National Energy Board

Office national de l'énergie

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13 February 2009

To: All Oil and Gas Companies under the Jurisdiction of the National Energy Board (the Board or NEB) and All Interested Parties

Report Issued by the National Energy Board February 2009 entitled *Investigation under the National Energy Board Act into the Death of Mr. Henri St. Pierre at the Enbridge Pipelines Inc. Kerrobert Pump Station on 24 March 2008*

The National Energy Board has completed an investigation pursuant to the *National Energy Board Act* into the death of an electrician employed by Enbridge Pipelines Inc. and has issued a report on the investigation entitled *Investigation under the National Energy Board Act into the Death of Mr. Henri St. Pierre at the Enbridge Pipelines Inc. Kerrobert Pump Station on 24 March 2008* (the Investigation Report). Advance copies of the report were provided to the St. Pierre family, Enbridge Pipelines Inc., and the Transportation Safety Board.

Through its investigation, the Board identified several immediate and underlying root causes that contributed to the accident and determined actions to be implemented by Enbridge Pipelines Inc. to address the causes. All Companies should note these immediate and root causes and the actions required to deal with them, as described in the Investigation Report.

All Companies should continue to examine their health and safety programs to ensure that their programs meet the requirements of the *Onshore Pipeline Regulations – 1999*, the *Canada Labour Code, Part II* and other applicable standards in order to protect employees from injury and promote a safe work place and strong safety culture.

The Investigation Report is available on the Board's website at www.neb-one.gc.ca. In addition, hard copies of the report can be obtained from the NEB library by e-mailing library@neb-one.gc.ca or by calling toll free 1-800-899-1265.

Should you have any questions or wish to discuss this report please contact Mr. Shane Richardson at 403-299-3926 or Ms. Kim Maddin at 403-299-2763.

Yours truly,

Claudine Dutil-Berry
Secretary of the Board

444 Seventh Avenue SW
Calgary, Alberta T2P 0X8

444, Septième Avenue S.-O.
Calgary (Alberta) T2P 0X8

Canada

Telephone/Téléphone : 403-292-4800
Facsimile/Télécopieur : 403-292-5503
http://www.neb-one.gc.ca
Telephone/Téléphone : 1-800-899-1265
Facsimile/Télécopieur : 1-877-288-8803

National Energy Board

Office national de l'énergie

Investigation Under the *National Energy Board Act* into the Death of Mr. Henri St. Pierre at the Enbridge Pipelines Inc. Kerrobert Pump Station on 24 March 2008

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Comments or questions regarding this report may be directed to Mr. Shane Richardson of the National Energy Board Operations Business Unit at (403) 299-3926 or to Ms. Kimberly Maddin of the National Energy Board Operations Business Unit at (403) 299-2763.

National Energy Board

Investigation under the *National Energy Board Act* into the Death of Mr. Henri St. Pierre at the Enbridge Pipelines Inc. Kerrobert Pump Station on 24 March 2008

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Executive Summary

On 24 March 2008 Mr. Henri St. Pierre, an electrician employed by Enbridge Pipelines Inc. (Enbridge), died while carrying out electrical work at the Enbridge Kerrobert Pump Station near the town of Kerrobert, Saskatchewan. The National Energy Board conducted an investigation into this incident under the authority of the *National Energy Board Act*.

Immediately following the incident, Enbridge activated its emergency response procedures. The Board considers that the Enbridge response was quick, appropriate and effective for the nature of the incident and it demonstrated the effectiveness of the emergency training received by the Enbridge and Power Comm Inc. staff that were on-site at the time of the incident. The Board has no concerns about the emergency response conducted for this incident.

The Board notes the Final Autopsy Report and Final Toxicology Results dated 24 June 2008 from the Saskatchewan Ministry of Justice and Attorney General Office of the Chief Coroner (Saskatchewan Coroner). The Saskatchewan Coroner opines that contact with high voltage electricity, as reported in the case of Mr. St. Pierre, would result in essentially instantaneous cardiac arrest. Following the incident, Enbridge filed with the Board two summaries prepared by a medical expert retained by Enbridge. The summaries raise question as to the cause of death of Mr. St. Pierre and suggest that it may not have been the result of electrocution, as opined in the Saskatchewan Coroners report.

Nonetheless, the Board notes that the sequence of events leading up to the incident reveal several immediate errors that were committed prior to the incident, and the investigation revealed that there were several underlying root causes present in the Enbridge safety management system prior to the incident. These immediate and root causes had the effect of placing Mr. St. Pierre in a situation that put his personal safety at great risk immediately prior to his death. Where this report makes reference to the incident, it refers to the hazardous conditions to which Mr. St. Pierre was exposed immediately prior to his death but does not infer or conclude as to the cause of death. Other factors, while not considered to be immediate or underlying root causes, nonetheless contributed to the cause of the incident and are discussed below

The immediate causes related to this incident include:

- No pre-job safety meeting was conducted by Mr. St. Pierre or others involved with the work, as required by Enbridge Operations and Maintenance procedures.
- No hazard assessment of the work was conducted, and therefore no assessment of the need for a safe work permit or task analysis was done.
- No Electrical Equipment Isolation/Clearance form was completed as required by Enbridge Operations and Maintenance procedures.
- Mr. St. Pierre stood in front of the wrong power factor capacitor cell door when he asked Mr. Halter to unlock the door.
- Mr. St. Pierre entered the cell prior to Mr. Halter being able to correctly test the high voltage probe and sweep the inside of the cell.
- There was poor communication between Mr. Halter and Mr. St. Pierre.

- Mr. St. Pierre was not wearing the required personal protective equipment.
- Mr. St. Pierre and Mr. Halter lacked situational awareness.
- Mr. St. Pierre did not conduct a flash test with a hot stick prior to entering the cell or use a hot stick to apply the safety grounds as required by the Enbridge Operations and Maintenance procedures.

The underlying root causes related to this incident include:

- The Hazard/Risk Category assigned by Enbridge to the power factor capacitor cells corresponds to a lower level of personal protective equipment than required in order to protect personnel from being injured from an arc flash.
- The hazard assessment, safe work permit and task analysis procedures were not consistently applied or clearly understood by the Enbridge workers involved in this incident.
- The Electrical Equipment Isolation/Clearance forms filed by Enbridge show that the form is not consistently applied or clearly understood by the Enbridge workers who completed the forms, including those workers involved in this incident.
- There is a lack of safety culture and awareness among the workers involved in this incident.
- There are weaknesses in the Enbridge safety training program provided to the workers involved in this incident.
- There is an inconsistent knowledge and practice among the Enbridge workers involved in this incident on the required personal protective equipment for electrical work.

Other contributing factors include:

- The design of the 4-ESB-1 electrical switchgear building, while meeting the *Canadian Electrical Code* design standards, provides limited visual guidance between corresponding motor starter cabinets and power factor capacitor cells and does not provide for interlocks between them.
- Identification labels on the starter cabinets and power factor capacitor cells were not conspicuous.

In order to address the immediate and root causes and other factors, the Board will require Enbridge to conduct the following corrective actions and report to the Board:

- Re-evaluate the hazard analysis and risk rating procedures in Enbridge Operations and Maintenance Procedures Book 2 Safety.
- Identify adaptations to the Enbridge Operations and Maintenance Procedures Book 2 Safety and assess the adaptations with the view to revising the procedures.
- Re-assess and revise existing training modules.
- Monitor the use of the Electrical Equipment Isolation/Clearance form and safe work permit procedures to verify correct use.

- Demonstrate how the Hazard/Risk Category number 0 was determined for the power factor capacitor cells in 4-ESB-1.
- Re-assess the Hazard/Risk Category number assigned to the cells.
- Evaluate the effectiveness of the hazard assessment process and the suitability of hazard controls.
- Examine the feasibility of installation of Kirk Key interlocks.
- Conduct an inventory of the starter cabinets and power factor capacitor cells currently not in use in 4-ESB-1 at Kerrobert and in ESBs on the Enbridge system in Canada.
- Assess the electrical switchgear design factors in consultation with the Enbridge electricians and area supervisors.
- Assess and redesign the warning labels on the outside of starter cabinets and cell doors.
- Review the Enbridge compliance monitoring initiatives.
- Assess the feasibility of applying changes made in the Kerrobert operations area to other locations on the Enbridge System where racking out and grounding is conducted.
- Report to the Board on the status of completion of the recommendations of the Enbridge investigation.
- Conduct an assessment of the indicators noted in section 7.2.4 of this report, identify any management system factors that underlie these indicators and develop appropriate corrective actions.

As Enbridge works toward addressing the findings identified in this investigation, the Board may require further corrective action from Enbridge or may make a decision or order as necessary in order to promote safe construction, operation and maintenance of the Enbridge system.

National Energy Board

Investigation under the *National Energy Board Act* into the Death of Mr. Henri St. Pierre at the Enbridge Pipelines Inc. Kerrobert Pump Station on 24 March 2008

1. Introduction

On 24 March 2008 Mr. Henri St. Pierre, an electrician employed by Enbridge Pipelines Inc. (Enbridge), died while conducting electrical work at the Enbridge Kerrobert Pump Station near the town of Kerrobert, Saskatchewan. The death was reported by Enbridge to the Transportation Safety Board (TSB) and the TSB contacted the National Energy Board (Board or NEB). The NEB subsequently deployed two investigators to the Kerrobert Pump Station to conduct concurrent investigations under the *National Energy Board Act* (NEB Act or Act) and under the *Canada Labour Code* (CLC). This report presents the evidence, analysis, findings and recommendations of the investigation conducted under the NEB Act.

While the evidence strongly supports the argument that Mr. St. Pierre made contact with electricity, the Board does not make this determination, recognizing that no witness saw him make contact. The facts remain however, that the failures in the Enbridge management system placed Mr. St. Pierre in a very hazardous situation, with a very high potential for making contact with electricity and for receiving serious injury or the loss of his life. Where this report makes reference to the incident, it refers to the hazardous conditions to which Mr. St. Pierre was exposed immediately prior to his death but does not infer or conclude as to the cause of death.

2. Abbreviations Used in This Report

Abbreviation	Term or definition
4-ESB-1	Electrical switchgear building 4-ESB-1 located at the Enbridge Kerrobert pump station.
Book 2	The *Enbridge Operating and Maintenance Procedures Book 2 Safety*, version including updates to 1 December 2007.
CLC	*Canada Labour Code*
CPR	Cardiopulmonary resuscitation
DNV	Det Norske Veritas
ECC	Enbridge Control Centre
EHS	Environment, Health and Safety
Enbridge	Enbridge Pipelines Inc.
ESB	Electrical switchgear building
HRC	Hazard/Risk Category
kv	kilovolt
NEB Act or Act	*National Energy Board Act*
NEB or Board	National Energy Board
OPR-99	*Onshore Pipeline Regulations - 1999*
PLM	Pipeline Maintenance
Power Comm	Power Comm Inc.
PPE	Personal protective equipment, including high voltage personal protective equipment.
Project	Enbridge Southern Access Expansion project stages 2A and 2B
RCMP	Royal Canadian Mounted Police
ROW	Right of way
SWP	Safe Work Permit
TSB	Transportation Safety Board

3. Scope and Objectives of the Investigation under the NEB Act

The scope of the NEB investigation into this incident was restricted to the Board's mandate as set out in the NEB Act. A concurrent investigation was conducted pursuant to the CLC by a NEB staff member designated as a Health and Safety Officer under the CLC. The NEB staff members conducting the concurrent investigations jointly gathered evidence and conducted site visits and interviews related to the incident. However, the analysis of the evidence, determination of findings and recommendations were conducted independently pursuant to the provisions of the respective legislation. While reference is made in this report to certain requirements of the CLC, no analysis, findings or recommendations are made pursuant to that legislation.

> Certain sections of the NEB Act set out the authority of the Board to inquire into any incident and to make regulations as to safety. Section 12 of the NEB Act sets out the jurisdiction of the Board:
>
> 12. (1) The Board has full and exclusive jurisdiction to inquire into, hear and determine any matter
>
> (*a*) where it appears to the Board that any person has failed to do any act, matter or thing required to be done by this Act or by any regulation, certificate, licence or permit, or any order or direction made by the Board, or that any person has done or is doing any act, matter or thing contrary to or in contravention of this Act, or any such regulation, certificate, licence, permit, order or direction; or
>
> (*b*) where it appears to the Board that the circumstances may require the Board, in the public interest, to make any order or give any direction, leave, sanction or approval that by law it is authorized to make or give, or with respect to any matter, act or thing that by this Act or any such regulation, certificate, licence, permit, order or direction is prohibited, sanctioned or required to be done.
>
> (1.1) The Board may inquire into any accident involving a pipeline or international power line or other facility the construction or operation of which is regulated by the Board and may, at the conclusion of the inquiry, make
>
> (*a*) findings as to the cause of the accident or factors contributing to it;
>
> (*b*) recommendations relating to the prevention of future similar accidents; or
>
> (*c*) any decision or order that the Board can make.
>
> (2) For the purposes of this Act, the Board has full jurisdiction to hear and determine all matters, whether of law or of fact.

