ELECTRICAL SHOCK SEQUELA

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Abstract

Electric Shock Hazard:

"A source of possible injury or damage to health associated with current flow through the human body caused by contact with or approach to exposed energized electrical conductors or circuit parts.

Note:

Potential severity of injury and damage to health resulting from shock is dependent on the magnitude of the electrical current, the power source frequency (e.g., 60hz, 50hz, dc) and the path and time duration of current through the body. The physiological reaction ranges from perception, muscular contraction, inability to let go, ventricular fibrillation, tissue burns and death."[1, 2]

Historically, an electrical injury was considered a form of thermal burn injury mediated by Joule Heating. However, over the past twenty years, medical research has revealed that this is just one component of a complex multi-system injury.

Electrical trauma produces a pattern of injury that depends on three main factors: the intensity and frequency of the current, the anatomical path that the current takes through the body, and the duration of current exposure.

Sequela:

"A morbid condition following or occurring as a consequence of another condition or event." Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing and Allied Health, 7th Edition, 2003 by Saunders, an imprint of Elsevier, Inc.

"A sequela. Any condition or state that follows a disease, disorder, or injury, especially one that is a consequence of it. A complication. The term most often used is the plural form, sequelae." Collins Dictionary of Medicine, Robert M. Youngson, 2004-2005.

Electrical Shock Versus Electrocution:

Electrocution
e·lec·tro·cu·tion (ē-lek'trō-kyū'shŭn),
Death caused by electricity. See: electrocute.

Synonym(s): electrothanasia
Farlex Partner Medical Dictionary © Farlex 2012

Electric Shock

"The sum of immediate and delayed pathophysiologic responses of living tissue to a current of electricity of sufficient magnitude to induce abnormal sensations (for example, paresthesia, pain) or objective changes (for example, muscle spasm, cardiac arrhythmia, neurologic impairment including coma, tissue damage)." Farlex Partner Medical Dictionary © Farlex 2012

The electric shock hazard has existed since electricity was invented. The short-term effects for low voltage electric shocks were not visible and workers did not report short term duration (momentary inadvertent contact) electric shocks. For high voltages the electric shock hazard had a significant high probability of immediate electrocution.

The electrical shock hazard has been neglected, has been accepted as "part of the job" for electrical workers, historical training instructed the use of the human body as a voltage detector for low voltages[5] and to date has not been effectively eliminated in the workplace not only for electrical workers, but also non-electrical workers.

Historically electrical workers and non-electrical workers have not reported low voltage shocks. The electric shock hazard is an invisible injury, there is currently no medical scan or test that can detect that the electrical injury has occurred, most patients assessed achieve an inconclusive diagnosis.

There are long term consequences from an initial electric shock hazard exposure where electrical current flowed into the human body that electrical workers and non-electrical workers have not been made aware of in the workplace and in electrical safety training received. This is electrical shock sequela.

John Knoll is suffering from sequelae related to receiving multiple low voltage electrical shocks while working as an apprentice and journeyperson electrician.

Electrical workers need to be made aware that they may be suffering from sequela due to electric shock exposure.

Industry needs to change the narrative from a focus on arc flash to a focus on the electrical shock hazard.

Index Terms — Arc Flash Hazard, Electric Shock Hazard, Electrocution, Electrical Injury, Potential Severity of Injury or Damage to Health, Likelihood of Occurrence, Establishing an Electrically Safe Work Condition, De-energize, Energized,

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Eliminate, Absence of Voltage, Harm, Hazardous, Sequela, Sequelae, Fibrillation, Risk, Risk Assessment, Risk Assessment Procedure, Shock Risk Assessment, Arc Flash Risk Assessment, Rubber Electrical Protective Equipment, Insulated Hand Tools, Voltage Rating, NFPA 70E, CSA Z462, OSHA, OHS.

I. INTRODUCTION

When a worker is exposed to the electric shock hazard there are two possible outcomes. A shock is received, and the worker survives, or they die (e.g., electrocution). Electrical incidents statistics confirm that fatal electrical injuries from the electric shock hazard are still occurring at an alarming rate, on average still once a day in North America[3]. What is not published in electrical incident statistics reports is the number of electrical workers that may suffer from the long-term effects of receiving multiple low voltage (≤1000V for Canada (CE Code Part I, 2021 Edition), ≤1000V for the USA) electrical shocks. The medical term for this is electrical injury.

