

Control of Hazardous Energy Lockout-Tagout and Other Methods

Prepared for



Why Enforcement?

- ✱ Hazards involving inadequate machine guarding and lockout procedures are among the top 4 causes of workplace injuries, and are typically considered the most severe.
- ✱ Recent MOL blitzes have included:
 - ✱ Lockout procedures that prevent machine start-up during maintenance and repair.
 - ✱ Proper training and supervision for workers on lockout procedures.
 - ✱ Exposed moving parts and in-running nip hazards.
 - ✱ Protection for workers from all other hazards.

MOL Enforcement LOTO

| Company | Fine | Section | Comments |
|------------------|-----------|------------|--|
| Ontario Power | \$125,000 | OHSA S25 | Bypass key used, no LOTO, bypass key available |
| IMT Corp | \$75,000 | 851-S75 | Greasing machine, no LOTO, stepped on pedal |
| Linamar | \$125,000 | 851-S25 | Robot restarted – master key incorrectly installed |
| Sandvik | \$143,750 | 851-S76 | Die change – no LOTO |
| Paper Fibres Inc | \$125,000 | 851-S75/76 | Entered bailer to clear jam, no LOTO, motion |
| Maple Leaf Food | \$125,000 | 851-S75 | Adjusted pump while running, no LOTO |
| Cadbury | \$68,750 | 851-S25 | Tried to clear jam, no guard, no LOTO |
| Rieter Mastico | \$150,000 | 851-S75 | Spiked roller still in motion after LOTO |
| Iron Mountain | \$112,500 | OHSA S25 | Jam removal, lost arm, no LOTO |
| Coca-Cola | \$87,500 | OHSA S25 | Cleaning while in motion, fractured arm, no LOTO |
| BC Hydro | \$97,500 | | Working on live circuits, failed to provide training and supervision needed to ensure safety |
| Maple Leaf Foods | \$137,500 | 851-S76 | Worker lost fingers, blade didn't stop when guard raised, controlled access didn't work |
| Nelco Mechanical | \$81,250 | 851-S42 | Worker shocked, removing old HVAC unit with live power still attached, cut with metal shears. No LOTO. |

Enforcement examples

- ☀ Cimcoe & Sobey's fined \$156,250 - worker suffered electrical burns and head injuries when he fell off a ladder servicing an electric door. No Lockout.
- ☀ ThyssenKrupp fined \$200,000 and supervisor \$13,750 for serious electrical burns to a worker from an arc flash while removing live conductors from a panel. No lockout.
- ☀ St. Mary's Cement, Bowmanville fined \$93,750 and supervisor \$3,750. Guilty of failing to ensure that gravity-stored energy was dissipated while work done on a sluice, supervisor guilty of failing to ensure workers worked in a manner and with protective devices and procedures required by OHSA. Had locked out electrical supply but not vanes and a bar used to prevent rotation was not sufficient, vanes rotated and the bar struck worker causing concussion and facial fractures.

More enforcement

- ☀ Apprentice electrician electrocuted when he contacted live 600 V taps of a transformer in an electrical panel.
- ☀ SNC-Lavelin (constructor) fined \$300,000 and Lockerbie & Hole (electrical contractor) fined \$250,000.
- ☀ Charge - Failed to take every precaution reasonable to protect worker, and in particular failed to ensure its lockout procedures complied with current regulations. No record of training in applicable lockout procedures.

More enforcement

- ☀ Westario Power fined \$137,500 after worker killed while replacing equipment damaged during a storm. Thought they had de-energized but some was still energized. Did not have a current single line diagram. Guilty of not providing information, instruction and supervision required to protect worker from hazardous energy.
- ☀ Algoma Tubes fined \$87,500 after 2 workers injured decommissioning an out-of-service MCC. Cable came in contact with live 480 V panel causing arc flash and burns to workers. Guilty of not ensuring workers used proper PPE to protect against shock and burns. No hazardous energy control.
- ☀ Par-Pak Ltd. fined \$112,500 after worker caught and injured in moving machinery. MOL stated that even though employer had written procedure not to tape while spindle was moving and had a certificate of compliance regarding the use of a safety mat, the machine was not adequately guarded to prevent access to the hazard.
- ☀ Pasta Quistini and supervisor fined total of \$165,000 when worker killed after falling into hopper of pasta machine. Cover interlock did not operate to stop machine. Didn't ensure that protective devices were maintained in good condition.