In light of the authority of the Board set out under subsection 12.(1) of the Act, the objectives of the NEB investigation are to: gather all evidence related to the incident; conduct an analysis of the evidence; make findings as to the cause of the incident or factors contributing to it; make

recommendations relating to the prevention of future similar incidents; and make any decision or order the Board can make, as appropriate, to prevent similar incidents from occurring.

Section 48(2) of the Act also allows that the Board may make regulations as to safety:

> (2) The Board may, with the approval of the Governor in Council, make regulations governing the design, construction, operation and abandonment of a pipeline and providing for the protection of property and the environment and the safety and security of the public and of the company's employees in the construction, operation and abandonment of a pipeline.

The requirements of the *Onshore Pipeline Regulations, 1999* (OPR-99), in respect to operations and maintenance manuals, safety procedures and training are discussed in section 6.3 of this report.

4. Incident Investigation Methodology

The NEB investigation included the following components:

a) Site observation, photographs and information gathering.
b) Interviews.
c) Documentation.
d) Information Requests.
e) Analysis of evidence.
f) Determination of findings.
g) Recommendations.
h) Report.
i) Follow-up.

On 25 March 2008 the NEB investigators conducted a site visit to the Enbridge Kerrobert Pump Station. The investigators met with Enbridge personnel, underwent the Enbridge safety orientation and then with Enbridge personnel in attendance, inspected the incident site within the 4-ESB-1 electrical switchgear building (4-ESB-1). Photographs were taken inside the 4-ESB-1, some of which are included in this report. Investigators also conducted interviews with witnesses who were inside the 4-ESB-1 at the time of the incident; including Enbridge electrician Mr. Jordan Halter and Power Comm Inc. (Power Comm) employees Mr. Ron Horak, Mr. Ron Grove and Mr. Graham Taylor. Investigators also met with and received information from other Enbridge personnel at the Kerrobert pump station including those listed in the table below.

Table 4.1: Enbridge Staff in Attendance at 25 March 2008 Investigation at Kerrobert Pump Station

Name	Position
Rolf Matsson, P.Eng.	Sr. Electrical Engineer, Engineering Services
Dale Burgess, P.Eng.	General Manager, Western Region
Stephen J. Wuori	Executive Vice President, Liquids Pipelines
Ab Mouallem, P.Eng.	Manager, Regional Services and Development Western Region
Michael P. Koby	Director, Operations Services for Liquid Pipelines
C. D. (Craig) Sluser, CRSP	Senior Safety Coordinator Canadian Operations
Jim Veronelly	Maintenance Coordinator, Kerrobert Station
Leon Zupan	Vice President Operations

Mr. Art Nordholm, an investigator from the Transportation Safety Board (TSB), was also in attendance at the pump station on 25 March 2008. After a preliminary assessment of the facts surrounding this incident, the TSB determined that it would not conduct an investigation since the incident appeared to be related to occupational safety and health issues and not to a systemic problem posing a threat to public safety, property or the environment. The NEB was therefore able to conduct a full investigation pursuant to the NEB Act.[1]

The investigators re-visited the Kerrobert Pump Station on 25 June 2008 in order to conduct follow-up interviews and gather additional information. Investigators met with Mr. Jordan Halter, Mr. Jim Veronelly, Mr. Dan Tischler, Ms. Tamara Trull and Mr. Ab Mouallem.

Information Request No. 1 was sent to Enbridge on 7 May 2008 and the Enbridge reply to Information Request No. 1 was filed with the Board on 28 May 2008. Information Request No. 2 was sent to Enbridge on 27 June 2008 the Enbridge reply to Information Request No. 2 was filed with the Board on 17 July 2008. For ease of reference in this report, the Enbridge responses to Information Request No. 1 will be in the numbering format "IR1-xx" and the Enbridge responses to Information Request No. 2 will be in the numbering format "IR2-xx".

A listing of the documentation and evidence received during the investigation is provided in Appendix I.

1 The Transportation Safety Board (TSB) is an independent agency created to advance transportation safety through the investigation of occurrences associated with the operation of an aircraft, a ship, a pipeline or rolling stock on a railway to determine cause and contributing factors. If the TSB investigates an occurrence associated with the operation of a pipeline, the NEB can only investigate that occurrence for reasons other than determining cause and contributing factors. In that instance, the NEB would co-ordinate its investigation through the TSB.

The overall NEB investigation was guided by the procedures established under the Det Norske Veritas (DNV)[2] investigation methodology. The DNV loss causation model shows that incidents typically do not occur as a result of one clear factor, but are the result of multiple factors and underlying latent conditions. An incident event will most often occur because of lack of control, underlying root causes and immediate causes which lead to the incident and result in unintended harm or damage (DNV, 2003). The loss causation model was used to guide the NEB investigation towards identification of the factors that contributed to the incident and what must be done to control the causes.

The analysis of the evidence related to the incident was further guided by use of the DNV systematic causal analysis technique. The DNV systematic causal analysis technique is a method of examination and processing of evidence which leads to identification of problems and their significance, and the development of appropriate remedial measures. The analysis is based on the facts of the incident and, where appropriate, on reasonable assumption. The analysis is iterative as the evidence is refined and tested. The DNV causal analysis of the evidence is presented in table format in Appendix II.

5. The Incident

The Enbridge Southern Access Expansion project stages 2A and 2B (Project) were approved by Board Order XO-E101-01-2007 on 25 January 2007. The Project includes the upgrade of four mainline pumps and the addition of one booster pump at the Enbridge Kerrobert pump station. As part of the Kerrobert station pump upgrades, the Unit 4-U-3 pump was to be replaced by a unit with higher horsepower. Prior to removing the Unit 4-U-3 pump, it first needed to be electrically isolated by racking out (switching off) the unit from the 4160 volt power supply and then grounding to eliminate any residual electricity that may be present in the unit. Prior to racking out, the electrical equipment within any of the power factor capacitor cells in use in 4-ESB-1 would be electrically live, carrying 4160 volts. Racking out and grounding was to be conducted by Enbridge electricians on 24 March 2008 from within building 4-ESB-1.

On 24 March 2008 prior to Enbridge personnel and contractors beginning work for the day, Enbridge personnel and contractors conducted a morning meeting at the Enbridge Kerrobert pump station in order to discuss the work schedule and assignments for the week. Mr. Halter and Mr. St. Pierre were present at the meeting. Mr. Halter was originally scheduled to go to Herschel station however, the Maintenance Coordinator asked Mr. Halter to rack out Unit 4-U-3 for a planned outage.

Approximately 15 to 20 minutes after the morning meeting Mr. Halter was in building 4-ESB-1 where he confirmed that pump Unit 4-U-3 was placed on local control. Mr. Halter then racked out and placed a lock on the unit starter for pump Unit 4-U-3, thereby electrically isolating Unit 4-U-3, including the Unit 4-U-3 power factor capacitor cell.

Mr. Halter left building 4-ESB-1 and proceeded towards the storage shed in order to locate a set of safety grounds. He met with Mr. St. Pierre outside building 4-ESB-1 where Mr. St. Pierre had

2 Det Norske Veritas (DNV) is an independent and autonomous worldwide foundation whose objective is to safeguard life, property and the environment. DNV provides assistance to organizations through training, consultancy, research and development in loss control management, including incident investigation.

indicated that he too had been unable to locate grounding cables but that he had found a set that would suffice for the grounding work to be done inside building 4-ESB-1. Mr. Halter and Mr. St. Pierre then entered building 4-ESB-1 where they quickly located grounding cables lying on the floor in a corner of the building. Mr. St. Pierre picked up the grounding cables and they both went to the row of power factor capacitor cells.

Mr. Halter commenced a test of the high voltage probe that was to be used to sweep the inside of the Unit 4-U-3 power factor capacitor cell to check for the presence of electrical energy. The sweep is a safety precaution taken before conducting any work within the cell. The voltage probe test involves turning the probe on, setting the appropriate voltage level on the probe, and then holding it in close proximity to a known energized electrical source, in this case the overhead fluorescent lighting (photo 5.2). The probe detects the electric field surrounding the alternating current potential. A successful test of the probe results in a constant audible alarm tone being emitted from the probe while it is held near the known energized source. As the probe is moved away from the known energized source, the constant alarm tone will change to an intermittent tone. If no electrical energy is present, the probe will emit an intermittent tone throughout the test.

Mr. Halter stated to Mr. St. Pierre that he was having difficulty with the test of the voltage probe. Mr. St. Pierre stood in front of a power factor capacitor cell door and as he was still holding the cables he asked Mr. Halter to unlock the door. Mr. Halter unlocked the door that Mr. St. Pierre was standing in front of, and resumed his test of the voltage probe. Mr. Halter could not obtain the appropriate audible tone from the probe and he indicated this to Mr. St. Pierre. In his statement Mr. Halter said "I continued to test the high voltage tester. I held it up to a light, it did not alarm. Henri opened the door. I told him the high voltage tester was not picking up the light." Mr. St. Pierre acknowledged Mr. Halter by giving him "a look" (statement of Mr. Halter dated 25 March, 2008).

Mr. St. Pierre then opened the unlocked power factor capacitor cell door. Mr. Halter did a sweep inside the cell with the voltage probe which did not emit the appropriate signal indicating the presence of electrical energy. Mr. Halter then proceeded to turn his back to Mr. St. Pierre in order to continue testing the probe by holding it up to the overhead lighting. Mr. Halter did not expect that Mr. St. Pierre would enter the cell. In his statement to the NEB investigators Mr. Halter said "I heard an arc, just a quick buzz and saw Henri back out and looked like he had the wind knocked out of him." In his statement to the RCMP Mr. Halter said "I did not see Henri enter the cell, I just heard the arc". In his written statement Mr. Ron Grove said "I heard a bang and turned around. The Enbridge employee staggered back from the equipment". In his interview statement to the NEB investigators Mr. Ron Grove said he "had his back turned and didn't see anything, heard the bang, an out of the ordinary sound". In his interview statement to the NEB investigators Mr. Graham Taylor said "could see their heads and see them checking for voltage and heard the bang/pop and smelled smoke and saw the cell door hit, like Henri walked into it".

After hearing the arc, Mr. Halter turned to face Mr. St. Pierre. Mr. St. Pierre stood away from the cell briefly, then fell to one knee and collapsed. One part of the grounding cables was inside the cell.

Immediately after Mr. St. Pierre collapsed, Mr. Halter and other Enbridge and Power Comm employees initiated an emergency response. Mr. Halter immediately moved Mr. St. Pierre to a safe location away from the power factor capacitor cell and initiated cardiopulmonary resuscitation (CPR). A Power Comm worker shouted "man down", a phone call was made to 911, the station alarm was sounded, workers were evacuated to muster points and the local emergency services arrived within approximately 25 minutes of Mr. St. Pierre being injured. When other Enbridge staff entered the 4-ESB-1 Mr. Halter noticed that the door to Unit 4-U-2 power factor capacitor cell was open, and not the door to Unit 4-U-3. Mr. Halter then made the scene safe for the emergency responders by calling the control centre to shut off power from Unit 4-U-2, racking out the starter for Unit 4-U-2, donning safety gloves, removing part of the grounding cable from Unit 4-U-2 and closing the door to Unit 4-U-2.

The table provided in Appendix III outlines the sequence of events leading up to the incident and the response actions immediately following the incident, as based on the evidence gathered from the investigation.

5.1 Post-Incident Site Observations

The Board notes that the emergency response actions of the Enbridge and Power Comm staff involved in the incident was conducted generally in accordance with the Enbridge emergency response procedures. The Board considers that the response was quick, appropriate and effective for the nature of the incident and it demonstrated the effectiveness of the emergency training received by the Enbridge and Power Comm staff. The Board has no concerns about the emergency response for this incident.

The investigators conducted a site visit with Enbridge personnel wherein several photographs of the scene were taken. Several of these photographs are provided here to assist in clarifying the events leading up to the incident.

Photo 5.1 shows the bank of five unit starters left undisturbed immediately following the incident as required by section 127(1) of the CLC. The unit starters are numbered from 4-U-1 to 4-U-5 in sequence from left to right. The photo shows that starters 4-U-2 and 4-U-3 are in the racked out position (indicated by the red levers in the down position). A lock is applied to starter 4-U-3; however a lock is not applied to starter 4-U-2 due to the emergency nature of racking out this starter immediately following the incident. Starters 4-U-4 and 4-U-5 are extra starters, which were not in use and not connected to equipment at the time of the incident.

Photo 5.1: Unit starters located in 4-ESB-1 building.

