

1.0 INTRODUCTION

Many of the tasks performed in the workplace create the hazard of being in the line of fire. It is estimated that 27% of workplace fatalities are a result of Line of Fire incidents, second only to slips, trips and falls.

The line of fire is the path an object under tension, pressure, suspension or any other energy will travel should something fail or go wrong. Examples include cutting towards yourself, pulling tools or equipment towards yourself, walking under employees who are working above, being in a load drop zone or working in proximity of cables / rope under tension.

2.0 SCOPE

This Standard applies to all NB Power employees and contractors working on behalf NB Power.

3.0 REFERENCES

NB Occupational Health and Safety Act	Duties of the Employer, Supervisor, Contracting Employer, and Employee
NB OHS Act / Reg 91-191	New Brunswick Occupational Health and Safety Regulation
CAN/ULC-S801-14,	Standard on Electric Utility Workplace Electrical Safety for Generation, Transmission and Distribution
CSA B167-08	Overhead travelling cranes - Design, inspection, testing, maintenance, and safe operation
Rigging Handbook	The complete illustrated field
CSA Z150-98	Safety Code on Mobile Cranes
ASME B30	Safety Standard for Cableways, Cranes, Derricks, Hoists,
HSEE-03-01	Hazard Assessment
HSEE-03-12	Lifting and Rigging
H&S Standard III-11	Tailboard Conference (Pre-Job Briefing, PJB)
H&S Standard III-9	Barrier Tape

4.0 TERMS AND DEFINITIONS

Line of Fire	The line of fire is the path an object with stored energy will travel or the path hazardous energy will travel if released.
Pressure	Is the force exerted against an opposing fluid or thrust distributed over a surface. Expressed in force or weight per unit of area.
Tension	Is a force associated with the pulling of an object such as a rope, cable, or chain.
Suspended load	A load is considered to be suspended when the rigging equipment is under tension even if there is still contact between the load and the floor or ground.
Force	Is the push or pull on an object with mass that causes it to change velocity (eg. accelerate, decelerate)

Health & Safety Standards



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Managing the Line of Fire

Exclusion Zone	An exclusion zone is the area in which no one can be positioned due to the hazard of line of fire. Protective devices (eg. metal cage or jersey barrier) are required for a person to work within this zone.
Stored Energy	Stored energy is accumulated energy that can release suddenly, potentially causing serious injury or death
Safety Zone / Exclusion Zone	A safety zone is the area established outside the anticipated or calculated line of fire that can be occupied by personnel involved in the work. Personnel not involved in the work are not permitted within this area. A safe zone must be established for all work that may pose a line of fire hazard be barricaded and sign-posted or tagged in accordance with Health & Safety Standard HSEE-03-34 Barrier Tape or site specific procedure where that procedure meets or exceeds HSEE-03-34. For areas where it is not feasible to use barrier tape, a sentry must be in place to prevent unauthorized access.
Competent Person	<ul style="list-style-type: none"> a) is qualified, because of such factors as knowledge, training and experience, to do the work assigned in a manner that will ensure the health and safety of persons and; b) is knowledgeable about the provisions of the Act and the Regulations that apply to the assigned work and; c) is knowledgeable about potential or actual danger to health or safety connected with the assigned work and; d) can prove competency by providing up-to-date training records.
Load Drop Zone	<p>A Load Drop Zone is the area below a suspended load that presents a high risk to personnel safety if the load drops while they are in that area.</p> <p>The edge of the Load Drop Zone must be a distance from the load that is equal to the height of the load from the floor or 10 feet, whichever is less, plus the height of the load.</p> <p>Horizontal pulls will create “line of fire” hazards so additional barricades are required when applying horizontal forces</p>
Hierarchy of Controls	<p>The hierarchy of controls is the prioritized approach for hazard mitigation, in order of the most effective to least effective, being:</p> <ul style="list-style-type: none"> • Elimination (remove the hazard) • Substitution (replace with non-hazardous material or equipment) • Engineering Controls. (create a physical barrier around the hazard such as limiting access or exposure to a hazard, reducing energy available or providing an alternate means of interacting with a hazard) • Administrative Controls (procedures, training, technology, lights, audible alarms, and warning signs) • Personal Protective Equipment PPE (equipment to be worn or held by a worker for protection). • The best way to avoid line of fire incidents is to eliminate the

	hazards that cause these incidents whenever possible. Substitution and Engineering Controls are the next preferred methods to control the line of fire while Administrative Controls (body position) and PPE is a last line of defense to protect workers.
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5.0 ROLES AND RESPONSIBILITIES