More Enforcement

- ✱ Tackaberry Construction fined \$137,500 after worker killed. Worker climbed between partly-folded head and centre frame of mobile rock crusher to remove a retaining pin and contacted hydraulic fitting causing hydraulic pressure to be lost. No blocking material between head frame and centre frame to prevent collapse. Worker crushed to death.
- ✱ Entropex fined \$512,500 after work's leg broken. Worker was helping to troubleshoot in front of plastics baler when bale ejected and crushed him against forklift. Guilty of not providing guarding, performing maintenance while baler in operation, and not providing information, instruction and supervision to protect worker.
- ✱ Welwyn Garden City, UK – firms including Kidde Fire Protection fined \$1,200,000 after worker killed. 66 of 80 argonite 142 kg gas cylinders rocketed around construction site at speeds up to 170 mph after one was toppled and discharged setting off a chain reaction – no protective safety caps and not secured in racks. Plumber walking in vicinity died and 6 others injured. Pictures.





More enforcement

- ☀ Konecranes Canada fined \$156,250 after manager electrocuted on a scissor lift with another worker making repairs to a 20 ton overhead crane at a client site. MOL investigation determined they did not follow the energy isolation and verification procedure set out in the Konecranes manual.
- ☀ Linergy Manufacturing fined \$100,000 after worker's hand trapped between chuck and frame on a CNC machine. Machine in manual but no LOTO and no training on how to do LOTO for chuck removal. First time worker had been asked to do this task.

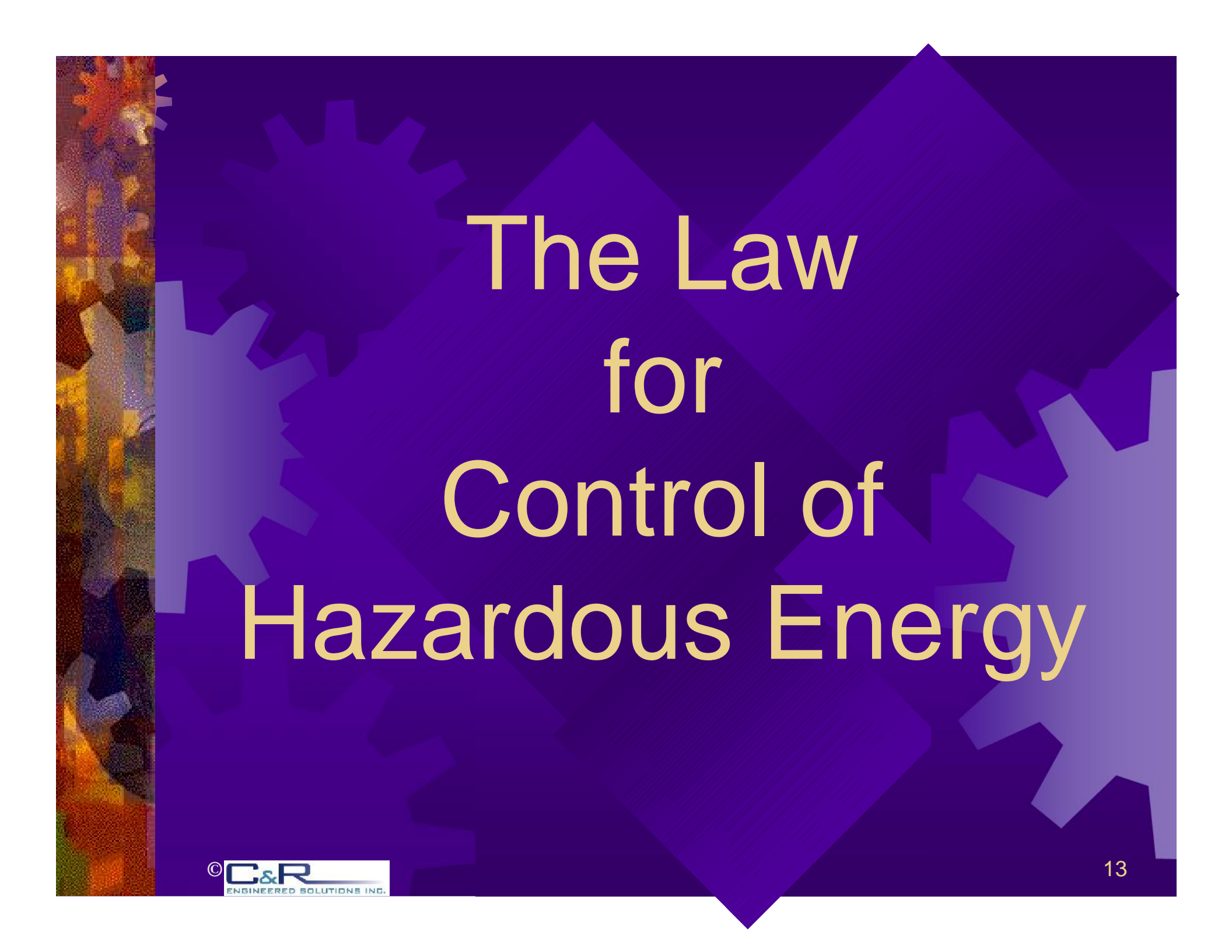
What is Hazardous Energy?