Photo 5.2 shows the relative positions of the five unit starters (left) and the five power factor capacitor cells (right). The grounding cables in use at the time of the incident can be seen lying on the floor in front of the power factor capacitor cells. Also seen in the photo is the overhead lighting that was used by Mr. Halter to test the function of the voltage probe prior to conducting a sweep inside the cell with the probe.

Photo 5.2: Unit starters and power factor capacitor cells.

Photo 5.3 shows the bank of five power factor capacitor cells. The power factor capacitor cells are numbered from 4-U-1 to 4-U-5 in sequence from left to right.

Photo 5.3: Power factor capacitor cells.

Photo 5.4 shows the inside of power factor capacitor cell 4-U-2. The metal bus bars are labeled A, B and C. After racking out the unit, grounding is accomplished by connecting the three tail ends of the grounding cables to the three bus bars and then the lead end of the grounding cables to a ground point.

Photo 5.4: inside of power factor capacitor cell 4-U-2.

Photo 5.5: Warning labels on outside of door to power factor capacitor cell 4-U-3. The labeling is common to all power factor capacitor cells in 4-ESB-1.

On 2 July 2008 the Board received copies of the Final Autopsy Report and Final Toxicology Results for Mr. St. Pierre dated 24 June 2008 from the Saskatchewan Ministry of Justice and Attorney General. The Final Autopsy Report states that electrical burns were present on parts of the left hand and opines that contact with high voltage electricity, as reported in the case of Mr. St. Pierre, would result in essentially instantaneous cardiac arrest.

6. Applicable Procedures, Standards, Regulations and Legislation

There are several industry standards, company procedures, Acts and Regulations that apply to Enbridge Pipelines Inc. and that are in place to ensure the health and safety of the company's employees. While the CLC applies in this case, it is not necessary to discuss the requirements of the CLC in this report as those requirements will be addressed through the CLC investigation and report. The regulations and legislation that apply include the National Energy Board Act and the Onshore Pipeline Regulations – 1999.

6.1 Enbridge Operations and Maintenance Manuals

The Enbridge Operations and Maintenance manuals undergo periodic revision and updating. For the purposes of the investigation, the manuals and procedures described below are those that were in place at the time of the incident.

6.1.1 Enbridge Operating and Maintenance Procedures Book 2 Safety

6.1.1.1 Hazard Assessment

The Enbridge Operating and Maintenance Procedures Book 2 Safety (Book 2) tab 3 sets out the company requirements for conducting a hazard assessment and completion of a safe work permit for work activities at facilities and on the right-of-way.

Book 2 states that before work begins regions are responsible for:

- Ensuring affected workers are trained in:

a) hazard identification and assessment; and

b) selection and use of personal protective equipment (PPE);

- Conducting a risk assessment of the work activity;
- Where reasonably practicable, involving all workers associated with the work activity in the risk assessment.

As described in Book 2, the hazard assessment process includes the following steps. A risk rating is determined using Figure 1 Book 2 -03-02-01 page 6-7. If the risk rating is determined to be less than 4, the risk is considered low and the task may be completed immediately. A risk rating of 4 to 16 is considered high and a safe work permit must be completed for the work prior to the task being undertaken. Where a safe work permit is required, it is to be completed prior to commencement of the work.

Book 2 requires that hazard assessments must be performed for all high risk activities and must be documented through the completion of a safe work permit; exemptions must be approved by the regional manager at their discretion (Book 2, 03-02-01, page 2-7).

Book 2 also states that the safe work permit is verification that a hazard assessment has been completed and that permit approvers and issuers must not approve or issue any safe work permit until the scope of the work has been (a) defined in sufficient detail to ensure all hazards are identified and controlled, and (b) reviewed with the permit issuer for accuracy, and all potential hazards and controls have been identified. The permit receiver is responsible for reviewing hazards and controls with affected workers and ensuring requirements on the permit are followed.

6.1.1.2 Lockout

Enbridge Book 2, 06-03-01 indicates that lockout is required when there is a risk of unexpected release of stored energy, be it electrical, mechanical, pneumatic or hydraulic. The standard procedures are as follows:

1 Identify and locate all potential energy sources to be isolated

2 Notify affected workers

3 Shut down operating equipment

4 Isolate equipment from its energy source by operating the switch, valve or other energy isolating device

5 Relieve, disconnect or restrain potentially hazardous stored or residual energy

6 Lock and tag the equipment

7 Verify the lockout by confirming that energy sources have been isolated and locked out

8 Proceed with maintenance.

If the lockout involves electrical equipment, use the Electrical Equipment Isolation/Clearance form where required.

Enbridge Book 2, 07-03-02 also includes steps for lock and tag of High Voltage Equipment. Under the Unit Motor/Unit Pump procedure (page 7-8), step 7 requires a lock and tag upon isolation of the high voltage equipment.

6.1.1.3 Electrical Safety

For high voltage work Book 2 requires that a pre-job meeting be conducted to review potential hazards associated with the work, work procedures, personal protective equipment and safe clearance distances.

Book 2, tab 7 Electrical Safety provides a standard procedure for de-energizing or switching high voltage equipment and several specific procedures for work on various pumps and other electrical equipment. For the racking out and grounding of Unit 4-U-3 the standard procedure and the Unit Motor/Unit Pump procedure would apply (Mr. Veronelly interview). The Standard procedure sets out the following numbered steps:

1 Complete the Electrical Equipment Isolation/Clearance form.
2 Coordinate pending power shutdown with affected users.
3 Review what circuits or cutouts will be switched.
4 Review what circuits or cutouts will be locked out.
5 Identify potential hazards located near the work area (make a single line sketch of the circuit if one is not available.).
6 Ensure all onsite personnel involved in the work sign the form.
7 Shed major loads on the circuit.
8 Lockout necessary equipment.
9 Test for potential.
10 Apply safety grounds.
11 Complete work.
12 Check for clearance of tools and personnel.
13 Remove safety grounds.
14 Ensure all electricians involved with the work initial the form.
15 Ensure the person in charge signs off the form.
16 Re-energize the equipment.

The Unit Motor/Unit Pump procedure sets out the following numbered steps:

1 For electrical maintenance, complete the Electrical Equipment Isolation/Clearance form.

2 Notify the Control Center, site supervisor, and line operators stating the reason and probable length of time that the unit will be out of service.
    a. If the lockout will affect throughput or is part of a major repair, also notify Operations management.
3 Verify off status by checking the motor amps and the breaker/contactor (both contactors if equipped with variable frequency drive [VFD]).
4 Position selector switches to LOCAL and OFF.
5 Press the STOP button
6 Open isolation switch completely; rack out a screw-in type breaker to the test position
7 Lock and tag
8 Visually inspect stabs, shutters and/or indicating levers to ensure an open condition
9 For electrical maintenance:
    a. Test circuit conductors with a high-voltage detector on a hot stick
    b. Apply safety grounds to conductors
    c. Shut off breakers for suction and discharge valves; lock and tag
10 For mechanical maintenance:
    a. Close, chain, lock and tag the unit suction and discharge valves
    b. Verify isolation and shut off, lock and tag the valve breakers
11 Shut off drain line heaters, and lock and tag as required
12 Shut off motor cooling fan breaker, and lock and tag as required
13 Shut off lube oil pump breaker, and lock and tag as required
14 Disconnect and remove RTDs as required.
    a. When air is vapour free, disconnect wires by separating and insulating one wire at a time, avoiding contact with ground.
15 For mechanical maintenance:
    a. Drain pressure from pump.
    b. Close and isolate the valve used to drain pressure.
    c. Observe gauges for any pressure build up.
16 Return the unit to service.

The Electrical Equipment Isolation/Clearance form is completed in stages during the completion of the work. Part of the form applies to the issuance of the clearance prior to transfer of the work to contractors. The form is fully completed at the point of surrender of the clearance and the final check before energizing the equipment. The form also includes a flow diagram of the main tasks associated with the electrical work. The flow diagram leads the electrician(s) through a step by step review of the work.

6.1.1.4 Personal Protective Equipment

Book 2, tab 3 states that regions are responsible for:

- Ensuring affected workers are trained in:

a) hazard identification and assessment; and

b) selection and use of PPE;

Book 2, tab 13 sets out the Enbridge requirements for personal protective equipment to be worn by employees during the course of work where hazards may be present. For the task of racking out and grounding Unit 4-U-3 conducted by Mr. Halter and Mr. St. Pierre, the minimum PPE required to be worn includes hard hat, safety glasses, fire retardant long sleeve shirt, fire retardant pants and safety footwear. Where work takes place within electrical approach boundaries as defined in the National Fire Protection Association NFPA 70E, certain additional high voltage protective equipment must be worn, as discussed below in section 6.2

6.2 The National Fire Protection Association Standard NFPA 70E

The *National Fire Protection Association Standard 70 E* (NFPA 70E) addresses the electrical safety requirements for the practical safeguarding of employees in the work place.[3] In its Operations and Maintenance Procedures, Enbridge has adopted the NFPA 70E as the standard for electrical safety that it will apply to electrical work on its system.

Article 130 and Annex D of NFPA 70E provides for Flash Hazard Analysis and calculation of the Flash Protection Boundaries and incident energy for electrical equipment and tasks. Table 130.7(C)(9)(a) of NFPA 70E outlines Hazard/Risk Category (HRC) classifications for various tasks conducted on electrical equipment. The HRC classifications are then applied in Table 130.7(C)(10) to determine the appropriate PPE to be worn while conducting tasks on electrical equipment. The task of applying safety grounds ranges from classification HRC-2 for 600 volt class switchgear to HRC-4 for metal clad switchgear, 1 kilovolt (kv) and above, assuming the equipment is energized and work is done within the flash protection boundary.

Table 130.7(C)(10) of NFPA 70E requires that, when working on energized equipment with a HRC-0, protective clothing and equipment will include long sleeve non-melting shirt and pants and safety glasses. However, voltage rated gloves are not required to be worn. HRC-2 to HRC-4 requires that leather gloves be worn as well as the use of other high voltage protective equipment over and above that required for HRC-0.

6.3 Onshore Pipeline Regulations – 1999 (OPR-99)

The *Onshore Pipeline Regulations - 1999* (OPR-99), brought into force 1 August 1999, governs the design, construction, operation and abandonment of a pipeline and provides for the protection

3 The National Fire Protection Association (NFPA) is an organization in the United States of America and is responsible for the creation and maintenance of standards for fire prevention, suppression, training and equipment, including standards for electrical safety.

of property and the environment and the safety of the public and of a company's employees during the construction, operation and abandonment of the pipeline.

Among other matters, some of the key related sections of the OPR-99 with regards to the Enbridge incident are as follows:

> **27.** A company shall develop, regularly review and update as required, operation and maintenance manuals that provide information and procedures to promote safety, environmental protection and efficiency in the operation of the pipeline and shall submit them to the Board when required to do so.
>
> **28.** A company shall inform all persons associated with operation activities on the pipeline of the practices and procedures to be followed and make available to them the relevant portions of the operation and maintenance manuals.
>
> **31.** (1) A company shall develop a maintenance safety manual and shall submit it to the Board when required to do so.
>
> (2) The company shall keep a copy of the maintenance safety manual or the relevant parts of it at each maintenance site of the pipeline, in a location where it is accessible to every person engaged in maintenance at the site.
>
> **36.** A company shall
>
> (*a*) maintain communication facilities for the safe and efficient operation of the pipeline and for emergency situations;
>
> (*b*) periodically test instruments and equipment at the pipeline stations to verify their proper and safe operation;
>
> **46.** (1) A company shall develop and implement a training program for any employee of the company who is directly involved in the operation of the pipeline.
>
> (2) The training program shall instruct the employee on
>
> (*a*) the safety regulations and procedures applicable to the day-to-day operation of the pipeline;
>
> (*b*) responsible environmental practices and procedures in the day-to-day operations of the pipeline;
>
> (*c*) the procedures for the proper operation of the equipment that the employee could reasonably be expected to use; and
>
> (*d*) the emergency procedures set out in the manual developed under section 32 and the procedures for the operation of all emergency equipment that the employee could reasonably be expected to use.

(3) The company shall use reasonable efforts to ensure that any employee who attends a training program has a working knowledge of the subject-matter of the program at the end of the program.

47. A company shall develop and implement a safety program to anticipate, prevent, manage and mitigate potentially dangerous conditions and exposure to those conditions during all construction, operation and emergency activities.

6.4 Canadian Electrical Code CAN/CSA C-22

The *Canadian Electrical Code CAN/CSA C-22* sets the standard for the installation and proper maintenance of electrical equipment in Canada. Given that the work underway by Mr. St. Pierre and Mr. Halter at the time of the incident was not related to new electrical installation or maintenance, the *Canadian Electrical Code CAN/CSA C-22* does not apply. However, the standard did apply to the original design and installation of the panel boards and equipment at the Enbridge Kerrobert station, and will apply to any future maintenance or technical modifications of the panel boards.

