Role	Position Title	Coversheet Approval Role
Corporate Element Owner	Sr. Mgr. Occupational Safety	Approver
Corporate Process Steward	Safety Specialist, Occupational Safety, Process & Occupational	Checker
HOIMS MSD Coordinator	Process Performance Improvement Advisor	QA Reviewer
Electrical Subject Matter Expert	Electrical Engineering Specialist	Originator

Definitions and Acronyms

Term	Definition
Arc flash hazard (“arc flash”)	A dangerous condition associated with the release of energy caused by an arcing fault current.
Arc blast	The pressure wave and associated projectiles caused by an electrical arc.
Arc Flash Hazard Level	The degree of risk due to a potential arc flash. This term is expressed in terms of incident energy if a detailed incident energy analysis has been performed or in terms of the required Arc Flash PPE Category if the Table Method has been used.
Arc Flash Boundary	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 electrical arc flash were to occur. NOTE: A second-degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 1.2 cal/cm^2.
Arc Flash PPE Category	A method for classifying arc flash protective clothing, based on a four-category system of AFC 1 to AFC 4 as presented in CSA Z462 *Workplace Electrical Safety.*
Arc Rated	Having an arc flash protection rating that has been established in accordance with the applicable standard listed in Appendix – D *Approved Standards for Electrical Specific PPE*.
Arc Rating	The value attributed to materials that describe their performance on exposure to an electrical arc discharge. • The arc rating is expressed in cal/cm^2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of breakopen threshold (EBT) (if a material system exhibits a breakopen response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value. Arc-rated clothing or equipment indicates that it has been tested for exposure to an electric arc. Flame-Resistant clothing without an arc rating has not been tested for exposure to an electric arc. All arc-rated clothing is also Flame-Resistant.
Arc Thermal Performance Value (ATPV)	The incident energy (in cal/cm^2) on a material or a multi-layer system of materials that results in a 50% probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve.

Term	Definition
De-energized	Free from an electrical connection to a source of potential difference and from electrical charge, i.e., not having a potential different from that of the earth.
E(bt) (breakopen threshold energy)	The incident energy on a material or material system that results in a 50% probability of breakopen. Breakopen is defined as a hole with an area of 3.23 cm^2 (0.5 in^2) or an opening with a 2.54 cm (1.0 in) dimension in any direction.
Electric shock	Physical stimulation that occurs when electrical current passes through the body.
Electrically knowledgeable person	A person who is an electrician, electrical engineer, electrical technologist or has an equivalent designation to one of these three occupations and has a high level of knowledge pertaining to electrical safety and the hazards of electric shock and arc flash.
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).
Energized	Electrically connected to or is a source of voltage.
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.
FR	Flame resistant, as defined by other Husky standards.
Ground-fault circuit interrupter (GFCI)	A device that functions to interrupt a circuit or portion of a circuit, within a predetermined time, when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit. A “Class A GFCI” will interrupt the circuit when the ground-fault current is 6 mA or more but not when the ground-fault current is 4 mA or less.
Hazard	A source of possible injury or damage to health.
Hazardous	Involving exposure to at least one hazard.
Heavy duty leather gloves	Gloves made entirely of leather with a minimum thickness of 0.7 mm (0.03”) and that are unlined or are lined with non-flammable, non-melting fabrics.

Term	Definition
Incident Energy	The amount of thermal energy impressed on a surface a certain distance from the source, generated during an electrical arc event. NOTE: Incident energy is typically measured in units of calories per centimetre squared (cal/cm^2).
Incident Energy Analysis	A component of an arc flash risk assessment used to predict the incident energy of an arc flash event for a specified set of conditions.
Limited Approach Boundary	An approach limit at a distance from an exposed energized electrical conductor or circuit part within which an electric shock hazard exists.
Lockout	Placement of a lock on an energy-isolating device in accordance with an established procedure, thereby indicating that the energy-isolating device is not to be operated until the lock is removed in accordance with an established procedure. A tag is normally also affixed to the lockout device indicating the reason for the lockout, the date the lockout was performed, the personnel involved in the lockout and any other pertinent details.
PPE (personal protective equipment)	Clothing or other items designed to be worn by a person in order to provide protection from specified hazards.
Qualified Electrical Worker (QEW)	A person who meets all of the following criteria: • holds a certificate in the electrical trade or other certification that is acceptable to the local authority having jurisdiction with respect to the task being performed NOTE: the definition of “Qualified Electrical Worker” is in addition to all applicable federal, provincial/state, local and site-specific requirements, and is intended to further define the required traits, training, skills, and experience of the electrical worker to ensure they are competent for the specific tasks they are required to perform. • is authorized by someone having authority in Husky to work on electrical equipment • can identify the hazards involved in the task being performed; • has demonstrated skills and knowledge related to the construction and operation of the electrical equipment and installations involved in the task being performed • has received safety training to identify and avoid the hazards involved.