- ✱ Any electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, gravity, or other energy that could cause injury to personnel.
 - CSA Z460 definition

Energy Hazard!

Grease pumps at high pressure.





The Law for Control of Hazardous Energy

Control of Hazardous Energy “The Law”

☀ Industrial Regulation 851:

- S. 42 lockout of electrical equipment
- S. 50 prevent supply of material to hoppers & silos
- S. 75 motion stopped and movement blocked
- S. 76 locking out to prevent any starting
- S. 78 energy release to atmosphere for drums, containers, pipelines, etc.
- S. 119.13 lockout of equipment when entering a confined space

MOL LOTO Engineering Data Sheet circa 1980

- 1.3 While Regulation 80 (now 76) refers generally to the hazards associated with the accidental starting of a machine, etc., this will be understood to include the possibility of injury from working near inter-connecting machines or equipment in which case they too shall be shut down and locked out; electrical shocks and burns; injuries associated with the accidental starting of steam, hydraulic, pneumatic, chemical processing or other systems.
- 1.4 Since a very high percentage of machines and equipment use electricity as the source of power and as the control for other sources of power, this data sheet will deal primarily with the locking-out of electrical switches. This does not preclude the requirement for the locking-out or blanking of other types of control mechanisms or systems, e.g., valves clutches, line shafts, etc., where accidental starting is likely to endanger the safety of any person.

MOL 1980 LOTO continued

- ☀ 3.1 Experience has shown that the **accidental starting of machines while others are working on them is one of the major causes of amputations and fatalities**. Work on machines is seldom routine. It is often done during other than normal working hours. There is usually a sense of urgency. Certain large installations may require several trades, each working under a different foreman who has his own ideas regarding safety conditions. Workmen may be separated or out of communication with those near the control switch. All of these factors contribute to the possibility of the accidental starting of a machine and emphasize the need for a uniform policy with clearly defined procedures and responsibilities.
- ☀ 3.3 The only POSITIVE method of protecting workman from the hazards associated with the accidental starting of machines is to lock the main control(s) in the "OFF" position and **to have a separate lock for each person** or foreman.
- ☀ 3.4 As with all safety programs, **constant supervision, periodic reviews and training are required** to ensure consistent observance of what should become routine procedures.