7. Analysis of Evidence

Examination of the evidence gathered shows that immediate causes and unsafe acts occurred immediately preceding the incident, and root causes (underlying conditions, lack of control and management system causes) were present prior to the incident occurring. Further, other factors were present that, while not considered to be either immediate or root causes, nonetheless had a role in contributing to the incident. The following is a discussion of the immediate and root causes identified through the causal analysis presented in Appendix II and a discussion of other contributing factors to the incident.

7.1 Immediate Causes

7.1.1 Pre-job Safety Meeting

A pre-job safety meeting was not conducted by Mr. St. Pierre and Mr. Halter prior to commencing the racking out and grounding of Unit 4-U-3, as required by Book 2, tab 07-02-02, page 1-3. Nor did the morning meeting conducted by Enbridge staff address the safety aspects of the racking out and grounding of Unit 4-U-3. Book 2 states that the purpose of the pre-job meeting is to review the potential hazards, work procedures, PPE and safe clearance distances. Had a pre-job meeting been conducted in accordance with the Book 2 requirements, with the participation of both Mr. Halter and Mr. St. Pierre, it is reasonable to suppose that potential hazards would have been identified, work procedures reviewed, PPE identified and safe clearances reviewed.

7.1.2 Hazard Assessment, Safe Work Permit and Task Analysis

Mr. St. Pierre and Mr. Halter did not conduct a risk assessment of the work activity before commencement of the racking out and grounding of Unit 4-U-3, as required by Book 2, tab 3.

This would have determined a risk rating for the work and whether or not a safe work permit would be required. In response to IR1-18a Enbridge stated that a formal risk rating was not conducted for this activity and that some employees understood that a task analysis was required for open system and hot work activities but not for what they considered routine tasks such as racking out and grounding equipment. The Board notes that since a risk rating was not determined, it was not known by Mr. Halter and Mr. St. Pierre whether the work was categorized as high risk or low risk, and therefore whether or not a safe work permit and a task analysis were required to be completed prior to the work commencing.

Although determination of the risk rating would not necessarily have resulted in the completion of the safe work permit or task analysis, the Board considers that not conducting the risk assessment was an unsafe act which reduced the ability of Mr. Halter and Mr. St. Pierre to evaluate the risks associated with the work and the controls to put in place to address the hazards. Further, the Board notes the inconsistent practice and uncertainty among the Enbridge employees in the Kerrobert area around the need for conducting the risk rating, safe work permit and task analysis.

7.1.3 Electrical Equipment Isolation Clearance Form

An Electrical Equipment Isolation/Clearance Form was not completed for the electrical isolation and grounding of Unit 4-U-3 prior to the work commencing, as required by Enbridge Book 2, tab 7 Electrical Safety procedures (Standard, 07-03-01 page 2-8 and Unit Motor/Unit Pump, 07-03-01, page 7-8) and as required by a written statement on the form itself. The Board notes that the Electrical Equipment Isolation/Clearance Form used by Enbridge includes a schematic diagram for planning the work, a box for identifying potential hazards near the work area, and a table titled “Isolation Procedure Steps”.

The Board finds that had the appropriate sections of the Electrical Equipment Isolation/Clearance Form been completed and signed by the person in charge of the work prior to the work commencing, Mr. Halter and Mr. St. Pierre would have had a greater opportunity to plan the work, identify the steps to be taken, identify potential hazards associated with the work area and put appropriate controls in place. While it cannot be known if completion of the form would have prevented the incident, the Board believes that if done, this step would have significantly narrowed the potential for an incident to occur.

7.1.4 Unlocking and Opening of Power Factor Capacitor Cell

Mr. St. Pierre stood in front of the wrong power factor capacitor cell door when he asked Mr. Halter to unlock the door. Neither Mr. St. Pierre nor Mr. Halter observed the door number plate and they did not confirm that they were opening the correct power factor capacitor cell. The Board notes that by standing in front of the 4-U-2 cell door, Mr. St. Pierre provided a visual cue to Mr. Halter when he asked Mr. Halter to unlock the door. The Board finds it reasonable that Mr. Halter would unlock the door in front of which Mr. St. Pierre was standing. These unsafe acts were unintentional errors, unconsciously committed while conducting a routine task.

7.1.5 High Voltage Probe

Mr. Halter was not familiar with the operation of the high voltage probe that he used at the time of the incident, and therefore was unable to correctly conduct a test of the probe and a sweep of the cell. Mr. St. Pierre entered the cell with the grounding cables prior to receiving confirmation from Mr. Halter that the high voltage probe was operating correctly and prior to the cell being swept with the probe in its proper operating mode. Enbridge provided training to its electricians on the types of high voltage probes that it uses, however, this training did not include instructions on the correct operation of the probes. It was confirmed by Enbridge following the incident that the high voltage probe in use by Mr. Halter was in proper working order.

The Board notes that Enbridge provided training to Mr. Halter and Mr. St. Pierre in the use of safety equipment such as fire extinguishers, respiratory protective equipment, gas detectors, PPE and mobile radios. The Board considers a voltage probe to be an essential piece of safety equipment, such as those noted above, and therefore the proper use of high voltage probes should be included in an Enbridge training module. Section 46 of the OPR-99 requires companies to provide training to their employees on equipment that they could reasonably be expected to use. The Board expects that Enbridge will ensure that training on the correct operation of high voltage probes is provided to its employees that use the high voltage probes, in accordance with the requirements of the OPR-99.

7.1.6 Horizontal Communication

The evidence shows there was a lack of horizontal communications between Mr. St. Pierre and Mr. Halter at the time of the incident regarding the use of the high voltage probe. Mr. Halter told Mr. St. Pierre that the voltage probe was not working properly, whereas Mr. St. Pierre did not verbally respond but gave Mr. Halter “a look”. In his statement Mr. Halter said “I continued to test the high voltage tester. I held it up to a light, it did not alarm. Henri opened the door. I told him the high voltage tester was not picking up the light.”.

There was a lack of horizontal communications regarding roles and the use of PPE. The Enbridge Safety Manual sets out the PPE requirements for employees. Mr. St. Pierre should have been wearing a hard hat in order to be inside the 4-ESB-1 building. Further, in his statement to the NEB investigators, Mr. Halter said that initially he did not know that Mr. St. Pierre would be assisting in this job and that he and Mr. St. Pierre did not discuss the job. He also stated that Mr. St. Pierre should have been wearing hard hat, safety glasses and gloves. However, Mr. Halter and Mr. St. Pierre met outside the 4-ESB-1, they entered the 4-ESB-1, Mr. St. Pierre stood in front of the cell door while holding a set of safety grounds, he asked Mr. Halter to unlock the door, Mr. Halter unlocked the door, Mr. St. Pierre opened the door and Mr. Halter did a sweep with the voltage detector. At this point Mr. St. Pierre was fully participating in the work without wearing the minimum required PPE. Although Mr. Halter was initially unaware that Mr. St. Pierre was to assist him that day, the grounding task commenced with Mr. St. Pierre actively assisting, however there was a lack of horizontal communication between Mr. St. Pierre and Mr. Halter regarding roles and the required PPE. Mr. Halter and the three other electricians in the building did not advise Mr. St. Pierre to put on the minimum required PPE. The Board believes this lack of horizontal communication demonstrates the need for a stronger

safety culture, where safety is a shared responsibility. The responsibility to improve the Enbridge safety culture is that of Enbridge.

7.1.7 Personal Protective Equipment

At the time of the incident Mr. St. Pierre was not wearing the appropriate PPE as required by Book 2 procedures, Enbridge training requirements, NFPA 70E and as indicated on the warning label on the outside of the power factor capacitor cell door. In addition to the fire protective clothing that Mr. St. Pierre was wearing, he should also have been wearing safety glasses, hard hat and high voltage gloves. The Board notes that in response to IR2-5c, Enbridge included the details of the High Voltage Training module that was provided to Mr. St. Pierre and Mr. Halter. The High Voltage Training module emphasized the need for and the requirement to wear high voltage gloves for applying safety grounds. The evidence also indicates that throughout his work history, Mr. St. Pierre was very diligent about wearing the proper PPE and Enbridge did not have reason to be concerned about Mr. St. Pierre's compliance with requirements for PPE. Therefore, it may never be known why Mr. St. Pierre did not wear the proper PPE at the time of the incident. PPE was Mr. St. Pierre's last line of defence when all other systems failed.

7.1.8 Lock and Tag

The procedures require a lock and tag upon electrical isolation of high voltage equipment. Also, the lockout/tag out training module filed by Enbridge in response to IR1-4k states that a properly filled out tag must be used with every lockout and that once the equipment is shut down, apply lockout/tag out devices. The Board notes that Mr. Halter applied a lock to the Unit 4-U-3 starter but not a tag. This was considered accepted procedure at the Kerrobert station for this job as long as the tag was applied prior to handover of the work to the contractor and pipeline maintenance (PLM). The Board notes the discrepancy between the Book 2 requirements, the training and the adopted procedures at Kerrobert and would expect Enbridge to address the discrepancy either by enforcement of the Book 2 procedures and training, or by analysis of the adapted procedure being conducted in the workplace and revisions to Book 2 and training modules as appropriate. As it stands, the acceptance of an ad hoc procedure at the Kerrobert station rather than formal amendment of the documented procedure is indicative of a malfunctioning safety culture at Kerrobert.

7.1.9 Situational Awareness

At the time of the incident Mr. Halter and Mr. St. Pierre lacked situational awareness. There were a series of unsafe conditions that immediately preceded the incident that include:

a) Mr. Halter not being able to operate the voltage probe correctly.

b) Mr. St. Pierre not wearing appropriate PPE.

c) Not communicating effectively about the function of the voltage probe (Mr. St. Pierre giving Mr. Halter "a look") or roles and PPE requirements

Further, Mr. Halter and Mr. St. Pierre were likely aware of the Book 2 procedures for the job that were not being followed, including:

a) Conduct a pre-job meeting.

b) Assign a risk rating and, if required, complete a safe work permit and task analysis.

c) Complete an Electrical Equipment Isolation/Clearance form.

d) Use a hot stick or conduct a flash test prior to installing the grounds.

If Mr. St. Pierre and Mr. Halter had recognized the unsafe conditions and the failure to follow procedures as warnings that the work situation was becoming increasingly unsafe, they could have temporarily suspended the work, re-assessed the grounding task and then put the appropriate controls in place to protect themselves from injury. The Board concludes that a lack of situational awareness contributed to putting Mr. St. Pierre's personal safety at great risk. The Board considers this to be a safety culture issue that could be addressed through leadership and awareness training for those involved in this incident.

7.1.10 Other Immediate Causes

Mr. St. Pierre did not conduct a flash test with a hot stick prior to entering the power factor capacitor cell. The Board notes that since the incident, a flash test is now included in the steps identified in Electrical Equipment Isolation/Clearance forms completed 31 March, 1 and 17 April.

Mr. St. Pierre did not use "an adequately rated and tested hot stick for installing or removing safety ground cables to high voltage equipment and conductors" (Book 2, 07-02-02, Standards, High Voltage Work page 1-3 bottom of page). This suggests that there was lack of safety awareness and Mr. St. Pierre was not following safety procedures.

7.2 Root Causes

7.2.1 Design

The Board notes that Enbridge applies the NFPA 70E Standard for determining the appropriate approach boundaries to live parts, Hazard/Risk Categories (HRC) and corresponding PPE required to be worn for work conducted on or near electrical equipment at its facilities The Board notes that NFPA 70E, paragraph 120.2(A), General, states the following:

> (A) General. All electrical circuit conductors and circuit parts shall be considered energized until the source(s) of energy is (are) removed, at which time they shall be considered deenergized. All electrical circuit conductors and circuit parts shall not be considered to be in an electrically safe condition until all sources of energy are removed, the disconnecting means is under lockout/tagout, the absence of voltage is verified by an approved voltage testing device, and, where exposure to energized facilities exists, are temporarily grounded. (*See 120.1 for the six-step procedure to establish an electrically safe work condition*) Electrical conductors and circuit parts that have been disconnected, but not under lockout/tagout, tested

> and grounded (where appropriate) shall not be considered to be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used. Lockout/tagout requirements shall apply to fixed, permanently installed equipment, and to portable equipment.

The Board notes the statement that electrical parts that have been disconnected, but not under lockout/tagout, tested and grounded shall not be considered to be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used. Applying this rule to the grounding of Unit 4-U-3, the conductors and busbars within power factor capacitor cell 4-U-3 would not be in an electrically safe condition prior to lockout/tagout, voltage testing and applying safety grounds to the busbars. This rule also implies that appropriate PPE shall be worn for the circuit voltage and energy level that may be present before the equipment is in an electrically safe condition.

