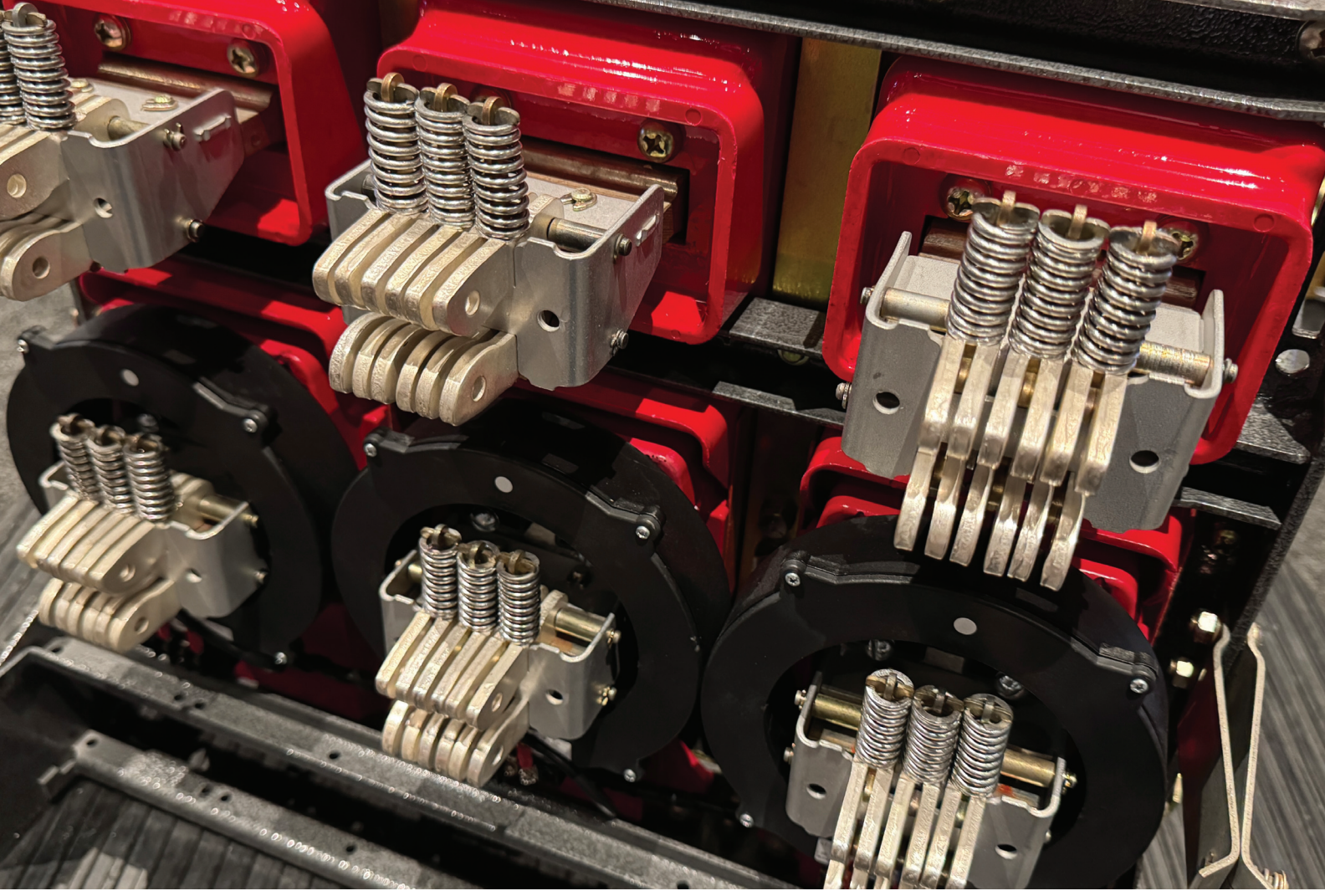

Safety Measures ELECTRICAL

"Elimination is the first priority! Ensure a risk assessment is completed before energized work tasks are completed."

Electrical Maintenance Program (EMP) Project Execution Plan

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

When developing an Electrical Maintenance Program (EMP) or validating that an existing EMP is effective the application of project management practices is recommended. A Project Manager needs to be assigned, scope of work documented, Management Sponsor established, and an Electrical Maintenance Committee (EMC) constituted with relevant stakeholders. A formal Project Execution Plan (PEP) shall be followed. In Phase 1 of the PEP it is recommended that the Project Manager complete pre-work data gathering and a gap assessment. Before any work can be completed an as-built electrical equipment asset inventory is required, this would also involve ensuring the single line diagrams for the facility(ies) are as-built.

Gap Analysis

The EMP development project will be used to create an Electrical Maintenance Program or validate/update an existing Electrical Maintenance Program. The following assumptions have been made and will be validated in the gap assessment of the PEP Phase 1:

1. Facility(ies) are operational and electrical equipment maintenance is active.

2. An insurance audit may have occurred, and corrective actions identified. Other consequences related to power distribution system reliability have been identified that need to be addressed (e.g., legal, regulatory, etc.).

3. Electrical maintenance staff are familiar with the operational requirements of the facility(ies), the nature of the business been undertaken, any unique requirements of the business and the assessment of the criticality of the facilities operations/processes. This will be applied when completing the criticality of service/prioritization assessment of electrical equipment assets.The criticality of service/prioritization criteria that need to be assessed for each electrical equipment asset identified as requiring maintenance are listed in Table 1 below.