We know what the short-term effects of receiving an electric shock are, as noted above you survive the electric shock or you are electrocuted. The table below lists the short-term immediate effects of a human being receiving an electric shock.

Table 1 – Immediate Effects of Electrical Current Flow Through the Human Body

Current (milli-amps)	Physiological Effect On Human Body	Human Perception & Effect On Human Body
< 1ma	None	Imperceptible
1 mA	Perception threshold	Mild sensation
1-10 mA		Painful sensation
10 mA	Paralysis threshold of arms and hands	Cannot release hand grip "no let go" threshold
30 mA	Respiratory paralysis	Breathing may stop
75 mA	Heart fibrillation possible	Heart action mis coordinated
250 mA	Heart fibrillation	Heart may stop
4 amps	Heart paralysis threshold	Heart stop for duration of current flow
5 amps or greater	Tissue burns	Most likely fatal vital organs are burned or damaged, can lead to amputation of limbs

Note:

The amount of current, the power source frequency, the current flow path through the human body, and length of time of current flows through the human body determines heart fibrillation probability. Male and female body resistance will be different and added muscle mass increases conductivity. Wet or dry skin at the point of current entry will impact current flow. The number of times an electric shock is received impacts the long-term effects and possibly sequelae.

With respect to the potential long-term effects of electric shock, sequela the following table is provided:

Table 2 – Long Term Sequelae of Electrical Injury[4]

Psychological Symptoms	Neurologic Symptoms	Physical Symptoms
Depression	Memory Loss	Generalized Pain
Posttraumatic Stress Disorder	Numbness	Fatigue, Exhaustion
Insomnia	Headache	Reduced Range of Motion
Nightmares	Chronic Pain	Contracture
Anxiety	Weakness	Pruritus
Flashbacks	Poor Concentration	Muscle Spasm, Twitches, Aches
Fear of Electricity	Paresthesia	Headache, Migraine
Frustration	Syncope	Night Sweats, Fever, Chills
Hyperarousal	Loss of Balance	Joint Stiffness
Panic Attacks	Gait Ataxia	
Low Self-Esteem	Sciatica	
Guilt	Carpel Tunnel	
Moodiness	Seizure Disorders	
Memory Loss or Impairment	Dizziness	
Increased Temper	Poor Coordination	
Reduced Attention Span	Tinnitus	
Poor Verbal Learning	Tremor	

The potential long term effects, electric shock sequelae are documented based on research completed or identified in multiple articles and reports.

There are also two specific research organizations that have been established and have and are researching the electrical shock hazard and electrical shock sequelae, the Sunnybrook Health Sciences Centre, St John's Rehabilitation Centre, Electrical Injury Program (https://sunnybrook.ca/content/?page=sjr-patvis-prog-electrical) and the University of Chicago, Chicago Electrical Trauma Rehabilitation Institute (CETRI, https://cetri.org/).

II. HISTORY & QUICK FACTS

Since electricity was invented exposure to the electric shock hazard has occurred. Lightning strikes would have been experienced before this with survival or an immediate fatality. Electric fish exposure in Ancient Egypt resulted in electric shocks. In modern times the evolution of our use of electricity evolved, "safe installation" requirements were documented and eventually put into law. Occupational health & safety regulations did not exist, workers were still being exposed to the electric shock hazard, both electrical workers and non-electrical workers.

From 1942 to 1960 the American Electrician's Handbook published and taught that the human body be used as a voltage detector[5].

In the United States and Canada occupational health and safety acts/law started to emerge in the late 1800s. The Occupational Safety Health Administration (OSHA) was created on April 28, 1971. In Canada the Federal Occupational Health & Safety Act was passed in 1978.

The first edition of NFPA 70E Standard for Electrical Safety in the Workplace published in 1979. The CSA Z462 Workplace electrical safety Standard, 1st Edition only published in December 2008. Globally the NFPA 70E Standard for Electrical Safety in the Workplace has started to be applied and some countries have developed their own Standards related to identification of the electric shock and arc flash hazards.

