2.5 Case Study: Electrical-Related Injury

While performing preventive maintenance to a motor controller in an industrial facility, an electrician received a 4800V shock that resulted in a critical injury.

The electrician (the victim) was part of a two-man crew working for an electrical contractor doing preventive maintenance (PM) on the motor controller (MCC) powering the Heating Ventilation and Air Conditioning (HVAC) unit for the plant. This was a task the contractor, including the two electricians, had done for the facility many times without incident. The lead electrician had previously performed PM on this MCC but had done the work alone.

To perform this task as part of the facility’s safe work procedure, the crew first had to obtain a Safe Work Permit from the facility. The process requires a contractor to fill out the form, have it signed off by their contact person at the plant and then proceed with the work. Once the work is completed, the contractor completes the checklist on the Safe Work Permit, signs it and returns it to their contact person.

The scope of work for the MCC entails inspecting and cleaning all contactors and cells of the unit. It involves rolling the contactors out of their respective cells (Figure 1), inspecting and cleaning the cells and the contactors, and then rolling the contactors back into place. Prior to rolling a contactor from its cell, the contactor must first be mechanically disengaged from the buss of the MCC so that it is de-energized and can be pulled out of the cell. This procedure is called racking. Racking is done twice, once when disengaging (racking out) and the second time when engaging the contactor back into place (racking in).

The lead electrician briefly discussed with the victim the task at hand before starting work. They performed PM on the first three cells without incident.
While the victim rolled contactor “B” out of Cell 3L (Figure 3) and completed PM on it, the lead electrician did the same with contactor “A”. The lead electrician completed PM on contactor “A” then rolled it back into Cell 2U. Then, he cleaned and checked Cell 3L while the victim was completing PM on contactor “B”. The lead electrician then closed the door for Cell 2 and went to the truck to retrieve his face shield and gloves. With his Personal Protective Equipment (PPE) on, he exercised the racking handle two or three times. There was no discussion between himself and the victim about exercising the racking handle before proceeding to do so.

After exercising the racking handle, the lead electrician returned to his truck to drop off his PPE before heading back to help the victim with his work. He found the victim on the floor. He had received a shock while making contact with contactor “B” through the A and C phases. He performed CPR until help arrived and Emergency Response was called in. The victim survived, but lost both of his arms as a result.

The investigation found:

- There was no line diagram of the MCC, and the crew did not request to see the diagram before starting work;
- Contactors “M” and “B” shared the same branch in the circuit, meaning that when in the closed (energized) position, the circuit was completed and the machine was energized;
- When contactor “M” was racked in, 4800V was fed into contactor “B” through the exposed buss;
- When Cell 3L door was open, the buss mentioned above was still energized;
- No attempt was made to lock out the entire station. The main switch for the unit was located on Cell 4U (Figure 3) and workers assumed it was safe to work on the machine once they received the work permit.
2.5 Case Study: Electrical-Related Injury (continued)

Causal Factor 1:  
*Crew did not consider the hazards when there was a change in work method*  
According to the lead electrician, PM was previously performed on this equipment without incident and the PM had always been performed by one technician on one cell at a time. The electrician did not realize that working with two people introduced new hazards. The awareness of the associated hazards would have led to several other preventative measures (indicated below as other causal factors to this incident, such as reviewing electrical schematics as well as lock and tagout).

Causal Factor 2:  
*Crew did not review schematics of equipment or line diagram*  
It is unknown whether the line drawings for MCC-42 were reviewed in previous visits by the contractor, but no one reviewed the electrical drawings for this particular job on the day of the incident. As well, the lead electrician indicated that the drawings in the control cell appeared to be a control diagram and not a line diagram.

Causal Factor 3:  
*No hazard assessment was performed by the client or contractor crew*  
Aside from a brief discussion of the work to be performed, no hazard assessment was conducted by the facility or contractor crew. No discussions took place between the contractor and customer regarding potential hazards involved with performing PM on the MCC. The crew did not perceive that the work related to this assignment posed any hazard.

Causal Factor 4:  
*Safe Work Permit failed to identify gaps in the contractor’s work procedure*  
The facility owner’s criteria for granting a Safe Work Permit is unknown because the document was not obtained during the investigation. Best practice for Safe Work Permits typically includes identification, assessment and control of the hazard. The investigation points to a gap in either the criteria of granting a Safe Work Permit and/or the review process of the Safe Work Permit conducted by the facility owner.
2.5 Case Study: Electrical-Related Injury (continued)

**Causal Factor 5:**
*Crew did not lockout and tagout in accordance with the Occupational Health and Safety Act & Regulations Requirements (OHSA)*

OHSA and Regulations requires a lockout of the power supply to be implemented when two or more individuals are working on the same equipment. Both the customer and the contractor have written procedures for lockout and tagout which were not followed.

**Causal Factor 6:**
*Lead Electrician did not communicate to the victim that he was racking his unit in*

While the victim was performing PM on contactor “B”, the Lead Electrician racked his contactor in without informing the victim of his action. This action energized the Lead Electrician’s unit and the victim’s.