The Board notes that Enbridge has assigned flash hazard number HRC-0 to the power factor capacitor cells in the Enbridge 4-ESB-1 building (photograph 5). The Board also notes the requirements of NFPA 170E to conduct a Shock Hazard Analysis, a Flash Hazard Analysis and, through calculations provided in Annex D, to determine Flash Protection Boundaries and incident energy exposure of a worker. However, these calculations do not determine a HRC number for flash protection. The standard allows for determination of the HRC number and PPE requirements using section 130.7(C)(9) in lieu of the detailed flash hazard analysis approach.

In reviewing the tasks listed in Table 130.7(C)(9)(a), the Board notes that the HRC for the task of applying safety grounds, after a voltage test, ranges from HRC-2 for 600 Volt Class Motor Control Centres, to HRC-4 for Metal Clad Switchgear of 1 kV and above. There are no other tasks listed in Table 130.7(C)(9)(a) that correspond to HRC-0 for the task of grounding the busbars in the power factor capacitor cells within 4-ESB-1. Using NFPA70E, Table 130.7(C)(10), HRC-0 requires workers to wear non-melting long sleeve shirt and pants, and safety glasses. However, HRC-2 and HRC-4 require additional PPE that is not required for HRC-0, including, for HRC-4, the use of V-rated gloves.

Applying the rule that electrical conductors and circuit parts that have been disconnected, but not under lockout/tagout, tested and grounded (where appropriate) shall not be considered to be in an electrically safe work condition, and safe work practices appropriate for the circuit voltage and energy level shall be used, the Board questions the appropriateness of the HRC-0 assigned by Enbridge to the power factor capacitor cells in the 4-ESB-1 for flash hazard protection, and the corresponding PPE requirements. The Board further questions how Enbridge calculated or otherwise determined the HRC-0 for the power factor capacitor cells for flash hazard protection. The Board will require follow-up from Enbridge on this matter (Section 10 of the report).

The Board notes that in addition to the HRC-0 flash hazard indicated on the warning labels to the power factor capacitor cells, there is reference to Glove Class 1. The Board interprets this sign to mean that gloves are required to be worn regardless of the PPE requirements indicated by HRC-0. The Board finds this may cause confusion for workers as the HRC-0 does not require high voltage gloves to be worn, but the Glove Class 1 is indicated. The Board also notes that the warning label warns specifically against “Arc Flash and Shock Hazard”, however, the PPE requirements of HRC-0 would not be sufficient to protect against the arc flash and shock hazard

that may be present within the approach boundaries of the cells. The Board will require Enbridge to address these inconsistencies in labeling.

7.2.2 Hazard Assessment, Safe Work Permit, Task Analysis

Enbridge uses a safe work permit system that was implemented in spring of 2007. Under this system the work performed by Mr. Halter and Mr. St. Pierre on 24 March 2008 required that safe work permit procedures be followed, and where the risk rating assigned to a task is greater than 3, a hazard assessment and safe work permit must be completed. The Board notes that a risk rating for the work was not determined by Mr. Halter and Mr. St. Pierre prior to commencing the racking out and grounding of Unit 4-U-3. The Board also notes that the risk rating procedure provided in Book 2 is subjective in nature and may result in either a low or high risk rating to be assigned to a job depending on factors such as worker experience level and the number of times the worker has done the job before.

In the Enbridge response to IR1-1c the company provided all safe work permits completed by Mr. St. Pierre from 1 April 2007 to 24 March 2008. The Board notes that there are no task analyses included with the safe work permits completed by Mr. St. Pierre. However, in the Enbridge response to IR1-1d, many of the safe work permits completed by other electricians include detailed task analyses. The root of this inconsistent practice may be found in the hazard awareness training module and the Book 2 procedures as explained below.

The Hazard Awareness training received by Mr. St. Pierre on 15 June 2005 (Enbridge response to AVC dated 4 April 2008 and Enbridge response to IR1-4j) provides a different set of steps for the hazard assessment process than provided in Book 2. The training module states that "Work with a risk ranking of less than 4 is considered low risk; a hazard assessment must still be completed to assess the work and identify potential hazards before work begins. This includes completing a hazard assessment utilizing a Task Analysis to record the methods used to control or eliminate the hazards identified." However, Book 2, section 03-02-01, Safe Work Permit – Hazard Assessment, page 4-7 states under Risk Assessment, item 4 "Take action corresponding with the risk: For a high risk activity, complete a hazard assessment. For a low risk activity, no further action is required." The updated procedure found in Book 2 does not include the requirement for completion of a task analysis as a tool for conducting a hazard assessment prior to performing work with a risk ranking of less than 4. The Board finds the hazard awareness training and Book 2 procedures to be inconsistent and should be addressed by Enbridge.

The Board also notes that in response to IR1-2 Enbridge provided copies of safe work permits completed at pump stations identified for pump upgrade in Board Order XO-E101-01-2007. The Risk Assessment Model Ranking (number) is not completed on several of these safe work permits, however, the Board notes that the ranking must be assigned for all tasks. Also, almost all of the safe work permits issued for Kerrobert have a risk ranking of 3, which according to the Book 2 procedures does not require that a safe work permit be completed. Whereas almost all the safe work permits issued for Herschel and Milden do not have a risk ranking assigned at all. This inconsistent completion of the safe work permits further indicates that the risk ranking procedure is not fully understood and consistently applied by Enbridge workers at these stations.

The training records filed by Enbridge for Mr. Halter do not include the Hazard Awareness training module. However, Mr. Halter's records do include a training module for safe work permits, which included training in how to complete the safe work permit, explanation of hazards and controls and when the permit is to be used for hazard assessment.

The Board also notes that in response to IR1-18, Enbridge stated: "From interviews with employees it appears that some employees understood that a task analysis was required for open system and hot work activities but not for what they considered routine tasks such as racking and grounding of equipment. Therefore, a formal risk rating was not conducted for this specific activity." Book 2 procedures however, do not make this distinction and state that "Before work begins, regions are responsible for... conducting a risk assessment for the work activity". The Board also notes that the Directive issued by Enbridge on 31 March 2008 to all electrical workers and supervisors states that high voltage work will be considered a high risk activity and a documented hazard assessment is required.

In response to IR1-12, Enbridge states that "The racking out and grounding of units is a common task which the qualified electricians have a great deal of experience with and have performed a task analysis on in the past for all future jobs. This task analysis was provided to the NEB while on-site after the incident." The Board notes the two task analyses that were provided to the investigators on site after the incident and which are titled Hazard Analysis Work Sheet, *Western Region*. The hazard analysis work sheet to rack out the unit contactor provided by Enbridge lists 4 task steps as follows:

a) Notify appropriate personnel of intention to remove a specified unit from service.
b) Isolate Unit.
c) Wear proper PPE.
d) Rack out unit contactor.

The Hazard Analysis Work Sheet for 5 KV Equipment Isolation provided by Enbridge lists 6 task steps as follows:

a) Notify appropriate personnel of intention o 5KV equipment to be isolated.
b) Hold pre-job meeting, with all participating groups, to review the isolation requirements as per the Single Line Drawing.
c) Request approval from operators to isolate equipment.
d) Complete the isolation, and document steps as per the Electrical Isolation/Clearance Form. Ensure all required locks and tags are in place and all Interlock Keys are collected and stored properly. Review Isolation/Clearance form with recipient to ensure he understands, then have him sign it before he accepts the document.
e) When work is complete the isolation/clearance form must be received from the recipient after verifying that the work is complete and is safe to re-energize.
f) Re-energize following the isolation/clearance form procedure.

While the Hazard Analysis Work Sheet for these tasks appear to be detailed enough to lead the worker through the identification of the tasks, chances of loss, and control measures, the Board finds that since these work sheets are standardized for racking out and grounding of units, it is unlikely that the electricians refer to a copy of the work sheet each time these jobs are done, particularly since some employees understood that a task analysis was required for open system and hot work activities but not for what they considered routine tasks such as racking and grounding of equipment. The Board believes that the intent of the task analysis work sheet should be to lead the worker through a step by step identification of the tasks and identification and assessment of the hazards of the job, before and each time a job is done. This was not done by Mr. St. Pierre and Mr. Halter at the time of the incident.

Finally, the Board notes the safe work permit prepared by Jim Veronelly on 31 March 2008) included the following task steps:

a) Enbridge Control Centre (ECC) approval to proceed.
b) Electrical Isolation Clearance form procedure.
c) Hazard Analysis.
d) Safe work permit.
e) Pre-job meeting.

The Board notes the focus of Mr. Veronelly's safe work permit on following correct procedures to ensure that hazard analysis is conducted and controls put in place. The Board considers it a good example of how a safe work permit should focus on an effective hazard assessment for the racking out and grounding tasks, and through completion of the safe work permit; the task analysis. The Board considers these to be critical steps to safely completing the racking out and grounding job and should have been completed by Mr. St. Pierre and Mr. Halter prior to conducting their work.

In summary, the Board notes the deficiencies with the risk rating procedures, the inconsistent practice and knowledge around completion of a task analysis, the conflicting task analysis procedures described in Book 2 and in the Western Region Hazard Prevention Program training, and the inconsistent completion of the safe work permit by Enbridge employees at Kerrobert, Milden and Herschel stations. These are significant management system causes that were in place prior to the incident and which contributed to the placement of Mr. St. Pierre in a very hazardous situation. The Board considers these matters to be serious deficiencies in the hazard analysis and safe work permit process that need to be immediately addressed by Enbridge.

7.2.3 Electrical Equipment Isolation/Clearance Form

The clearance form includes a hazard assessment, a flow diagram for the work, and Isolation Procedures Steps for detailing how the electrical isolation would be completed. The Board understands that the intent of preparing the Electrical Equipment Isolation/Clearance form prior to commencement of the work is primarily to plan for the safe conduct and completion of the job, and to establish and confirm a safe state of the electrical switchgear for the transfer of the job to the contract electrical workers. The Electrical Equipment Isolation/Clearance form was

not completed by Mr. St. Pierre or Mr. Halter for the racking out and grounding of Unit 4-U-3. If the appropriate sections of the form were completed by Mr. St. Pierre and Mr., Halter prior to commencement of the work, it may have allowed for the step by step evaluation and planning of the work procedure and the identification and elimination of hazards, as well as serve to improve communications between them.

The Board also notes that in response to IR2-2, Enbridge indicated that Mr. St. Pierre's main field work site was Cactus Lake and that this station had undergone pump upgrades included under Board Order XO-E101-01-2007. Enbridge was unable to locate any Electrical Equipment Isolation/Clearance forms completed by Mr. St. Pierre for the work conducted at the Cactus Lake station and was unable to locate any Electrical Equipment Isolation/Clearance forms completed by Mr. St. Pierre for the time period following 1 January 2007.

The Board notes the significant changes since the incident to how the Electrical Equipment Isolation/Clearance form is completed. What was previously 3 steps (form dated19 November 2007 by Doug Croke for the Herschel Station) to rack out and ground the 4-U-3, 4160 volt contactor, has been expanded to 13 and 21 steps respectively (forms dated 31 March 2008 and 1 April 2008 by Jim Veronelly) to isolate Unit 4-U-3 at the Kerrobert Station. In the 31 March 2008 Electrical Equipment Isolation/Clearance form the steps included:

a) Put on proper PPE for the category of arc flash hazard.
b) Verification of correct capacitor/interconnect door.
c) Perform function test on high voltage detector.
d) Use a high voltage detector on a hot stick.
e) Connecting safety grounds using proper PPE and hot-stick.
f) Conducting a flash contact test with a safety ground to each phase.

In the 1 April 2008 Electrical Equipment Isolation/Clearance form the steps included:

a) At this point wear all proper PPE for racking out contactors.
b) Ensure cabinet for unit 4U3 capacitor/interconnect is selected and open.
c) Ensure electrical tester is functioning properly.
d) Test for the presents [sic] of potential at unit 4U3 capacitor/interconnect cabinet.
e) Do a flash test c/w [sic] hot stick of all three phases and install grounds at this location 4U3 capacitor/interconnect cabinet.

The Board notes that the Electrical Equipment Isolation/Clearance forms are not completed in a consistent manner by Enbridge electricians. The form was not completed for the racking out and grounding of Unit 4-U-3 on the day of the incident. Mr. Halter indicated in his statement that after a job is done a clearance form is to be filled out; Mr. Veronelly indicated that the electrical equipment isolation clearance form is completed prior to turnover to the contractor, and Mr. St. Pierre was not diligent about completion of the form for previous work. These inconsistent practices for completion of the form are indicative of a lack of training and management

oversight and control of this aspect of the electrical work being conducted for the pump station upgrades.