Recently, in March of 2015, The Fire Protection Research Foundation completed and issued a report "Occupational Injuries From Electrical Shock and Arc Flash Events[3]." In generating this report, the authors reviewed and summarized information and data from sixty-four (64) referenced documents. Within the body of the report, on Page 11, one of the electrical incident fatality statistics quoted from the Census of Fatal Occupational Injuries (CFOI), introduced by the Bureau of Labor Statistics in 1992 it identified that between 1992 and 2013 CFOI recorded a total of 5587 fatal electrical injuries, an average of 254 fatal electrical injuries each year. It lists that 99% or 5527 were reported to be electrocutions, and less than one percent of the fatalities were due to burns. The information in this report is exhaustive in content with multiple statistics listed and qualified.

The Fire Protection Research Foundation report also identified electric shock sequela on Pages 3 and 4 and references documentation that this paper is quoting[4]. On pages 3 and 4 it identifies that long term sequelae from electrical injury can be psychological and neurological.

The Fire Protection Research Foundation report is one of the most comprehensive documents reviewing electrical injury statistics.

In Canada, Technical Safety British Columbia (TSBC, Province of British Columbia) in 2018 place enhanced focus on the electrical shock hazard by completing a review of electrical incidents and interviewed electrical workers to identify why electrical workers have been, are and most likely will still be exposed to the electrical shock hazard. The TSBC Shock Report identified that electrical shock hazard exposures occurred related to energized work been performed because of sociocultural, environmental and behavior factors.

Electric shock sequela had been previously identified in Canada as early as 2003 by the Sunnybrook Health Sciences Centre, Electrical Injury Program, Dr. J. Fish.

Separately in 2013, in an article in the Canadian Family Physician, "Long-term sequelae of electrical injury," Dr. MA Wesner and Dr. J. Hickie (both Alberta Workers Compensation Board medical consultants)[4] summarized research into electrical injury that they performed for Alberta's Worker's Compensation Board. Before this article was published it was reviewed by Dr. Lappi and approved for publication. This article reviews or references a total of twenty-five (25) other articles, many which are also quoted in The Fire Protection Research Foundation report "Occupational Injuries from Electrical Shock and Arc Flash Events[3]". The Fire Protection Research Foundation report provides an exhaustive detailed review and analysis of over sixty-four (64) other articles, reports, and technical papers related to electrical injuries.

What Does The Research Tell Us?

Besides the many articles and papers published the research completed by the St John's Rehabilitation Centre, Electrical Injury Program and Chicago Electrical Trauma Rehabilitation Institute (CETRI) confirms that electric shock sequela is an injury as an outcome of a worker receiving one or more electric shocks. These two programs are the only formal organizations in North America that exist studying and outlining treatment for electric shock sequela.

Additional information is available from The Journal of Neuropsychiatry and Clinical Neurosciences.

Mechanisms of Electrical Injury

"Four mechanisms of cellular injury by electricity are presently known. They are the direct effects of the current, thermal burns, mechanical injury due to falls, and electroporation. The passage of the current through tissue can cause intense muscle contractions. Current pathways including the chest can be life-threatening as a result of induced asystole and/or apnea. Electricity may also be converted into heat, resulting in the varying degrees of burns particularly associated with high-voltage electrical injury. Loss of consciousness is possible, which may lead to a fall and mechanical blunt force trauma to the head. Finally, electricity can directly cause pore formation in the lipid bilayers that form cell membranes, a process called electroporation.

Electroporation is the process by which an electrical field induces formation of pores through the cell membrane, allowing free passage of ions and fluid. The cell will attempt to maintain its ionic gradients through great expenditures of energy. If the pores do not reseal, the cell will eventually exhaust its energy reserves and die. If the pores seal, the cell may eventually recover. However, the sealing process is considerably slower than the pore opening. Even if the pores close, secondary injury processes may be disruptive or even fatal to the cell. The influx of sodium ions in a permeabilized cell prevents the transmission of signals.

While affective disturbances are present following electrical injury, most research suggests these deficits generally have later onset (rather than precede) neuropsychological impairments. Thus, electrical injury can lead to a neuropsychological syndrome with acute, prolonged, and delayed symptoms that can greatly interfere with a person's functioning.[7]"

A notable quote from the Dr. ML Wesner and Dr. J Hickie, "Long-term Sequela of Electrical Injury" article is:

"progressive cellular damage and death account for the evolution of delayed-onset symptoms.[4]"

Surviving an Invisible Iceberg Injury[8]

"While electrical injuries clearly can cause measurable acute neurological injury and even death, the long-term sequelae for survivors are more controversial. Incorrect assumptions associated with electrical injury have interfered with both research and treatment. These include the use of visible burns as a basis for judging injury severity, belief that high voltage exposures are more dangerous than low voltage, belief that psychological factors are the primary cause of poor outcomes, and overemphasis on the importance of secondary gain.