Control of Hazardous Energy “The Law”

★ Construction Regulation 213

- S. 190 Employer shall establish and implement written measures and procedures to ensure workers are adequately protected from electrical shock and burn and make procedures available to worker. Worker shall follow procedures. Power supply shall be disconnected, locked out and tagged before work.
- S. 48 Drum, tank, pipeline or container internal pressure to atmosphere before any fastener removed.
- S. 108 Blocking required to prevent any movement that may endanger a worker.
- S 221.1 Lockout for confined spaces.





Control of Hazardous Energy “The Law”

☀ Healthcare Regulation 67

- S. 43.12 Control of hazards in confined spaces via lockout, blocking, blanking etc.
- S. 44 Machinery shall be provided with locking devices to prevent accidental operation.
- S. 50 Worker shall repair, maintain or adjust a machine only if, (a) control switches or other control mechanisms are locked out; (b) moving parts are stopped; and (c) hydraulic, pneumatic or gravity-stored energy is dissipated or contained.
- S. 52 energy release to atmosphere for drums, containers, pipelines, etc.
- S. 53 Blocking required to prevent any movement that may endanger a worker.
- S. 66 Lockout and tagout of electrical equipment.

Control of Hazardous Energy “The Law”

✦ And of course:

- ✦ OHSA S. 25(2)(h) (Employer shall) take every precaution reasonable in the circumstances for the protection of the worker.
- ✦ OHSA S. 27(2)(c) (Supervisor shall) take every precaution reasonable in the circumstances for the protection of the worker.

Ontario Legislation

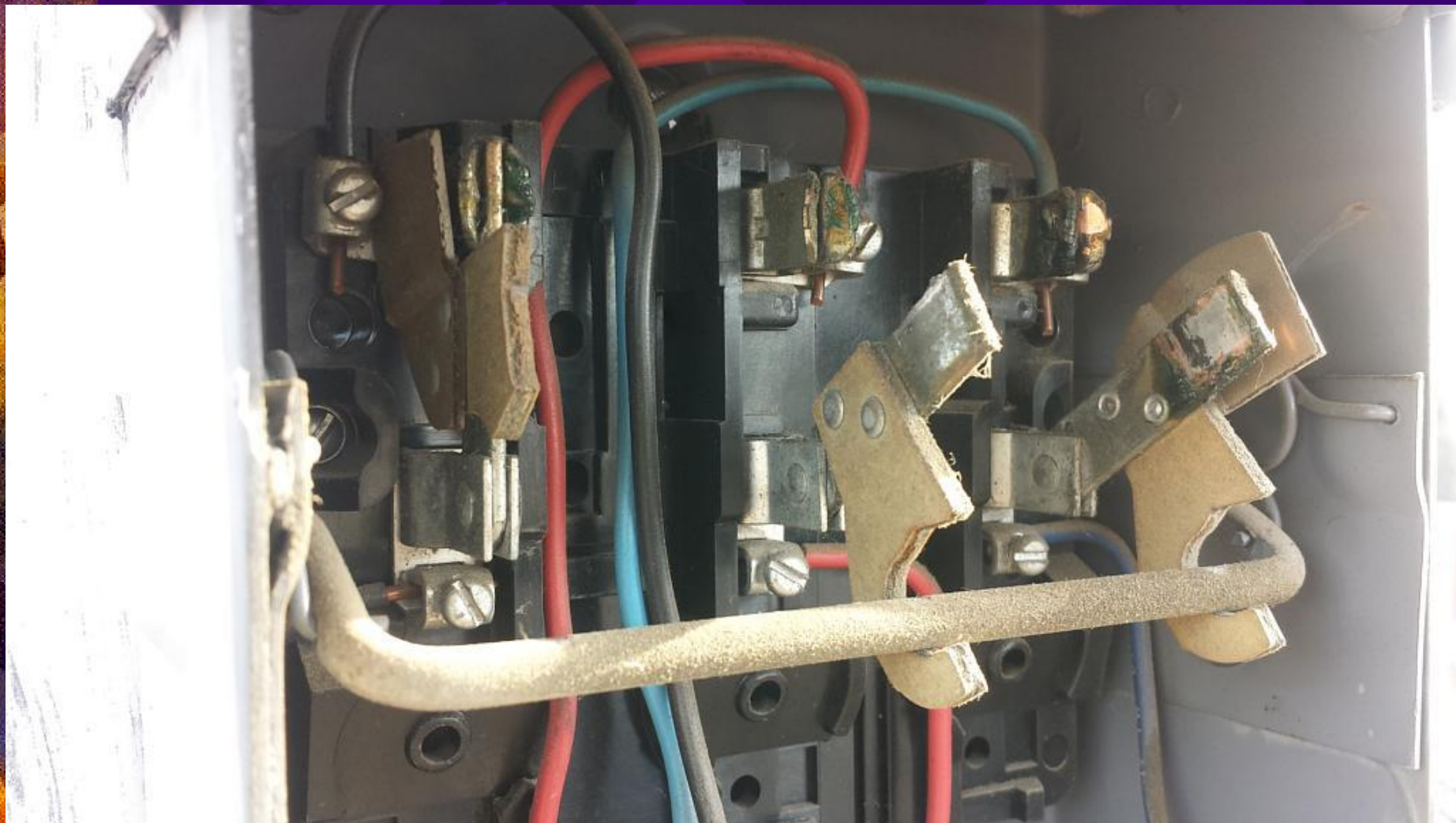
- ☀ OHSA Sec 25(2)(d) Employer shall..acquaint a worker or person in authority over a worker with any hazard in the work..
- ☀ OHSA Sec 28(1) A worker shall (a) work in compliance with the provisions of this Act and regulations, (b) use or wear the equipment, protective devices or clothing that the worker's employer requires to be used or worn.....