7.2.4 Safety Culture and Awareness

A developed safety culture should lead to effective planning, adherence to procedural requirements, effective communications, clarification of roles, and where required, completion of a safe work permit, hazard assessment and pre-job safety meeting. An effective safety culture means that all employees use their experience, training and communication skills to ensure that they and their co-workers are working safely at all times. It also means that employees actively identify and correct deficient procedures and work practices. The numerous immediate and root causes that preceded the incident are indicators that the safety culture at Enbridge Kerrobert was not adequately developed. The indicators include:

a) Nobody told Mr. St. Pierre to put on his PPE while in the 4-ESB-1.

b) Mr. St. Pierre and Mr. Halter lacked situational awareness immediately prior to the incident and did not stand back to re-assess the job.

c) Book 2 procedures were not being followed.

d) Mr. St. Pierre was not wearing proper PPE.

e) There was poor communications between workers regarding safety, roles and procedure.

f) Because the racking and grounding out were considered routine tasks, there was likely some complacency about the risks associated with the tasks and the controls that should be in place to protect against the hazards.

The Board expects that Enbridge will take into consideration the indicators noted above and develop appropriate corrective actions to address the management system factors that underlie these indicators.

7.2.5 Training

The evidence shows that there has been adequate training of Enbridge electricians with respect to safe work procedures and proper use of personal protective equipment. However, there are some weaknesses in the training program provided to Kerrobert personnel involved in the incident that contributed to the incident. In order to address the weaknesses the Board expects that Enbridge will assess its training needs in the areas of:

a) Enabling employees to better communicate with each other and with supervisory levels about job planning, roles and safety issues.

b) Hazard assessment, determination of risk rating and completion of safe work permits.

c) Completion of Electrical Equipment Isolation/Clearance forms.

d) Use of safety equipment such as the voltage probe.

e) Appropriate and consistent use of PPE and high voltage protective equipment.

f) Developing a strong safety culture.

7.2.6 Personal Protective Equipment

Enbridge demonstrated to the investigators that historically, Mr. St. Pierre was a safe worker and was fastidious about wearing the required PPE. The Enbridge supervisory staff at Kerrobert were in disbelief that Mr. St. Pierre would be working within the 4-ESB-1 building without wearing the proper PPE. In this regard Enbridge did not have reason to be concerned about Mr. St. Pierre's use of PPE on the day of the incident.

However, the Board notes that there is an inconsistent approach or understanding among Enbridge employees at Kerrobert on PPE requirements. Although historically he always wore PPE, Mr. St. Pierre did not wear the required PPE for the grounding task. In an interview with Mr. Jim Veronelly, he stated that he has done this same grounding task within 6 months prior to the incident and he would wear hot gloves, hot flash gear, glasses and coveralls. He stated that this was his standard procedure. Also, Mr. Halter indicated to investigators that the arc flash gear was new to the system and was not worn as much as it should have been. The Board notes the inconsistent approach or understanding on the use of PPE at Kerrobert and expects Enbridge to address this management system issue.

7.3 Other Contributing Factors

The investigation identified other factors that contributed to the incident however these factors are not considered to be either immediate errors committed by any person nor are they considered to be root causes or management system errors that were in place before the incident occurred. The Board believes these factors are relevant to the incident and are therefore noted in this report.

While the design of the 4-ESB-1 meets the requirements of the *Canadian Electrical Code*, certain factors related to design may have contributed to the incident. There is an offset alignment between the row of unit motor starter contactors and the row of power factor capacitor cells which increases the potential for choosing the wrong cell door if a worker is guided by alignment. The unit identification labels on the unit motor starter contactors and the power factor capacitor cell doors are all similar in appearance and are not conspicuous, which may contribute to the mis-identification of a door. There are no interlock mechanisms between the unit motor starter contactors and power factor capacitor cells such that only the corresponding power factor capacitor cell can be opened when the unit motor starter contactor is racked out.

In his statement, Mr. Halter suggested that an additional safety design measure would be the installation of interlocks on the starters and power factor capacitor cells so that once the starter is racked out, only the corresponding cell could be unlocked. In response to IR2-10b Enbridge indicated that the Kirk Key interlocks are included on new starters and cells associated with the Southern Access expansion project and that there are no current plans for retrofitting existing equipment with this exact system. Enbridge stated that it anticipates a formal recommendation

from a committee of individuals, with experience in this area, to look further into this issue and make a recommendation for the entire Enbridge system.

8. Summary

Examination and analysis of the evidence related to the incident reveals that numerous immediate causes occurred and underlying root causes were in place prior to the incident. The causes relate to human factors and to breakdowns in the defensive layers that were put in place to protect the Enbridge employees.

At the time of the incident, Enbridge had in place multiple defensive layers to ensure the protection of employees. These layers include a corporate wide health and safety policy, Operations and Maintenance manuals, safety procedures, training program, PPE requirements, safety equipment, monitoring, adherence to applicable health and safety legislation and emergency management program. Although there were multiple defenses in place to deal with the potential for an accident, there were sufficient weaknesses such that the layers of mitigation to protect Mr. St. Pierre were not sufficient to prevent his exposure to the hazardous conditions. While no one weakness can be identified as a primary factor, the significance of each weakness cannot be underestimated, as a correction in any one may have been enough to prevent the incident. It is worth summarizing the human factors and defensive breakdowns of this incident in order to fully understand the mechanisms that lead to the incident.

The cabinet was misidentified by Mr. St. Pierre and Mr. Halter, so that rather than opening the de-energized cabinet, a live cabinet was opened. The Board recognizes that a human factor possibly contributed to this misidentification through a concept called visual cueing, where Mr. Halter took the visual queue of Mr. St. Pierre standing in front of a particular cabinet. This failure did not make it inevitable that the incident would occur, but yet another defensive barrier failed. Had Mr. Halter been able to correctly use the voltage probe, it would have been discovered that the cabinet was live. The Board finds this to be a failure in training and in procedure; that a person should not use a piece of equipment that they have not been trained, tested and cleared to use. The next defensive barrier to fail was when several indicators that the work was becoming increasingly unsafe were not recognized, the work was not immediately halted and procedures re-assessed. The Board considers this to be a training and safety culture issue, where the electricians lacked the situational awareness to recognize that their actions could lead to an accident. Further, had Mr. St. Pierre donned the appropriate PPE, including arc flash gloves, prior to attempting to install the ground cables, he would have reduced the risks to which he was exposed. The Board notes that these causes may indicate a safety culture failure. Although a weak safety culture cannot be demonstrated as a system wide problem within Enbridge, through this incident and investigation the Board believes Enbridge should actively and aggressively look for such culture failures as part of its safety programs for each region.

The Board notes that a responsibility of safety managers is to identify and apply additional defenses but with an eye to practicality as well as economic cost and benefit. In other words where a significant hazard and consequence is present, if an effective defensive barrier can be added for reasonable cost and reasonable administrative or functional burden, then it should be added no matter how many barriers are already in place. Where potential defensive mitigation is

examined and found not to be practicable or reasonable, the decision is documented complete with rationale so that due diligence can be established.

As an example, the type of grounding cables used at Kerrobert station at the time of the incident required that the user directly apply the cables to buses without the use of a hot stick and, based on the HRC number 0, without the requirement for voltage rated gloves. If one does not use the hot stick or voltage rated gloves while installing the cables to energized equipment, it is likely that the user will be seriously injured. Using the principle of applying the maximum practical defensive barriers, the company would examine whether or not it is practical and cost effective to use equipment readily available on the market that isolate the user from the energy source, such as the use of the MT3 Safety ground kit now in use at Kerrobert since the incident.

The Board notes that since the incident, Enbridge has added defensive layers to the racking out and grounding procedures, including:

a) Book 2 revisions: clearly categorizes all work on electrical equipment with circuits and voltages greater than 750 V to be high risk, requiring the completion of a safe work permit and hazard assessment, wear high voltage PPE in accordance with tab 13, use a hot stick for applying safety grounds, use a voltage detector with a hot stick.

b) New safety equipment in use in the Kerrobert area including a telescoping hot stick for use in applying grounds in areas with limited space and a Kirk Key interlock (one key system) on the new equipment.

c) A Directive was issued by Enbridge management to all area supervisors and electricians that identified the safety requirements of electricians when conducting high voltage work and provided revised procedures for racking out and grounding work.

d) The ESP hotliner voltage probe was taken out of service.

Although these added defensive layers have been applied at Kerrobert by Enbridge to address this specific incident, the Board believes Enbridge should assess the need for, and practicality of applying these defensive layers elsewhere on its system where the racking out and grounding tasks are conducted.

9. Areas for Corrective Action

9.1 Corrective Actions Implemented by Enbridge

Enbridge conducted its own investigation in to the death of Mr. St. Pierre. Enbridge identified nine recommendations that it would act upon in order to address the immediate and root causes of the incident that it identified through its investigation. The recommendations and dates for completion are as follows:

a) Review of the Electrical Isolation and Grounding Procedures to ensure they meet the equipment realities at Enbridge locations and industry best practices. 31 December 2008.

b) Review the minimum electrical maintenance equipment standards for Enbridge locations, including consideration of the use of hot sticks, voltage probes, grounding cables, electrical PPE and Arc Flash equipment. 31 December 2008.

c) Develop and provide updated training on high voltage work and equipment, including the use of the hazard assessment process. 30 May 2009.

d) Develop and implement a safety audit program that will focus on reviewing compliance with safety requirements of Book 2. 31 December 2008.

e) Establish a technical team to review the applicability of Key Interlocks in Enbridge Electrical Switchgear cubicles. 31 March 2009.

f) Review the high voltage training course and content to be sure it meets the intent of Enbridge standards. 30 May 2009.

g) Require that power factor capacitor cells have bolts installed when not being accessed. 30 November 2008.

h) Conduct a Safety Culture Audit. 31 December 2008.

i) Form an Electrical Safety Committee to oversee and provide direction on electrical safety issues within Enbridge. No date.

The Board further notes that since the incident Enbridge has implemented the following changes to its safety management program and procedures in the Western Region:

a) Manuals were updated with revised safety procedures.

b) Enbridge Directive issued on 31 March 2008 to all company electrical workers and supervisors. The Directive identified the safety requirements of electricians when conducting high voltage work.

c) Kerrobert area implemented revised procedures for racking out and grounding which include the use of a hot stick and completion of an Electrical Equipment Isolation/Clearance form and a safe work permit prior to commencement of the work.

d) Kerrobert area purchased new telescoping hot sticks and grounding cables for use when grounding busbars within the power factor capacitor cells.

e) Kerrobert area supervisor and electricians developed revised work schedules in order to coordinate project and maintenance work.

f) ESP Hotliner taken out of service.

g) Progressive Discipline policy and training which will provide people leaders with clear guidelines for levels of discipline associated with employees actions due to safety non-compliance.

The Board accepts that the corrective actions implemented by Enbridge will address many of the immediate and underlying causes that were in place at the time of the incident.

9.2 Corrective Actions Identified by the Board

The Board has identified areas for corrective action that include:

a) Risk rating, safe work permit and hazard assessment processes need to be fully understood and consistently applied by those Enbridge personnel who are responsible for completion and signing of the safe work permit form.

b) The requirement and procedures for completion of the Electrical Equipment Isolation/Clearance form need to be understood and consistently applied by Enbridge electricians.

c) Hazard Awareness training and Book 2 procedures need to be consistent on the topic of completion of task analysis for low and high risk activities.

d) The requirement for pre-job safety meetings needs to be enforced and the meetings documented.

e) Lockout/tag out procedures need to be enforced.

f) Training to improve the safety culture of Enbridge Kerrobert employees, including effective communications in the workplace and situational awareness.

g) Training in the use of voltage probes.

h) Assessment of the design of electrical switchgear buildings (ESB) to include electrical equipment layout, visual queues and conspicuous labeling.

i) Re-assessment of the HRC number assigned to the power factor capacitor cells.

j) Demonstrate to the Board how the HRC-0 was calculated for the power factor capacitor cells.

k) Consistent and enforced use of PPE and clarification on the use of high voltage PPE.

l) Investigate the feasibility of applying the changes made in the Kerrobert area to other locations on the Enbridge system where racking and grounding tasks are performed, including the use of telescoping hot sticks for voltage testing and applying safety grounds, and conducting a flash test prior to installing grounds.

m) Investigate the feasibility of installing Kirk Key interlocks between motor starter contactors and power factor capacitor cells at all existing and future Enbridge facilities.