Term	Definition
Racking	Connecting or disconnecting a breaker or contactor assembly from an energized bus by means of the stabs being moved onto or off of the bus bars. During a racking operation, the breaker or contactor assembly rolls on wheels or slides in a track to connect and disconnect the bus stabs from the bus. The motive power is generally achieved by multiple turns of a hand crank or in some cases by a motor. NOTE: Racking is not the same as operating a disconnect handle which opens or closes contacts within a breaker (or contactor).
Restricted Approach Boundary	An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part.
Risk	A combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard.
Risk Assessment	An overall process that identifies hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of occurrence of injury or damage to health, and determines if protective measures are required. NOTE: Use of the term “risk assessment” in this document only implies the meaning given above; the use of other Husky “risk assessment” procedures / forms / matrices is not required.
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.
Table Method	A method of arc flash risk assessment for determining the Arc Flash PPE Category applicable to specific work tasks under specific conditions as described in CSA Z462 and NFPA 70E.
Test Before Touch	A consistent methodology for ensuring that electrical conductors and circuit parts are de-energized prior to work being performed on them. (Further details on the requirements for “test before touch” procedures are provided elsewhere in this document.)
Work (on energized electrical conductors or circuit parts)	Intentionally coming in contact with energized electrical conductors or circuit parts with the hands, feet, or other body parts, or with tools, probes, or test equipment regardless of the personal protective equipment a person is wearing. Note that operating equipment is not defined as "work" with respect to this Standard.

Reference Documents

The following documents should be referenced to provide context for the content of this document.

Document ID	Document Title
ANSI Z535.4	*Product Safety Signs and Labels*
ANSI/ISA S82.02.01	*Electric and Electronic Test, Measuring, Controlling, and Related Equipment: General Requirements*
ASTM F 711	*Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live-Line Tools*
ASTM F 855	*Standard Specification for Temporary Protective Grounds to be Used on De-Energized Electric Power Lines and Equipment*
ASTM F 1505	*Standard Specification for Insulated and Insulating Hand Tools*
ASTM F2249	*Standard Specification for In-Service Test Methods for Temporary Grounding Jumper Assemblies Used on De-Energized Electric Power Lines and Equipment*
CSA Z460	*Control of hazardous energy – Lockout and other methods*
CSA Z462	*Workplace Electrical Safety*
CSA Z463	*Maintenance of Electrical Systems*
NFPA 70B	*Recommended Practice for Electrical Equipment Maintenance or ANSI/NETA Standard for Maintenance Testing Specifications*
NFPA 70E	*Workplace Electrical Safety*
IEC 61010	*Safety requirements for electrical equipment for measurement, control, and laboratory use*
IEC 61243-1	*Live working - Voltage detectors - Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c.*
IEEE 1584	IEEE *Guide for Performing Arc Flash Hazard Calculations*

Appendix - A Approach Boundary Tables

For energized work, as described in section 11.0, the following tables stipulate the minimum distances to be established for the Limited Approach Boundary and the Restricted Approach Boundary around the electrical equipment worked on.

1. Approach Boundaries for ac Systems

Table 1: Approach Boundaries for Shock Protection - ac Systems

Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection (all dimensions are distance from energized electrical conductors or circuit part to worker)			
(Column 1)	(Column 2)	(Column 3)	(Column 4)
Nominal System Voltage Range, Phase to Phase [1]	Limited Approach Boundary - Exposed Movable Conductor	Limited Approach Boundary - Exposed Fixed Circuit Part	Restricted Approach Boundary; Includes Inadvertent Movement Adder
Less than 30 V	Not specified	Not Specified	Not Specified
31 V to 150 V	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	Avoid Contact
151 V to 750 V	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	0.3 m (1 ft 0 in)
751 V to 15 kV	3.0 m (10 ft 0 in)	1.5 m (5 ft 0 in)	0.7 m (2 ft 2 in)
15.1 kV to 36 kV	3.0 m (10 ft 0 in)	1.8 m (6 ft 0 in)	0.8 m (2 ft 7 in)
36.1 kV to 46 kV	3.0 m (10 ft 0 in)	2.5 m (8 ft 0 in)	0.8 m (2 ft 9 in)
46.1 kV to 72.5 kV	3.0 m (10 ft 0 in)	2.5 m (8 ft 0 in)	1.0 m (3 ft 3 in)
72.6 kV to 121 kV	3.3 m (10 ft 8 in)	2.5 m (8 ft 0 in)	1.0 m (3 ft 4 in)
138 kV to 145 kV	3.4 m (11 ft 0 in)	3.0 m (10 ft 0 in)	1.3 m (3 ft 10 in)
161 kV to 169 kV	3.6 m (11 ft 8 in)	3.6 m (11 ft 8 in)	1.3 m (4 ft 3 in)
230 kV to 242 kV	4.0 m (13 ft 0 in)	4.0 m (13 ft 0 in)	1.7 m (5 ft 8 in)
345 kV to 362 kV	4.7 m (15 ft 4 in)	4.7 m (15 ft 4 in)	2.8 m (9 ft 2 in)
500 kV to 550 kV	5.8 m (19 ft 0 in)	5.8 m (19 ft 0 in)	3.6 m (11 ft 10 in)
765 kV to 800 kV	7.2 m (23 ft 9 in)	7.2 m (23 ft 9 in)	4.9 m (15 ft 11 in)