Other Legislation

Ontario Electrical Safety Code

- ☀ **Rule 2-304(1) When conducting work on electrical installations, equipment or conductor systems, these shall be disconnected, locked out of service and tagged before any work is done.**
- ☀ **And remember – test before touch!**





Control of Hazardous Energy Discipline

Discipline for Safety Infractions.....Or Suffer the Consequences

- ☀ Progressive discipline is a key component in proving a due diligence defense.
- ☀ Case law reveals that to prove due diligence, the defense must demonstrate that they have developed a “proper system to prevent the commission of the offence” and **must have taken “reasonable steps to ensure the effective operation of the system”**.
- ☀ The second requirement is usually where a company’s due diligence case falls apart.
- ☀ **Unfortunately, the only discipline some workers face is a severe injury or death!**





Standards

Applicable Standards

☀ Control of Hazardous Energy Standards:

- CSA Z460 Control of Hazardous Energy
- ANSI Z244.1 Control of Hazardous Energy
- CSA Z462 Workplace Electrical Safety - **ESA analysis of electrical incidents indicated that adherence to CSA Z462 would have eliminated 100% of the fatalities and 94% of the critical injuries.**

☀ Specific Machinery Standards:

- CSA B354. Self-propelled Elevating Work Platforms
- CSA Z142 Code for Power Press Operations
- CSA Z431 Coding Principles for Indication Devices and Actuators
- CSA Z432 Safeguarding of Machinery
- CSA Z434 Industrial Robots and Robot Systems
- CSA Z271 Safety Code for Suspended Elevating Platforms
- NFPA 79 Electrical Standard for Industrial Machinery