10. NEB Follow-up Requirements

In order to address the corrective actions identified, the Board will require Enbridge to conduct the activities listed below. Enbridge shall develop a plan for completing these requirements and shall file with the Board within 30 days of the release of this report a copy of the plan. Unless otherwise indicated in the requirement, the plan shall include a schedule for completion of each of the requirements and for reporting to the Board. The Board requirements are as follows:

a) Re-evaluate and revise as necessary the hazard analysis procedures in Book 2 Safety in order to ensure consistent practice and knowledge of the hazard analysis procedures and to maintain compliance with applicable laws and regulations.

b) Re-evaluate and revise the risk rating procedures in Book 2 Safety in order to minimize the subjective nature of completing the rating procedure. The rating procedure should accurately rate all work that may pose a risk for workers, including those jobs that historically may be considered routine by some workers.

c) Identify any adaptations to Book 2 procedures that are in common practice in the Kerrobert area. Evaluate the adapted procedures with regard to maintaining or increasing the level of safety, practicality, cost effectiveness, compliance with applicable requirements and meeting corporate health and safety goals. Where the adapted procedures are found to be an improvement over existing procedures, make the appropriate revisions to Book 2 procedures and provide follow-up training.

d) Re-assess and revise existing training modules or develop new training modules where required for Enbridge employees engaged in electrical work at Kerrobert and at other Enbridge facilities, as necessary, in order to address the following training needs:

- effective knowledge and consistent application of the hazard analysis, risk rating, safe work permit and task analysis procedures,
- consistent application and completion of the Electrical Equipment Isolation/Clearance form by all Enbridge workers that are responsible for completing the form in accordance with Book 2 procedures,
- communications skills between employees with the focus on job planning, roles and safety culture,
- appropriate and consistent use of safety equipment including high voltage probes and hot sticks,
- appropriate and consistent use of PPE and high voltage PPE.

e) Monitor the use of the Electrical Equipment Isolation/Clearance form and safe work permit procedures to verify that they are being used appropriately and in a consistent manner for Enbridge maintenance, operations and construction activities conducted in the Kerrobert, Herschel and Milden areas, and as necessary, in other Enbridge regions.

f) Within 30 days of the issuance of this report, demonstrate to the Board how the HRC-0 was determined for the power factor capacitor cells in 4-ESB-1.

g) Re-assess the HRC number assigned to the power factor capacitor cells within 4-ESB-1 and all other ESBs on the Enbridge system, having consideration for the hazard assessment process, the potential for an energized state to exist, the nature of the tasks that may be completed within the cells, and that the equipment is not considered to be in a safe work condition prior to lockout/tagout, voltage testing and applying safety grounds to the busbars. If the assessment determines that the HRC numbers assigned to the power factor capacitor cells should be revised provide:

- a plan for revising the HRC numbers,
- a description of the training to be provided to electricians on the PPE required for work within the approach boundaries of the power factor capacitor cells.

h) Within one year of the date of issuance of this report, in accordance with Book 2 requirements, 03-02-01 page 2-7, all Enbridge regions in Canada shall evaluate (a) the

effectiveness of the hazard assessment process and (b) the suitability of controls based on, but not limited to:

- changes in the workplace conditions or work activities,
- workplace inspection reports,
- injury statistics,
- incident investigations.

i) Report to the Board within one year of the date of issuance of this report on the assessment and recommendations of the Enbridge technical team formed to examine the feasibility of installation of Kirk Key interlocks on existing equipment on the entire Enbridge system. The report shall provide the rationale for any decision(s) made by Enbridge with respect to installation of the interlocks, including the value, reliability, cost and the practicality of installing the interlocks.

j) Conduct site inspections at Kerrobert and other ESBs as well as other work locations on the Enbridge system in Canada with the objective being to ensure that there is a safe, unencumbered work environment for its employees, contractors and visitors. In doing this Enbridge should take into consideration all of its activities undertaken during the operation and maintenance of its facilities. Enbridge will report to the Board within 60 days of the issuance of this report on the results of the inspection. The report will include Enbridge's inspection protocol, the locations inspected, the results of the inspections and a mitigation plan for addressing all issues noted within a reasonable time frame.

k) Review the ESB design factors for the Kerrobert area including electrical equipment layout, visual queues and conspicuous labeling. Consult with Enbridge electricians and area supervisors on practical and appropriate design solutions that will increase protection from electrical hazards within the ESBs while maintaining compliance with applicable legislative requirements and standards.

l) Assess and redesign the warning labels on the outside of the power factor capacitor cell doors at Kerrobert to clarify the hazards and PPE requirements.

m) Review the Enbridge compliance monitoring initiatives in order to identify areas for improvement. The review should examine the effectiveness the compliance monitoring initiatives for the following:

- monitoring and reporting of the occurrence of health and safety incidents within the company,
- evaluation of the immediate and basic causes of all reported incidents,
- compliance with procedures.

Report to the Board within 60 days of issuance of this report with the results of the review.

n) Examine the feasibility of applying the changes made in the Kerrobert area to other locations on the Enbridge system where racking and grounding tasks are performed, including:

- The use of telescoping hot sticks for voltage testing and applying safety grounds,

- Conducting a flash test before applying safety grounds.

o) Report to the Board on the status of completion of the recommendations identified in the Enbridge Investigation. The dates for reporting to the Board shall be on or before 30 January 2009 for those Enbridge recommendations to be completed before 31 December 2008 and on or before 30 June 2009 for the remainder of the Enbridge recommendations.

p) Enbridge shall conduct an assessment of the indicators noted in section 7.2.4 of this report, identify any management system factors that underlie these indicators and develop appropriate corrective actions to address the management system factors identified. Enbridge shall report to the Board within 60 days of release of this report on its assessment of the indicators and the corrective actions developed to address the management system factors.

Appendix I: Documentation and Evidence Gathered

1 68 photographs taken by the NEB investigator at the Enbridge Kerrobert Pump Station on 25 March 2008.

2 Verbal communications with Enbridge personnel at the Kerrobert Pump Station on 25 March 2008 and 25 June 2008 (identified in section 4 of this report).

3 Enbridge Operating and Maintenance Procedures Book 2, Safety, updates to 1 December 2007.

4 Enbridge Operating and Maintenance Procedures Book 3, Pipeline Facilities, updates to 20 March 2008.

5 Assurance of Voluntary Compliance, File Number 2008-030, provided by Mr. Michael Koby, Director, Operations Services, Enbridge Pipelines Inc., no date.

6 Individual Training History, Jordan Halter, printed 26 March 2008.

7 Individual Training History, Henri St. Pierre, printed 26 March 2008.

8 Excerpt of Book 2, Safety, Section: Standards, Subject: Safe Work Permit – Hazard Assessment, 4 April 2008, Draft.

9 Excerpt of Book 2, Safety, Section: Procedures, Subject: De-energizing or Switching High Voltage Equipment, 8 April 2008, Draft.

10 Excerpt of Book 2, Safety, Section: Procedures, Subject: Safety Grounding High Voltage Equipment, 8 April 2008, Draft.

11 Electrical Equipment Isolation/Clearance, sample form, dated 11 April 2008.

12 Safe Work Permit (Hazard Assessment) sample form, dated June 2007.

13 Floor Plan Diagram, 4-ESB-1, no date

14 March 23-28, 2008, Work Assignments, one page.

15 Excerpts of day planner, Henri-St. Pierre, March 10-16 and March 17-23, 2 pages.

16 Enbridge, Kerrobert Station Electrical Hazardous Area Classification Plot Plan. 23 June 1997.

17 Enbridge, Kerrobert (SK) Station, Station 4, Civil/Structural/Mechanical, Scope of Work, Plot plan, 15 March 2007.

18 Enbridge, Kerrobert (SK) Station, Station 4, 4-SWGR-2 (4160V) One Line Diagram, 92/02/11.

19 Enbridge, Kerrobert (SK) Station, Station 4, 4-ESB-1, Lighting, Cable Tray and Equipment Layout, 21 January 1992.

20 Incident – Kerrobert Station – March 24, 2008, Personnel On-Scene, First Responders, Other Contacts.

21 E-mail from James Veronelly/CNPL/Enbridge to Dale Burgess, Brad Shamla, cc Ab Mouallem, bcc Dan Tischler, Subject: Monday am phone call, dated 03/24/2008, 08:01 am.

22 Coping With Trauma – What Can Help. Handout provided to Enbridge Employees following the incident.

23 Statement of Jordan Halter provided to NEB Investigators Karen Duckworth and Shane Richardson, 25 March 2008, 4 pages.

24 Combined interview with Ron Horak, Ron Grove and Graham Taylor conducted by Karen Duckworth and Shane Richardson, 25 March 2008, one page.

25 Statement of Jordan Brett Halter provided to Cst. Julianna Baldwin, 25 March 2008, 5 pages.

26 Statement of Ron Horak of Power Comm, 24 March 2008, one page.

27 Statement of Ron Grove of Power Comm, 24 March 2008, one page.

28 Statement of Graham Taylor of Power Comm, no date, one page.

29 Statement of Jordan Webb, 24 March 2008, one page.

30 Complete Operating Instructions for the ESP Hotliner, Fisher M-Scope, 2 pages, no date.

31 Enbridge response to NEB Information Request number 1, dated 28 May 2008.

32 Enbridge response to NEB Information Request number 2, dated 17 July 2008.

33 Enbridge Directive to all Electrical Workers and Supervisors, High Voltage Work, dated 31 March 2008.

34 Enbridge Preliminary Incident Report , Kerrobert Electrical Incident, Incident No. 1009, dated 4 April 2008

35 Hazard Analysis Work Sheet, *Western Region*, Task/Job: 5KV Equipment Isolation

36 Hazard Analysis Work Sheet, *Western Region*, Task/Job: Rack out Unit Contactor

37 Investigation Report, High Voltage Grounding Incident, Enbridge Pipelines Inc. – September 2008.

38 Final Autopsy Report and Final Toxicology Results of Henri Romeo St. Pierre, Office of the Chief Coroner, Saskatchewan Ministry of Justice and Attorney General, 24 June 2008.

39 Review of Final Report and Final Toxicology Results by Dr. Ernest P. Chiodo dated 30 September 2008.

40 Review of 2008 Kerrobert Fatality Investigation Report 09-30-2008.doc by Dr. Ernest P. Chiodo dated 10 October 2008.

Appendix II: DNV Systematic Causal Analysis Technique

	Event/Evidence	Immediate Causes (DNV Systematic Causal Analysis Technique)	Root Causes (DNV Systematic Causal Analysis Technique)	Reference	Corrective Action
Substandard or Unsafe Acts	Mr. St. Pierre was not wearing the required PPE while he was working in the ESB and when he came within the safe limits of approach to the 4160V electrical equipment.	7. Failure to wear PPE properly.	14.4 Inadequate monitoring of compliance.	Statement of Jordan Halter 25 March 2008. NFPA 70E Limits of Approach, Table 130.2(C), page 70E-25	Worker has responsibility to wear required PPE. Enbridge responsibility to train and enforce. Enbridge response to IR1 -21 indicates that Enbridge is in the final stages of implementing its new Progressive Discipline policy and training which will provide people leaders with clear guidelines for levels of discipline associated with employees actions due to safety non-compliance.
	Mr. Halter was not aware that Mr. St. Pierre entered the power factor capacitor cell prior to Mr. Halter confirming the proper function of the high voltage detector and that the cell had been de-energized. Mr. St. Pierre did not respond verbally to Mr. Halter's comments that the high voltage detector not working, but rather gave Mr. Halter "a look".		16.1 Inadequate horizontal communication between peers.	Statement of Jordan Halter 25 March 2008.	Development of work plan, conduct pre-job meeting, task analysis and identify roles. Training in horizontal communications, safe work planning and safety culture.

	Event/Evidence	Immediate Causes (DNV Systematic Causal Analysis Technique)	Root Causes (DNV Systematic Causal Analysis Technique)	Reference	Corrective Action
	Mr. Halter and other electricians in the ESB did not tell Mr. St. Pierre to don his PPE.				
	Mr. St. Pierre stood in front of cell door 4-U-2 rather than 4-U-3 and requested Mr. Halter to unlock the door.	9. Improper position for task.		Statement of Jordan Halter 25 March 2008.	Conspicuous labeling.
	Electrical Isolation Clearance Form not completed for the racking out and grounding of Unit 4-U-3.	16. Failure to follow procedure/policy/practice		Book 2 section 07-02-01 and 07-03-02 Enbridge response to IR1-1(a)	Revision/updating procedures. Retraining. Monitoring and enforcement.
	A risk rating was not assigned to the task and therefore no hazard assessment of the grounding out procedure was conducted. Enbridge stated that the racking and grounding out are standard procedures that have been done many times before and so a safe work permit was not completed specifically for the racking and grounding out. The racking and grounding out	17. Failure to identify hazard/risk		O&M Manual Book 2 Safety 03-02-01 pages 1 to 7.	Evaluate the risk rating procedure to remove the subjective nature of the rating procedure. Provide training to ensure consistent and correct completion of the risk rating, hazard assessment and safe work permit process.