5.1 Employer (Supervisor/Manager)

- Provide a safe workplace and safe working instruction
- Provide information on the possible hazards that may be present in the workplace
- Implementing and maintaining safety controls related to the line of fire
- Ensuring that employees are properly instructed in line of fire
- Considering workplace layout and plan around the potential for line of fire

5.2 Employee

- Assess the hazards and risk in the workplace
- Remain aware of the work environment for line of fire hazards
- Ensure controls are in place for hazards present and follow safe work instruction
- Properly use all tools and equipment related to the line of fire, and safety devices
- Not put themselves or others within the line of fire by their actions or omissions
- Be mindful of body positioning at all times considering all possible energy releases correct body position for the task is essential in conjunction with maintaining situational awareness to remain clear of the line of fire
- Review manufactures recommendations on tools or equipment for line of fire warning or recommendations
- Report incidents related to line of fire and ask for assistance when required

5.3 Total Health and Safety Team

- Provide guidance or instruction to employees and supervisors on safety controls related to the line of fire
- Participate in investigations related to line of fire

6.0 PROCEDURE

Line of fire incidents occur when the path of a moving object or the release of hazardous energy intersects with an individual's body.

Line of fire situations exist when objects are moving or have stored energy. Examples include:

- Caught-in or between: A worker is standing between a wall and an excavator. When the excavator spins around the counterweight pins the worker against a wall.
 - Another example would be a worker placing his hand too close to a rotating gear and gets it pulled into the gear.
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- Struck-by: A pedestrian struck-by a moving vehicle or an object falling from a higher level striking a worker below
- Released energy: A wire under tension, a pipe releasing hot steam from a valve that is being removed or a flame shooting out of a malfunctioning engine are examples of released energy.

These situations all highlight the importance of body position is critical in the prevention of line of fire injuries.

6.1 Hazard Assessment

Hazard awareness in the workplace, is the first step in managing line of fire. Assess the risk when planning work, consider aspects of the job that place you in the line of fire and implement control measures to remove the risk of being in the line of fire. HSEE-03-01 Hazard Assessment, Mitigation and Control Standard is the tool for planning safety controls for a project, job or task.

This assessment must be covered during the Tailboard conference / Pre-job brief to ensure instruction is provided to employees on the line of fire and controls in place.

When planning work, consider aspects of the job that pose a line of fire risk for employees and implement a mitigation plan to control the risks. Depending on the work being completed, there may be many different lines of fire or there could be very few. It is important to understand what the “line of fire” is and how to avoid being in it to reduce risk.

6.2 Controls for Line of Fire

The best way to avoid being in the line of fire is to eliminate the hazards whenever possible. By totally eliminating the hazards there is no chance that an employee can be injured by the hazard.

When elimination is not possible, engineering controls are the next best choice in protecting employees from injury. Some engineering controls that mitigate line of fire include;

- physical barriers / jersey barriers
- guarding around moving parts
- isolation curtains that can withstand the stored / potential energy
- shielding walls
- metal cages
- toe boards on elevated work platforms such as catwalks, scaffolding platforms, stairs, etc. to prevent objects from falling to the area below

There are other possible engineering controls that could be used depending on the specific hazard. Equipment to be used under tension or that will contain stored energy must be rated in excess of the energy calculated, understanding that an engineering assessment may be required for some work.

The manufacturer of any tools, equipment or components will include important warnings to the user including line of fire. Reference manufactures recommendations for important safety requirements.

Total elimination of hazards is not always possible and engineering controls may not be feasible or they can fail. As a result, it is important to decrease exposures to the line of fire. Continue to use the Hierarchy of Controls as you plan your work. Understanding the tasks going on around you and the associated hazards will make employees situationally aware of the risk in the work area.

To aid employees in entering the line of fire, a safety zone / exclusion zone must be established in work tasks with energy potential or stored energy such as lifting and rigging, pulling cables or placing cables under tension. An exclusion zone should include a barrier (jersey, rope or danger tape) and sign posted as a notification to employees.