CSA Z460 Highlights

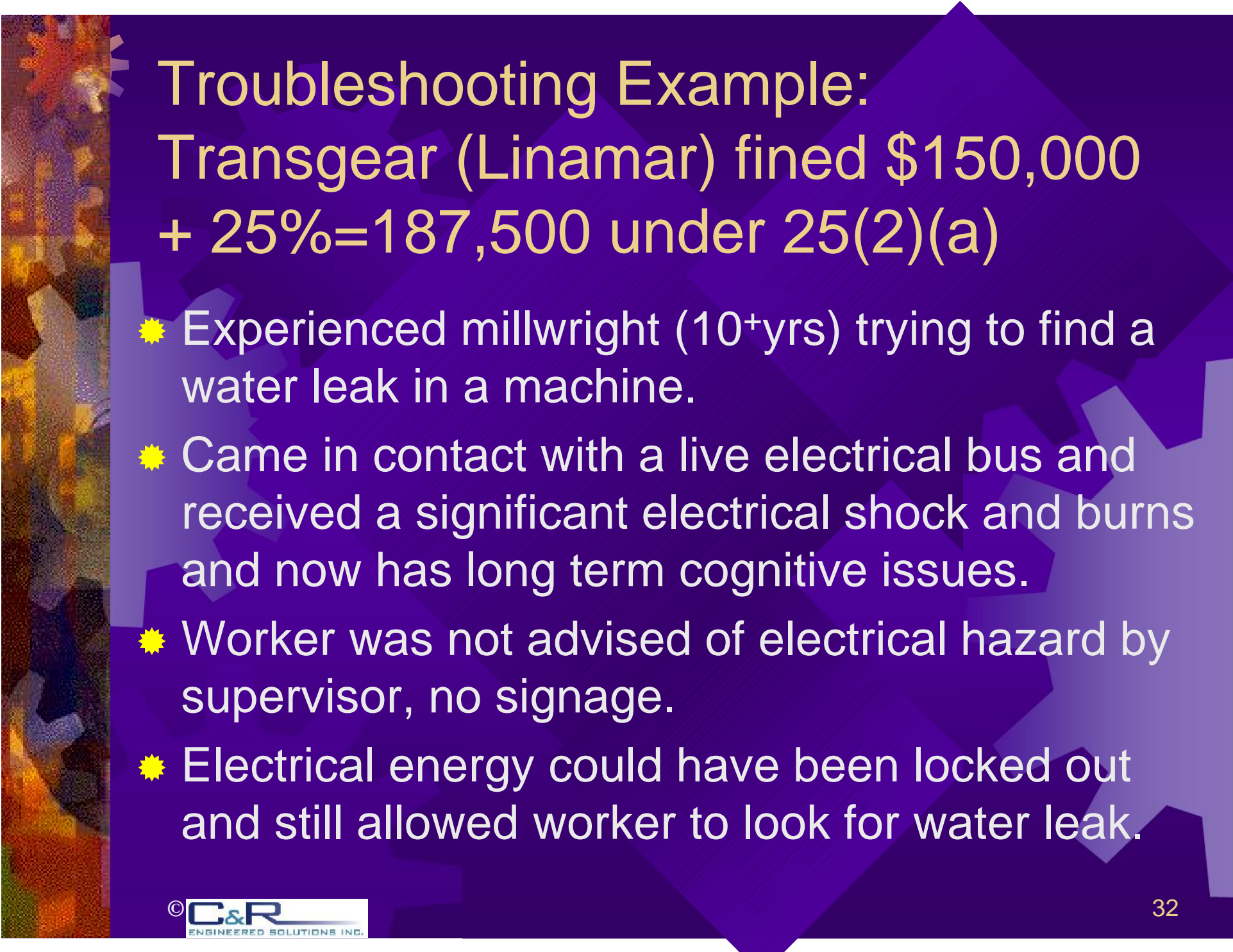
- ☀ Consensus standard- **not** regulation – may be referred to as best practice but doesn't replace the regulations.
- ☀ To be used in conjunction with the other standards previously listed.
- ☀ Full lockout is recognized as the primary method but the standard allows other approaches based on a Risk Assessment.
- ☀ **Remember – alternate control methods used when performing live troubleshooting and/or jam clearing are part of a good lockout (control of hazardous energy) program.**

CSA Z460 Highlights

7 Hazardous energy control program

7.5 Communication and training

- 7.5.1 Communication – Users are responsible for **informing all personnel of the program**, changes to the program, performance data **and auditing results**.
- 7.5.2 Training – User shall train authorized individuals on program and machine, equipment, process specific procedures. The user shall document training, and provide retraining. The **user shall also assess the effectiveness of the training** to ensure the authorized individuals adequately understand the lockout program, those that do not demonstrate an adequate level of understanding shall be retrained.