	Event/Evidence	Immediate Causes (DNV Systematic Causal Analysis Technique)	Root Causes (DNV Systematic Causal Analysis Technique)	Reference	Corrective Action
	was included in the safe work permit completed for the PLM work.				
	No interlocks installed between starters and power factor capacitor cells so that wrong cell cannot be opened.	21. Inadequate guard or barrier		Statement of Jordan Halter 25 March 2008. Jim Veronelly 25 June 2008.	Install Kirk Key interlocks. Kirk Key interlocks installed at Kerrobert.
Substandard Conditions	Mr. Halter could not get the voltage probe to work properly in order to test for energized condition within the cell Various probes were available and Enbridge expected the electricians to know how the worked, no training provided.	25. Inadequate warning system	5.3 Inadequate initial training	Statement of Jordan Halter 25 March 2008. Enbridge response to IR1-8a	Training in proper use of the probe, duty on Enbridge to ensure that employees know how to use safety devices supplied by the company. ESP Hotliner probes taken out of service by Enbridge following the incident, pending its investigation.
	No safe work permit, no Electrical Equipment Isolation/Clearance form, no task analysis, no hazard assessment done.	36. Inadequate preparation/planning			Updated training. Enforcement of pre-job meeting, task analysis and delegation, safe work permit and hazard assessment, electrical equipment isolation clearance form.

	Event/Evidence	Immediate Causes (DNV Systematic Causal Analysis Technique)	Root Causes (DNV Systematic Causal Analysis Technique)	Reference	Corrective Action
Personal Factors	The racking out and the grounding procedures were considered routine tasks, although not commonly conducted together.		4.4 Routine, monotony, demand for uneventful vigilance	Statement of Jordan Halter 25 March 2008.	Safety culture
	Mr. St. Pierre and Mr. Halter both either did not recognize or did not act on the deteriorating safety conditions and multiple signs that something could go wrong: • Mr. St. Pierre was not aware that he was standing in front of the wrong power factor capacitor cell door, • Mr. Halter was not aware that he had unlocked the wrong power factor capacitor cell door, • they were distracted by looking for cables, • Mr. Halter's inability to operate the high voltage detector,		5.6 lack of situational awareness		Safe work permit/hazard assessment. 4.e Critical task procedures/practices updated 15.a Training in personal communication techniques Safety culture training

	Event/Evidence	Immediate Causes (DNV Systematic Causal Analysis Technique)	Root Causes (DNV Systematic Causal Analysis Technique)	Reference	Corrective Action
	• Mr. St. Pierre did not communicate effectively to Mr. Halter, • they had not completed a hazard assessment of the job. • Mr. St. Pierre was not wearing required PPE, nobody said anything. • They had not prepared an Electrical Equipment Isolation/Clearance form as required by procedures				
	Safe work permit and corresponding hazard assessment were not completed as required by Enbridge procedures, Enbridge was aware of adaptations to Book 2 procedures.		6.5 Inadequate review of instruction 9.9 Inadequate identification and evaluation of loss exposures 7.1 improper performance is tolerated.	Book 2, 03-02-01 Enbridge response to IR1-12a. Statement of Jim Veronelly.	Assess adaptations to procedures and revise Book 2 as necessary and appropriate. Retraining and enforcement of procedures.
	Design of cabinets and floor plan of building. No colour		10.2 Inadequate consideration of		Assess design factors in consultation with electricians

	Event/Evidence	Immediate Causes (DNV Systematic Causal Analysis Technique)	Root Causes (DNV Systematic Causal Analysis Technique)	Reference	Corrective Action
	or other visual queue such as floor paint to guide or differentiate between cells. Small lettering on cell doors. Cells offset in floor plan.		human factors/ergonomics. 14.2.5 Reinforcing with signs, colour codes and job aids		
	Safetrak system was new within last year and is not designed to enforce compliance.		10.8 Inadequate evaluation of changes		Assess compliance monitoring initiatives with goal to improving monitoring, enforcement and compliance with procedures.
	Mr. St. Pierre gave Mr. Halter “a look”. Lack of verbal confirmation from Mr. St. Pierre regarding a critical equipment test.		16.6 Inadequate communication methods		Training on effective communications techniques between peers.
	Mr. St. Pierre did not wait for verification from Mr. Halter that the voltage detector was functioning properly and there was no live voltage within the Power Factor Capacitor cell before entering the cell		16.12 Verification/feedback techniques not used.	Statement of Jordan Halter 25 March 2008.	

Appendix III: Appendix III: Sequence of Events Leading Up To the Incident

Date and Time (Where known)	Order of Events	Description of Event	Reference
8 December 1992	1	Mr. St. Pierre received training in Safe Work Permits.	Individual training history filed by Enbridge 4 April 2008
20 May 1998	2	Mr. St. Pierre completed examination in Issue/Obtain Safe Work Permits – Final (Common).	Individual training history filed by Enbridge 4 April 2008
13 November 2001	3	Mr. St. Pierre received training in Safe Work Permits.	Individual training history filed by Enbridge 4 April 2008
1 June 2005	4	Mr. Halter received training in Safe Work Permits.	Individual training history filed by Enbridge 4 April 2008
15 June 2005	5	Mr. St. Pierre received training in Hazard Awareness.	Individual training history filed by Enbridge 4 April 2008
24 October 2005 to 27 October 2005	6	Mr. St. Pierre and Mr. Halter complete a four-day high voltage training course.	Enbridge Individual Training History - Dated March 26, 2008
1 June 2006	7	Mr. Halter received training in Safe Work Permits.	Individual training history filed by Enbridge 4 April 2008
16 May 2007	8	Mr. St. Pierre and Mr. Halter received training in Safe Work Permits.	Individual training history filed by Enbridge 4 April 2008
Spring 2007	9	Enbridge institutes the Safe Work Permit system.	Enbridge Response to IR1-12a Dated May 28, 2008
Summer 07	10	Mr. St. Pierre underwent triple bypass surgery.	Statements from Enbridge staff, meeting between Enbridge and NEB staff at Kerrobert Station - 25 March 2008
Sep - Oct 07	11	Mr. St. Pierre returned to work.	Statements from Enbridge staff, meeting between Enbridge and NEB staff at Kerrobert Station - 25 March 2008
25 January 2007	12	Enbridge Southern Access expansion project approved, Board Order XO-E-101-01-2007. Project includes greater capacity on line 4 through 4 pumping units. Unit 4-U-3 2500 hp motor to be replaced with 5000 hp package.	Board Order XO-E101-01-2007
22 – 23 March 2008	13	Mr. St. Pierre did not work over the weekend.	Statements from Enbridge staff, meeting between Enbridge and NEB staff at Kerrobert Station - 25 March 2008
24 March 2008	14	Morning meeting to discuss planned work for the week - initially Mr. Halter was to go to Herschel station but was requested to rack out 4-U-3 for a planned outage.	Note book page written by J. Veronelly describing work assignments; J. Halter statement - 25 March 2008

Date and Time (Where known)	Order of Events	Description of Event	Reference
24 March 2008	15	Unit 4-U-3 was put on local control by Mr. Neufeld and confirmed to be on local by Mr. Halter who referenced the control system interface and the single line sketch for Unit 4-U-3.	J. Halter statement - 25 March 2008
24 March 2008~ 08:17	16	4-U-3 breaker in the ESB was racked out and locked (not tagged) by Mr. Halter.	J. Halter statement - 25 March 2008
24 March 2008	17	Mr. Halter left the 4-ESB-1 to look for grounding cables for grounding Unit 4-U-3.	J. Halter statement - 25 March 2008
24 March 2008	18	Mr. Halter met Mr. St. Pierre outside the 4-ESB-1 and stated that he couldn't locate the ground cables.	J. Halter statement - 25 March 2008
24 March 2008	19	Mr. St. Pierre had already checked the storage shed for the ground cables and, unable to locate the preferred cables, had selected a set of cables that he thought would suffice.	J. Halter statement - 25 March 2008
24 March 2008	20	Mr. St. Pierre and Mr. Halter entered the 4-ESB-1 and immediately located the preferred ground cables in a corner on the floor.	J. Halter statement - 25 March 2008
24 March 2008	21	Mr. St. Pierre put down the grounding cables that he had taken from the storage shed and picked up the preferred set of cables.	J. Halter statement - 25 March 2008
24 March 2008	22	Mr. St. Pierre and Mr. Halter went to the bank of power factor capacitor cells that contain the bus bars.	J. Halter statement - 25 March 2008
24 March 2008	23	Mr. Halter began to test the high voltage probe near a light fixture prior to sweeping the inside of the power factor capacitor cell - he was not paying attention to Mr. St. Pierre as he was focused on testing the high voltage probe, which was a model he was not familiar with.	J. Halter statement - 25 March 2008
24 March 2008	24	Holding the ground cables, Mr. St. Pierre stood in front of a power factor capacitor cell door and asked Mr. Halter to unlock the door.	J. Halter statement - 25 March 2008
24 March 2008	25	Mr. Halter unlocked the power factor capacitor cell door that was in front of Mr. St. Pierre.	J. Halter's Statement - given 25 March 2008
24 March 2008	26	Mr. Halter resumed testing the high voltage probe but could not get a reliable signal. Testing is accomplished by holding the probe up to a live energy source such as a ceiling light, which should result in an audible signal being emitted from the	J. Halter statement - March 25, 2008

Date and Time (Where known)	Order of Events	Description of Event	Reference
		probe. Mr. Halter could not obtain the appropriate signal from the probe it was held up to the ceiling light.	
24 March 2008	27	Mr. Halter informed Mr. St. Pierre of his difficulties with the high voltage probe.	J. Halter statement - 25 March 2008
24 March 2008	28	Mr. St. Pierre acknowledged these difficulties with "a look".	J. Halter statement - 25 March 2008
24 March 2008	29	Mr. St. Pierre opened the cell door unlocked by Mr. Halter.	J. Halter statement - 25 March 2008
24 March 2008	30	Mr. Halter performed a sweep of the inside the cell with the high voltage probe which failed to indicate the presence of electricity.	J. Halter statement - 25 March 2008
24 March 2008	31	Mr. Halter turned his back to Mr. St. Pierre in order to hold the detector up to a light to attempt a second test of the probe.	J. Halter statement - 25 March 2008
24 March 2008	32	Mr. St. Pierre entered the cell with the grounding cables.	J. Halter statement – 25 March 2008
24 March 2008	33	Mr. Halter, back still turned to Mr. St. Pierre, heard the sound of an electrical arc. Mr. Grove heard a bang. Mr. Taylor “saw Henry start and then I heard a bang…then I smelled smoke and saw him drop to the floor”.	J. Halter statement – 25 March 2008 R. Grove statement – 25 March 2008 G. Taylor statement – 25 March 2008
24 March 2008	34	Mr. Halter turned to face Mr. St. Pierre, saw Mr. St. Pierre step back from the cell, fall to one knee and collapse.	J. Halter statement - 25 March 2008
24 March 2008	35	Mr. Halter dragged Mr. St. Pierre to a clear, safe area.	J. Halter statement – 25 March 2008
24 March 2008	36	Someone else inside the ESB called man down and Mr. Snell called 911.	J. Halter statement - 25 March 2008
24 March 2008	37	The alarm was sounded to evacuate all other personnel from the building.	J. Halter statement - 25 March 2008
24 March 2008	38	Mr. Halter commenced CPR on Mr. St. Pierre. Someone came into the ESB and asked what had happened. Mr. Halter looked up to answer and noticed that 4-U-2 power factor capacitor cell door was open, not 4-U-3.	J. Halter statement - 25 March 2008
24 March 2008	39	Mr. Kohlman and Mr. Neufeld took over CPR from Mr. Halter.	J. Halter statement - 25 March 2008
24 March 2008	40	Mr. Halter called the control centre to shut off power to 4-U-2 and he then racked out Unit 4-U-2.	J. Halter statement - 25 March 2008
24 March 2008	41	Mr. Halter donned his arc-flash gloves, removed the tail of the ground cable that was inside the Unit 4-U-2 power factor capacitor cell and closed the	J. Halter statement - 25 March 2008

Date and Time (Where known)	Order of Events	Description of Event	Reference
		Unit 4-U-2 cell door so that emergency responders would not be at risk.	
24 March 2008	42	Mr. Halter returned to assist Mr. Kohlman and Mr. Neufeld with CPR.	J. Halter statement - 25 March 2008
24 March 2008	43	Emergency responders arrived approximately 25 minutes after the incident and took over with paramedical aid. Emergency responders were not able to revive Mr. St. Pierre. Mr. St. Pierre was transported to the Kerrobert hospital and could not be revived at the hospital.	Enbridge Pipelines Inc Preliminary Incident Report - April 4, 2008
31 March 2008	44	Directive issued by Enbridge to all electrical workers and supervisors with regard to high voltage work.	Directive to all Electrical Workers and Supervisors High Voltage Work - March 31, 2008

Appendix IV: References

Det Norske Veritas, *Incident Investigation*, 52630 II a.R01, 2003.

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