While a person severely burned from a high-voltage electrical injury will likely seek emergency care, many victims of lesser shocks may not. Thus, researchers can only estimate the true extent of the problem, and patients and medical personnel may be unaware of the possible long-term sequelae of even low-voltage injuries[8]."

"The appearance of these consequences of electrical injury might be substantially delayed, with onset 1 to 5 or more years after the electrical injury. This poses a problem for patients and health care workers, making it hard to ascribe symptoms to a remote injury when they might not arise until well after the incident event[4]."

"The long-term sequelae of the electrical injury might be more subtle, pervasive, and less well defined, and are particularly difficult to diagnose, as the link between the injury and the symptoms can often go unrecognized by patients and their physicians. For family physicians who include compensation or legal medicine in their scope of practice, to present an informed, accurate medicolegal opinion, determining causation and attributing outcome to an ill-defined problem that might not result in objective clinical findings becomes a difficult challenge. Many who suffer electrical injury have considerable difficulty returning to work. The appearance of nonresolving, non–path-related symptoms following electrical injury is a scientific puzzle[4]."

"The severity of the electrical injury is, however, not proportional to the source voltage, visible burns, loss of consciousness, cardiac arrest, or neuroimaging findings. Electrical injury is unique in that it typically results in low mortality rates, but very high rates of short- and long-term morbidity.

Ultimately, electrical injury reflects a trauma that includes both neurological and psychological aspects. Each has significant overlap and interaction with the other, resulting in a complex syndrome of inattention, memory lapses, depression, anxiety, muscle weakness, fatigue, extremity numbness or tingling, pain, and sleep disturbances that greatly resembles mild TBI (Traumatic Brain Injury). Historically, the severity of electrical injury often was not recognized, and treatment not sought, especially when the acute symptoms were mild. Given the evidence for late-onset deficits, clinicians should consider screening for electrical injury in all initial patient intakes[8]."

III. JOHN KNOLL'S STORY

John Knoll is a Master Electrician, and a Professional Electrical Contractor (PEC) with the Electrical Contractors Association of Alberta (ECAA) and resides in Edmonton, Alberta. Unfortunately, John is currently not working in the trade and is suffering from sequelae related to receiving multiple low voltage shocks while at work starting as an Apprentice and while he was a Journeyperson Electrician. I think the story of John's career as an Apprentice Electrician and Journeyperson Electricians is very common. John worked in the non-unionized side of the trade for most of his apprenticeship and career. When I asked John about his exposure to shock he told me "as an Apprentice we played games in apartments while trimming out around being shocked at 120VAC with lighting circuits, we were not taught to fear electricity or respect it. I was never concerned about 120VAC, 240VAC, I didn't consider it an issue to receive those shocks. I always said I would rather receive one knowing it was coming than not knowing. So, after tick testing, we would touch the wires, sometimes the tick tester lied and it was better to know it was coming. It was the most we were able to do most times not being supplied the proper PPE or training to do our duties."

John started in the electrical trade in 2005 and told me he worked energized on three phase 208VAC panelboards as an Apprentice a few months into the trade and had received shocks as early as the first week in the trade. John stated, "I was probably shocked hundreds of times." This may be hard to believe, but I have talked to other Journeyperson Electricians who quote they were shocked hundreds of times during their career. John quoted that "the Journeyperson Electricians I worked with when I was an Apprentice never identified the hazards and long-term effects around the electric shock. There was no formal training and no personal protective equipment provided. If we wanted a tick tester we had to buy them ourselves." "Live" work was not questioned, "we had to work energized, as we couldn't de-energize parts of the job. For example, working in the parkade or on house panels, I couldn't turn off the power or the lights. We cut in panels energized and rarely could turn off the power as it impacted the other trades. I didn't receive any training on lockout until I worked the last few months of my fourth period in the Union."

John's comments about working on energized conductors and circuit parts was and is still the norm in the industry. Yes there have been changes in the last decade in Canada with the CSA Z462 Workplace electrical safety Standard published, but the focus unfortunately has been on arc flash and not shock.

