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Newsletter ~ "FMEA"

What is *FMEA*? FMEA (fē´-mä) is an acronym for *Failure Modes and Effects Analysis* which is used as a means to help identify reliability risk. By applying the plant's availability impact and the maintenance cost to the FMEA results, a financial impact can be determined. The information can help direct a facility's personnel to reduce operational cost and improve profit potential.

FMEA is not the same as *RCFA* - Root Cause Failure Analysis. RCFA is a process to identify the root cause of a particular failure incident. Chronic or costly failures are usually the motivating factor in performing a RCFA. Experiences gained through RCFA investigation help in the FMEA process to identify and discuss potential problem areas.

Why perform a FMEA? Is it cost-effective? Is it time-effective? Is it worth the effort? The answer: *YES*. Every piece of equipment has a potential failure rate during its life. The failure rates are higher, on average, at the beginning and at the end of life. FMEA's performed at the end of life help identify components which are failing, the mechanism for failure, and the financial impact of the failure. By this analysis, a cost prioritized maintenance/replacement program can be established to reduce the most costly expenditures.

How is the high potential failure rate addressed at the beginning of a piece of equipment's life? The answer is: Perform a FMEA. The reliability issues at the beginning of life are not necessarily due to defective equipment, although this factor must be considered. A higher potential failure rate can be the result of poor communication between various groups associated with the project — operations, maintenance, plant engineering, contract engineering, installers, manufacturers, purchasing, etc. — which can be minimized through a FMEA.

Do you remember in school when we were taught the effects of communication? One communication learning tool was to whisper a sentence to the person on the right. One by one, the sentence was passed around the room in chain-like fashion. Finally, the last student repeated aloud what was whispered

to him. What was the result? Often the sentence was dramatically different from the original. Life lessons tell us that the same communication effect happens in our work place. In performing a FMEA, this communication breakdown is prevented by having the appropriate individuals participate in the review process. When the proposed design is presented, the participants of the review can hear what is said, they can ask questions, and provide input based on their experiences.

Some points of concern may be: (1) Will the equipment handle the demand of the operating group? If not, either the design needs to be changed or a higher risk factor needs to be assigned; (2) Can the equipment be maintained? This impact may require a design change, a different manufacturer, personnel training, or assignment of a higher risk factor; (3) Is the equipment a new technology or unique to the facility? Standardization of equipment is an excellent way to reduce the risk factor. When new technology or unique equipment is used in a project, the operational and maintenance groups **must** be part of the decision process and they **must** be trained.

An important element in a FMEA is the "Risk Determination Point". The risk determination point is the load or equipment endpoint to be evaluated for the risk of a failure and the duration of the downtime. The risk value is a cumulative value starting at the source of the study to the point of review. These points may include a critical load, a key motor control center, an emergency bus, etc. These points may help evaluate the need for spare equipment or dual equipment. As an example, the failure of a particular pump could have an environmental impact if the outage is greater than twenty minutes. The risk determination point would be taken to the pump and if the length of the failure is calculated to be greater than twenty minutes, then all risk elements would be reviewed. Elements with a higher risk factor are considered to be "weak links". The review team then determines whether a design change is required, or if the risk is acceptable.

During the review process, the potential impacts on health, safety, and environment must be included in the discussion. This would seem to be basic and may be mentioned during the discussion, yet, a proper FMEA can help in providing key information of a project's Hazardous Operation Review– *HAZOP*. An example of an impact on safety: a FMEA identified a critical load with a higher risk factor for its source of power. To compensate for the risk, an unusual power source arrangement was proposed to provide different feeders to the load's starter. The loss of the normal source would allow the alternate source to power the load. However, a maintainability review might show that the personnel are not trained to inspect or repair the starter. The higher safety risk would require additional training.

The next step in the FMEA process is to assign risk factors by using manufacturers' and industrially recognized data of failures per year, as well as the duration period to repair the failures. Applying these factors to the design process will provide a value of the non-availability of a piece of equipment, of a system, and/or of a total process. Multiplying the duration of the failure by the operational financial impact and adding the maintenance cost, the result is the cost of the total outage. Some outage costs may be acceptable: a higher cost impact may result is a design change or other modification.

What is the conclusion about performing a FMEA? A FMEA review can be considered

"preventative medicine". Without anticipatory and preventative measures, once the project team has left, the facility may be in a continual battle trying to address reliability issues and reduce costs. The adage rings true, "an ounce of prevention is worth a pound of cure".

For electrical system FMEA references, we suggest IEEE Standard 493 (Gold Book) and NFPA 70B - Recommended Practice for Electrical Equipment Maintenance.