Troubleshooting Example: Transgear (Linamar) fined \$150,000 + 25%=187,500 under 25(2)(a)

- ☀ Experienced millwright (10+yrs) trying to find a water leak in a machine.
- ☀ Came in contact with a live electrical bus and received a significant electrical shock and burns and now has long term cognitive issues.
- ☀ Worker was not advised of electrical hazard by supervisor, no signage.
- ☀ Electrical energy could have been locked out and still allowed worker to look for water leak.

How to Troubleshoot Safely!

- ✱ Use other energy control methods rather than full Lockout as given in Z460 Section 7.4.
- ✱ Supervisors must make sure workers and contractors are aware of all the hazards they may encounter. Don't rely on "skilled trades" approach.
- ✱ Be aware of fellow workers and how it may affect them.
- ✱ This can be done with specific job briefings which include a risk assessment and identification of applicable safe work procedures.
- ✱ Develop and document troubleshooting procedures and train accordingly.

Typical Safe Work Procedure Requirements:

- ☀ Identify tasks that require full lockout.
- ☀ Identify tasks that can be done safely under controlled access procedures where safety devices such as interlocked gates provide worker protection.
- ☀ Identify what work tasks may involve live troubleshooting and what additional safeguards may be required to protect the worker – e.g. Arc flash & shock PPE for electrical troubleshooting.
- ☀ A task matrix at the machine can be very helpful.
- ☀ **Validate placards and matrix on a regular basis.**

Who does this apply to?

- ☀ All skilled trades including contractors.
Remember – not all skilled tradespeople are proficient in identifying all hazards.
- ☀ All affected workers and supervisors.
- ☀ Engineering personnel.

For example - Is your HVAC contractor trained in electrical troubleshooting and does he/she wear appropriate PPE as required by Sec. 42.1?
According to MCA about 70% of HVAC troubleshooting involves electrical measurements!
Ottawa fatality example at McDonalds.

Where to Start?

Normal Risk Assessment process applies:


- ✱ Identify tasks
- ✱ Identify person(s) performing the tasks
- ✱ Identify the hazards associated with tasks
- ✱ Determine how to mitigate the hazards
- ✱ Develop Safe Work Practices (SWP) including LOTO.
- ✱ Determine PPE requirements
- ✱ Determine training requirements
- ✱ Train
- ✱ Audit

Who? Everyone concerned!

- ☀ Safety officer/JHSC reps/Union safety reps.
- ☀ Engineering.
- ☀ Operator.
- ☀ Production management.
- ☀ Maintenance.
- ☀ Set-up/tool changers.
- ☀ Instrument Technicians.
- ☀ Equipment supplier/installer.
- ☀ Contractors.
- ☀ Outside specialists – eg Ergonomist, Hygienist, PSR Engineer.

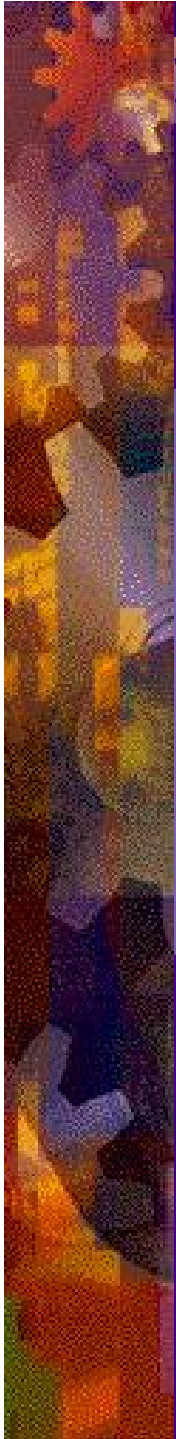
Who is affected?