NOTE: For single phase systems, select the range that is equal to the system's maximum phase-to-ground voltage times 1.732

2. Approach Boundaries for dc Systems

Table 1: Approach Boundaries for Shock Protection - dc Systems

Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection (all dimensions are distance from energized electrical conductors or circuit part to worker)			
(Column 1)	(Column 2)	(Column 3)	(Column 4)
Nominal System Voltage Range, Phase to Phase [1]	Limited Approach Boundary - Exposed Movable Conductor	Limited Approach Boundary - Exposed Fixed Circuit Part	Restricted Approach Boundary; Includes Inadvertent Movement Adder
Less than 100 V	Not specified	Not Specified	Not Specified
100 V to 300 V	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	Avoid Contact
301 V to 1 kV	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	0.3 m (1 ft 0 in)
1.1 kV to 5 kV	3.0 m (10 ft 0 in)	1.5 m (5 ft 0 in)	0.4 m (1 ft 5 in)
5.1 kV to 15 kV	3.0 m (10 ft 0 in)	1.5 m (5 ft 0 in)	0.7 m (2 ft 2 in)
15.1 kV to 45 kV	3.0 m (10 ft 0 in)	2.5 m (8 ft 0 in)	0.8 m (2 ft 9 in)
45.1 kV to 75 kV	3.0 m (10 ft 0 in)	2.5 m (8 ft 0 in)	1.0 m (3 ft 6 in)
75.1 kV to 150 kV	3.4 m (10 ft 8 in)	3.0 m (10 ft 0 in)	1.2 m (4 ft 0 in)
150.1 kV to 250 kV	4.0 m (11 ft 8 in)	4.0 m (11 ft 8 in)	1.6 m (5 ft 3 in)
250.1 kV to 500 kV	6.0 m (20 ft 0 in)	6.0 m (20 ft 0 in)	3.5 m (11 ft 6 in)
500.1 kV to 800 kV	8.0 m (26 ft 0 in)	8.0 m (26 ft 0 in)	5.0 m (16 ft 5 in)

Appendix - B Resetting Protective Devices by Non-Electrical Personnel

Documented Procedures Requirements

Documented procedures that allow trained personnel who are not QEWs to reset electrical protective devices shall meet all the following requirements:

- Only be developed after a risk assessment has been performed for the specific task and equipment involved
- Be approved and signed by all the following personnel:
  - Appropriate managerial personnel, including a Manager/ Superintendent/ Foreman/ Coordinator or other Husky employee with an equivalent level of authority for the facility, area or project
  - The Health Safety & Environment representative for the facility or project
  - A Husky electrically knowledgeable person familiar with the equipment and facility
- Include a description of the specific equipment and installations where the procedure is applicable, including, but not limited to, the type of device and its specific application, the minimum qualifications of the personnel that may reset the device, and any other specific requirements deemed necessary to ensure the safety of personnel
- Require the person resetting the device to be familiar with the operation of the electrical equipment and associated loads
- Require that the electrical protective device be reset without exposing personnel who are not QEWs to energized circuit parts or conductors, e.g. where a reset push button is on the exterior of the equipment
- Specify the maximum permissible number of resets that may be performed on a specific device over a specified time period, e.g. one reset over 48 hours
- Require a visual inspection of all associated equipment prior to performing the reset of the device. The purpose of the visual check shall be to verify there are no visible reasons that the circuit should not be re-energized. The visual checks shall include, but are not limited to, the driven load and the conduit/cable system (to the extent practical). These visual checks must not require any electrical equipment to be opened
- Require the cause of the protective device's operation to be identified with reasonable certainty (e.g. motor overload, lightning storm in the area, faulty extension cord, overloaded receptacle, etc.)
- Require that the cause of the trip has been removed or no longer exists for other reasons (e.g. overloaded circuits are no longer overloaded, disturbances from the Utility supply due to lightning/high winds/other storm conditions have dissipated, etc.)
- Require that no electrical protective device is reset when there is obvious evidence of damaged or faulty equipment.