The bottom line is Apprentice Electricians and Journeyperson Electricians have been shocked as a normal condition of doing their jobs with a complete lack of awareness of the potential often delayed long term consequences of receiving multiple low voltage shock throughout their careers. The American Electrician's Handbook from 1942 to 1960 taught electricians that the human body could be used to detect voltages up to 250VAC by touching with the hands or for low voltages using your mouth to "taste" electricity.

In John's case he was experiencing psychological, neurological, and physical symptoms that he did not know were attributed to low voltage shock exposure throughout his career. When I interviewed John and he discussed his injuries it was unbelievable but based on information that I had over 10 years ago published by Dr. Joel Fish who at the time was The Chief Medical Officer at the St Johns Rehab Centre in Ontario, the

long-term sequelae effects of electric shock are real. What changed John's perception of shock was in 2015, when he told me he received a 347VAC shock, he said that shock was different, "I was held and could not let go, I knew I was going to die and had no control of my body. I was saved by gravity when I fell off my ladder. I thought I was dying, the pain was unbelievable as I lost the ability to breath" and at that point, John said, "I had a newfound respect and fear of electricity."

John founded his own company from 2010 until he could no longer work due to escalation in his symptoms after the shocks he received throughout his career. He started experiencing symptoms as early as 2 years into the trade (2007) and began seeking chiropractic and massage care more often, a known relief of symptoms that are caused by the long-term sequelae of electric shock. In 2014 John started looking for more answers, with his mental health deteriorating, the sequelae continued to worsen until early 2017. John identifies this as his apex events, where he lost the use of his legs multiple times during the year, he quotes "It was the most painful excruciating experience of my life. The first two times I lost the use of my legs it felt as if my legs were on fire while being ripped apart from the inside. The third apex event spread from my legs to my entire body and brain. I fell to the ground screaming in the fetal position when it was over I could not walk again. I had to drag myself around with my upper body until I could relieve all the tension throughout my body." John noted that his life started to change rapidly and looking back now he knows that the multiple electrical shocks he received led to his deterioration in mental and physical health, his personal life was directly impacted, becoming divorced from his wife and issues with his friend and business partner.

Why was John shocked at work? His comments align with the results of a recent shock research project completed by Technical Safety British Columbia (TSBC). The TSBC in February 2019 published a report related to the shock hazard in BC "Negotiating Safety – Understanding the Behavioral and Sociocultural Factors Related to Electric Shock." The report was based on interviews and surveys completed and quoted reasons why electricians have worked and continue to work energized as: Societal, Sectoral, Organizational, Interpersonal and for Individual reasons. The report concluded that poor training, poor work practices, complacency, not refusing to work energized, "I thought someone else had turned off the power," or peer pressure (e.g. loss of job, keep boss happy, rebuked by other workers) influenced why working energized was never questioned.

John's story is not an isolated case. There are potentially hundreds of thousands of Journeyperson Electrician's and other Task Qualified Workers in Canada, the USA, and Internationally that have long term sequelae and have not correlated them to receiving multiple low voltage shocks throughout their career. The personal mental and physical health issues, impact on family and the potential impact on continuing in the trade and potential financial impacts are significant. If you are a Journeyperson Electrician and are experiencing symptoms listed in this article, they are most likely attributed to you receiving multiple low voltage electric shocks while working.

IV. CHANGING THE NARRATIVE

It is important that both of the electrical hazards of electric shock and abnormal arcing faults occurring causing an arc flash our identified against energized electrical work tasks electrical workers will perform and that the short term potential injury or damage to health to electrical workers is understood and appropriate hierarchy of risk control methods determined and field applied to reduce risk to as low as reasonably practical.

Eliminating electric shocks will eliminate the potential for the long-term sequelae related to symptoms occurring.

Industry needs to place more focus on the electric shock hazard.

V. WHAT CAN DONE?

The continued application of the CSA Z462 Workplace electrical safety Standard and the NFPA 70E Standard for Electrical Safety in the Workplace through the field application of a compliant Electrical Safety Program needs to continue.

Employers need to ensure they develop and implement an Electrical Safety Program that states that as a priority elimination of exposure to electrical hazards is a policy, if energized electrical work tasks are completed they shall be justified and authorized, that a job and discrete work task based risk assessment procedure is implemented by the employer and an element of the Electrical Safety Program, that is prescribes that an energized electrical job safety plan is documented that includes the a work task's shock risk assessment and arc flash risk assessment are completed to determine "additional protective measure," prescribes appropriate electrical safety training (focused on both electric shock and arc flash, not just arc flash), that arc flash & shock PPE is specified, procured, selected and used by electrical workers.