- ☀ Supervisor (Note “RACE” in new MOL Supervisor Training) ([Link](#))
- ☀ Competent Person
- ☀ Licensed Electrician
- ☀ Master Electrician
- ☀ Electrical Contractor
- ☀ HVAC Technician
- ☀ Millwright or Mechanical Contractor
- ☀ Automation Technician
- ☀ Janitor
 - And of course the employer is ultimately responsible for everyone!



Risk Assessment
is
An Essential Part of
any Hazardous
Energy Control
Program!







Lockout-Tagout
Is Also
An Essential Part of
any Hazardous
Energy Control
Program!

Full Lockout – Basic Control

- ☀ Most documented of all the hazardous energy control methods but typically poorly implemented and not understood.
- ☀ Documentation can consist of:
 - ☀ Generic LOTO document
 - ☀ Placards – Map showing hazardous energy locations and LOTO points
 - ☀ Labels – Identifies energy isolation devices
 - ☀ Task Matrix – A document that details what energy needs to be isolated for a task.

LOTO

- ✱ Probably the single most important SWP for worker safety!
- ✱ Also probably the most ignored!
- ✱ *CSA Z460 Control of Hazardous Energy*
 - ✱ Need specific individual LOTO placard for any complicated machinery.

Not a Good Example of LOTO!



Or this?





What work tasks expose a worker to Hazardous Energy?

- ☀ Maintenance Activities (Equipment rebuild, PM's, changeover, testing, troubleshooting, recovering from a jam)
- ☀ Operational Activities (Cleaning, Troubleshooting, part changeover, recovering from a jam)
- ☀ Teaching (Robot, machines with pendants for manual control)



What are a worker's options to Control Hazardous Energy?

- ☀ Full Lockout – Isolate, lock and block and dissipate all primary sources of hazardous energy. This is the first line of defence when work is required to be done in the hazard area.
- ☀ Alternative to Full Lockout – Take control or lockout a single device that is part of an “Engineered Safeguard”. Follow CSA Z460.



Does Your Hazardous Energy Control Program Pass the Test?

- ☀ Does the employer/supervisor/worker know that work is taking place while exposed to hazardous energy?
- ☀ Do they understand the OSHA and OESC regulations that apply?
- ☀ Do you have “competent” workers and supervisors?
- ☀ Can they perform risk assessments to determine proper hazardous energy control and LOTO?
- ☀ Can they determine what PPE is required?
- ☀ Are proper PPE and tools available?
- ☀ Are they used?
- ☀ Are workers trained?
- ☀ **Do you audit the system?** It can be done during monthly audits!



And the final word:

WORK DEAD

to

STAY ALIVE!



Laurence Polley, BSc (EE), MBA, P.Eng., CHSC

- More than 30 years experience, directly involved in the design, implementation and validation of engineered safety controls in industries such as medical device manufacturing, coil coating ovens and fume incinerators, recycling equipment, water treatment, waste water treatment, food and beverage, and automotive manufacturing.
- Laurence sits on four Technical Committees at CSA involved in the development of health and safety standards for Control of Hazardous Energy (Z460), Accident Investigation (Z1005), Work in Extreme Conditions (Z1010) and Nanotechnology (Z12885). He sits on several CSSE committees, and is a member of the Board for SAE Central Ontario Section.
- Laurence presents seminars and technical training on many topics to various associations, clients and educational institutions.
- Laurence has been qualified as an Expert Witness for OHS charges and equipment performance, and provides expert testimony and reports in support of Coroner's investigations, and in response to Ministry of Labour charges.

Questions?

Don't hesitate to contact us!

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