Item #	Criticality of Service/Prioritization Criteria Description Consequence	Comments / Notes
1	OH&S Regulatory, Injury/Fatality	e.g. liability.
2	Other Regulatory Compliance	e.g., airports Canada TP 312, hospital, etc.
3	Maintenance for Safety (e.g., abnormal arcing fault likelihood, electrical protective device opening times for incident energy calculations, etc..)	e.g., calculation incident energy levels are higher.
4	Criticality of Service (e.g., Uptime, Loss of Revenue)	e.g., profitability
5	Equipment Damage, Replacement Cost	e.g., unplanned expense budget, critical spares identified and cost.
6	Legal, Contractual Obligations, Confidentiality	e.g., data centres, production commitments (e.g., uptime and confidential data), production targets.
7	Insurance Requirements	e.g., production loss penalties.
8	Company Reputation, Valuation	e.g., license to operate, stock price.

Table 1. Criticality of Service/Prioritization Criteria, Description, Consequence

4. A Computerized Maintenance Management System (CMMS) is used to document a database of electrical equipment assets that were identified as requiring maintenance, planned or reactive. There may be a defined Maintenance Planner/Scheduler role, or the Electrical Maintenance Supervisor executes this role.

5. There are existing Single Line Diagrams. They may not be as-built.

6. There may or may not be an as-built detailed electrical equipment asset inventory MS Excel spreadsheet. This will need to be as-built for electrical equipment that is deemed to require maintenance and based on the criticality of service/prioritization criteria in Table 1. This inventory list will be required in order to complete a qualitative risk assessment for validation of existing/status quo maintenance and any changes (e.g., increased maintenance or potentially decreased maintenance).

7. As is electrical equipment condition assessment will be completed. Three defined conditions, Condition 1, Condition 2 or Condition 3 (e.g., reference CSA Z463 and/or NFPA 70B). Document the current maintenance strategies that are applied to the electrical equipment in the asset inventory. Identify any existing inspection and test procedures that are used.

8. A current Power System Study is most likely completed with the driver been completing an arc flash hazard incident energy analysis study. Electrical equipment withstand ratings/interrupting ratings have been validated (e.g., the report would identify any electrical equipment that is over duty and abnormal electrical equipment conditions exist

that need to be addressed), protection & coordination validated, and arc flash hazard incident energy analysis completed. Any electrical protective device setting changes have been implementing and additional incident energy reduction methods related to electrical protective devices have been implemented. Outcome should be updated single line diagrams and ensuring that the electrical equipment asset inventory is updated reflecting any changes.

9. An up-to-date Electrical Equipment Maintenance Report is available for reference in the electrical maintenance department. Electrical equipment maintenance labels may or may not have been installed.

10. Manufacturer's operating and maintenance manuals are most likely not available. In the absence of manufacturer's operating and maintenance manuals not been available the EMP will reply on the requirements of CSA Z463 and/or NFPA 70B as a priority and will most likely meet or exceed manufacturer's requirements.

11. EMC members may have different levels of knowledge and experience in the established electrical equipment maintenance and may not be aware of the history of the development of existing electrical equipment maintenance strategies, established inspection and test procedures and established maintenance intervals.

12. The EMC will complete a qualitative risk assessment for the electrical equipment asset inventory based on consequence(s) and validation of the electrical equipment condition required. This process may validate that the existing maintenance strategy, related inspection and test procedures and maintenance interval are adequate or that changes are required to achieve the new condition required.

13. There may or may not be documented inspection and test procedures for maintenance department use and related checklist/data sheets. These will need to be developed.

14. Implement any changes in the CMMS required as an outcome of the qualitative risk assessment.

Going forward the Electrical Maintenance Program will assist in the more effective management of electrical maintenance and ensuring specific consequences have been addressed. Some of the benefits of the development, implementation and eventual auditing of the Electrical Maintenance Program are:

- Saving lives! Reducing risk to as low as reasonably practicable. Maintenance for safety!
- Ensure confidence and certainty with workers that will lead to increased productivity.
- Stronger electrical safety and maintenance culture and positive/proactive behaviours.
- Consistency across the Company.
- Reduce risk of negative impact to the operation of facilities and the potential negative impact on reputation if injuries or a fatality were to occur.
- Limits the likelihood of damage to electrical equipment and then the related repair costs, extended outage costs and need for proactive management.
- Forward realistic budgeting of costs related to electrical equipment maintenance.
- Improved technical quality and lower costs of maintenance. More effective planning and budgeting.
- Improved document management.
- More effective management of insurance risk.
- Comply with regulatory requirements and reduce risk of regulatory oversight.
- No legal costs incurred.

More on an Electrical Maintenance Program in future articles.

I will continue my efforts to communicate information in Electrical Safety Measures and share the knowledge and experience I have in an effort to "Get it Right!!" My electrical safety journey and mission will continue!! Knowledge is power! TAKE CONTROL of ARC FLASH! PLACE MORE FOCUS on ELECTRIC SHOCK!

If you are interested in discussing the information presented in this article or would like a specific topic presented do not hesitate to contact me at terry.becker@twbesc.ca or 587.433.3777.

Terry Becker, P.Eng., CESCP, IEEE Senior Member is a founding member and the First Past Vice-Chair of the CSA Z462 Workplace electrical safety Standard Technical Committee and currently a Voting Member and Clause 4.1 and Annexes Working Group Leader. Terry is also a Founding Member and a Voting Member on the CSA Z463 Maintenance of electrical systems Standard and a Voting Member of the IEEE 1584 Guide for Performing for Arc-Flash Hazard Calculations. Terry has presented at Conferences and Workshops on electrical safety in Canada, the USA, India, Australia and Italy. Terry is a Professional Engineer in the Provinces of BC, AB and ON. Terry is an Electrical Safety Specialist, Management Consultant, and can be reached at 587.433.3777 or by email **terry.becker@twbesc.ca**.