Personnel not involved in the work are not permitted within this area. A safe zone must be established for all work that may pose a line of fire hazard be barricaded and sign-posted or tagged in accordance with Health & Safety Standard III-9 Barrier Tape or site specific procedure where that procedure meets or exceeds III-9. For areas where it is not feasible to use barrier tape, a sentry must be in place to prevent unauthorized access.

The key to reducing line of fire incidents is to increase hazard awareness as it relates to energy and line of fire. It's important to understand the four behavioral states that increase incidents related to line-of-fire. These states are;

1. *Fatigue* — A tired employee is a dangerous employee.
2. *Rushing* — When someone is in a hurry, they're much more likely to take unnecessary risks to complete the job.
3. *Frustration* — If someone is angry, annoyed, or irritated, the likelihood of them stepping into the line of fire is increased.
4. *Complacency* — Just because an employee may have completed a task several times and never been hurt before, it doesn't mean complacency will not guide them into the line of fire.

Employees must recognize these states in themselves and utilize human performance tools to help manage against these states in conjunction with situational awareness.

The controls planned for line of fire must be covered in the Tailboard / Pre-job Brief, per Health & Safety Standard III-11 Tailboard Conference (Pre-Job Briefing, PJB)

6.3 Pre-Use Inspections

As per the NB OHS Act, all employees are responsible to inspect their tools for defects that may impact the safe use of that tool prior to use.

This is especially critical when stored energy is created (pulling cable, rigging and lifting, etc.). For these high-risk activities, the employee must be competent to perform the inspections. Check local procedures as the pre-use inspection may be required to be documented in the equipment logbook.

All tools and equipment to be used for pulling cable, rigging and lifting, under pressure or any items that may have stored energy a pre-use visual inspection performed by a competent person is required. The findings must be documented in the equipment logbook for equipment to be used or in the Work Order as appropriate.

6.4 Equipment Deficiencies

- If a deficiency of a piece of equipment is discovered during a pre-use inspection, or at any time during operation of the equipment, and the deficiency impacts the safe operation of the equipment, it must be corrected immediately, or arrangements must be made to have it repaired or replaced, by a competent person.
- If the equipment is unsafe for use, it must be immediately removed from service and tagged as per local procedure.

6.5 Cable Pulling

Notwithstanding procedures outlined within this standard, cable installations using mechanical equipment to pull the cable shall have established work methods or procedures. As a minimum, these documents shall include the following items:

- Define the zone(s) where potentially there could be line of fire during the cable pull. Identify failure modes of pulling equipment, and the requirement to position workers in areas where they will not be in the line of fire zone(s).
 - Establish work procedures that prevent entry of personnel within the line-of-fire zone(s) during Pulling Operations. See Section 6.2 – Controls for Line of Fire for additional information.
 - Work procedures shall not allow workers in a subsurface chamber during Pulling Operations unless they can take a position safe from the line of fire zone.
 - Identify conditions in which pulling operations must be stopped, such as abnormal tensions, pulling equipment issues, etc.
 - Require engineering validation for each individual pull except those instances where the cable pull has an established pre-engineered standard procedure. The Engineering validation will establish the expected maximum cable pull tension and sidewall pressure for the pull and will validate that:
 - The cable can be pulled without exceeding the cable's rated maximum pull tension and sidewall pressure.
 - All pulling equipment to be used for the pull is sufficiently rated for the maximum pull tensions and side wall pressure the equipment is expected to experience during the pull. This includes all equipment that forms part of the pulling system including but not limited to: pulling rope, bullets, anchors, pulleys, slings, sheaths, tensioner machine and tension machine anchors.
 - Establish the maximum allowable pulling tension beyond which the cable pull operation must be stopped as per section 6.5.4.
 - Provide a method of monitoring or limiting the tension to ensure that the maximum allowable pulling tension is not exceeded.
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- Maintain continuous contact (visual or audible) in order to communicate risks or issue a request to stop Pulling Operations.
- Visual inspection shall be performed prior to cable pull to ensure all elements of the pulling equipment is in good operating condition.

Note - CAN/ULC-S801-14, Standard on Electric Utility Workplace Electrical Safety for Generation, Transmission and Distribution can provide additional guidance in the development of work methods.

APPENDIX

DOCUMENT APPROVAL/REVISION RECORD

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New	2020/08/27	New Standard	S. Riche	R. Condon	R Condon
1	2021/04/23	Added section 6.5 Cable Pulling	R.Condon	R.Condon	R.Condon

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Director
Total Health &
Safety