VI. CONCLUSIONS

Sequela related to electric shock is real. The history of our use of electricity came with exposure to the electric shock hazard and abnormal arcing faults and arc flash.

Electrical workers globally may have symptoms related to potential electrical shock sequelae effects, physiological, neurological and physical are real, more research is required and communication to the body of electrical worker not only in North America but globally is required to ensure electrical workers are diagnosed and receive appropriate treatment.

John Knoll's story is a testimonial that there are most likely hundreds of thousands of electrical workers globally that have electrical shock sequelae.

VII. ACKNOWLEDGEMENTS

John Knoll is suffering from sequelae related to receiving multiple electrical shocks that were received while working as an apprentice and journeyperson electrician. It was part of the job, accepted, it wasn't his fault. In Canada the CSA Z462 Workplace electrical safety Standard, first published in January 2009 has started to change what energized electrical work tasks are performed and with an acceptable residual risk level. CSA Z462 has been widely adopted across industry sectors across Canada, but we have a long way to go for both Qualified Persons and Unqualified Persons to not be shocked in the workplace. The NFPA 70E Standard for Electrical Safety in the Workplace first published in 1979 and is now available in it's 12th Edition, 2021 and it has also had a significant positive impact on electrical

hazards been identified against work tasks performed and elimination or risk reduction identified and implemented in the field to

John Knoll has came forward with his story and it has not been easy.

Thank you John for the bravery to come forward, for you exhaustive passion in review the body of knowledge and becoming an important advocate for electrical safety and specifically electric shock sequela.

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IX. VITAE

Terry Becker, P.Eng., CESCP, IEEE Senior Member:

Terry graduated from the University of Regina in 1991 with a B.A.Sci. in Electronic Information Systems Engineering. Terry worked as an Electrical Engineer for Mobil Oil Canada from 1991-1996, as an Electrical Engineer for DPH Engineering Inc, from 1996 -1999, when he was recruited to work for PanCanadian Petroleum, which became EnCana Corporation in 2002. In 2007 Terry created ESPS Electrical Safety Program Solutions Inc. and has been an independent Electrical Safety Specialist for over 14 years, currently with TW Becker Electrical Safety Consulting Inc. (www.twbesc.ca).

Terry is a founding member of the CSA Z462 Workplace electrical safety Standard Technical Committee in 2006, he is the first Past Vice-Chair and currently a Voting Member and Working Group Lead for Clause 4.1 and the Annexes. Terry is also a found member and Voting Member of CSA Z463 Maintenance of Electical Systems Standard. Terry is also a Voting Member on the IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations. Terry achieved IEEE Senior Member level for his work in electrical safety as recognized by his peers.

Terry is a Professional Engineer in the Provinces of Alberta, British Colombia, Saskatchewan, Manitoba and Ontario.

Terry has authored papers and presented at the IEEE ESW, NETA PowerTest, various CSA Conferences/Workshops and at other conferences and workshops in Canada, the United States, Australia and India.

John Knoll, CME, Professional Electrical Contractor (PEC)

John has worked in the electrical field for over 12 years, which included 10 years in leadership and project management roles in running his company JLE Electrical Ltd. an electrical contracting company that serviced Edmonton, Alberta, Canada clients. John founded and managed JLE Electrical Ltd. which included CRO, Project Management, Staff Management, Planning & Operational Leadership, Electrical Technical/IT, Permitting/QC/Compliance, Client Relations, Process Development/Improvement and Financial aspects of the company.

John is a past Board Member of the Electrical Contractors Association of Alberta (ECAA, https://ecaa.ab.ca/), and past Chapter President for Edmonton, Alberta. John achieved the status of Professional Electrical Contractor with the ECAA, demonstrating leadership and commitment to industry in operating his company to the highest professional standards.

John sold his company when an unknown ailment occurred in his life that debilitated him from continuing to work as a Journeyperson Electrician. John was diagnosed with electrical injury and has become an advocate for electrical safety and eliminating exposure to the electric shock hazard. John is raising awareness of the long-term sequelae related to the electrical shock injury, connecting with other injured electrical workers and helping them understand and manage what is called an invisible iceberg injury.