Review Intervals

These procedures shall be reviewed and signed by an equivalent team as specified above at intervals not to exceed five years.

Appendix - C Suggested Content for Procedures

Structure and content of procedures

Typical procedures may include, but are not limited to, the following:

- purpose of task
- qualifications and number of employees to be involved
- hazardous nature and extent of task
- limits of approach (for both the shock and arc flash hazards)
- safe work practices to be utilized
- PPE (both general and electrical specific) that is involved and/or required
- insulating materials and tools involved
- special precautionary techniques
- any required (or useful) electrical diagrams and drawings
- equipment details and manuals
- sketches/pictures of unique features
- reference data

Appendix - D Approved Standards for Electrical Specific PPE

Subject	Number and Title
Head Protection	CSA-Z94.1, *Industrial Protective Headwear* ANSI/ISEA Z89.1, *Industrial Head Protection*
Eye and Face Protection	CSA-Z94.3, *Eye and Face Protectors* ANSI/ISEA Z87.1-2010, *Occupational and Educational Personal Eye and Face Protective Devices*
Gloves	ASTM D 120, *Standard Specification for Rubber Insulating Gloves*
Sleeves	ASTM D 1051, *Standard Specification for Rubber Insulating Sleeves*
Rubber Insulating Gloves and Sleeves	ASTM F 496, *Standard Specification for In-Service Care of Insulating Gloves and Sleeves*
Leather Protectors	ASTM F 696, *Standard Specification for Leather Protectors for Rubber Insulating Gloves and Mittens*
Live Line Tools (“Hot Sticks”)	ASTM F 711, *Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live-Line Tools*
Footwear	CSA Z195, *Protective footwear* ASTM F 1117, *Standard Specification for Dielectric Footwear*
Apparel	ASTM F 1506, *Standard Performance Specification for Textile Material for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards*
Raingear	ASTM F 1891, *Standard Specification for Arc and Flame Resistant Rainwear*
Face Protective Products	ASTM F 2178, *Standard Test Method for Determining the Arc Rating and Standard Specification for Face Protective Products*
Temporary Protective Grounds	ASTM F 855, *Standard Specification for Temporary Protective Grounds to be Used on De-Energized Electric Power Lines and Equipment*

Appendix - E Versioning History

Revision Number	Date (drop down pick list)	Reason for Change – highlight what changed in document
0 (Original)	7 May 2009	*First Issue (as the Electrical Safety Code of Practice), actual issued date was August 31, 2009*
1.0	25 April 2012	*First revision (as the Electrical Safety Code of Practice). Updated to reflect changes in CSA Z462-12 and other changes approved by the Electrical Safety Document Review Working Group.*
2.0	5 May 2015	*Second revision. Updated to reflect changes in CSA Z462-15 and other changes approved by the Electrical Safety Document Review Working Group. Changed title to "Electrical Safety Standard".*
3.0	24 June 2019	*Third revision. Updated to reflect changes in CSA Z462-18 and other changes approved by the Electrical Safety Work Group, including:* - *Changed lower voltage limit from 50 V to 30 V* - *Added requirement to address potential for human error in risk assessment.* - *Added requirements to document results of risk assessments.* - *Eliminated reference to "electrical workers" where possible, often changing to "Qualified Electrical Workers".* - *Specified that rubber insulating gloves are not required for voltage testing under 150 V when certain requirements are met.* - *Updated references to CSA Z462 and NFPA 70E* - *Provided more guidance on when an Energized Electrical Work Permit is required and not required.* - *Added requirement to maintain electrical equipment in accordance with manufacturer's instructions or industry consensus standards.* - *Provided more guidance on documenting worker training.* - *Modified requirements for periodic review/update of arc flash studies.* - *Added requirement to examine and maintain forced and natural ventilation systems for batteries.* - *Modified requirements for retraining of electrical workers.* - *U*pdated definitions to match changes in CSA Z462 and NFPA 70E. - *Made changes to match IEEE 1584-2018. New version of IEEE 1584 applies to lower capacity 208/240 V systems than previous version which implied no arc flash hazard for 240 V and below, 125 kVA and below.*