

CHAPTER 6

RESULTS OF FMECA

6-1. Overview

At the conclusion of the FMECA, critical items/failure modes are identified and corrective action recommendations made based on the criticality list and/or the Criticality Matrix generated by the Criticality Analysis.

- a. Utilizing the criticality list, the items with the highest criticality number or RPN receive attention first. Utilizing the Criticality Matrix (recommended), items in the upper most right hand quadrant will receive attention first. Typical recommendations call for design modifications such as; the use of higher quality components, higher rated components, design in redundancy or other compensating provisions.
- b. Recommendations cited must be fed back into the design process as early as possible in order to minimize iterations of the design. The FMECA is most effective when exercised in a proactive manner to drive design decisions, rather than to respond after the fact.

6-2. Recommendations – from the criticality matrix example

Once the items are assigned their respective "squares" in the criticality matrix, the team now has the ability to rank which components need further review. From the above example the items can be quickly judged. If there are items that have similar RPNs and fall in the roughly the same vicinity in the matrix, then the team will have determine which item should be addressed first. Remember, as the design matures and information is collected, this tool will be able to identify more clearly which items should take priority.

- a. Item #110.0 is the reservoir and has a high failure rate. Possibly another choice for a reservoir with a lower failure rate and an annual inspection/evaluation of condition of reservoir should be considered.
- b. Item #220.1 is the inability of the chiller to remove any heat from the chilled water supply. This has a relatively high failure rate and severity. The chiller should have inspections at specified intervals including eddy current testing annually to monitor breakdown of tubes. Motor should be tested annually as well for breakdown of windings. Because there is a redundant component this can be done at a predetermined time. Continuous monitoring of temperature with existing sensors and alarms should prevent catastrophic failure of the chiller. These procedures should address item 220.0 as well.
- c. Item numbers 310.0, 310.1, & 310.2 are all associated with the air handler system. #310.0 and #310.1 have a higher failure rate and are therefore more likely to occur and possibly predict due to their nature of failure mechanisms which are a "wear out" type mechanism. Therefore, typical preventative maintenance actions at manufacture's recommendations should be employed initially. This interval can be adjusted according to inspection reports from the maintenance actions. The fan should not be driven by one belt. Use a sheave with three grooves for three belts to decrease the chance that one broken belt will make the item fail. A spare motor should be on hand to quickly replace the existing motors in the event one fails. Bearings should be greased quarterly (do not over grease!) and air filter(s) changed semi-annually.
- d. Item numbers 130.0, 130.1, and 130.2 have relatively high severities and average failure rates. These items are all related to the cooling towers. Most of the failures associated with this item are related to contamination of the water, therefore monitoring the condition of the water through water analysis and

chemical treatment should eliminate or lower the possibilities of these failures occurring. Filtering the water and changing the filters at a regular interval (again, adjust this as needed) should also be implemented. An annual inspection should be done as well. Replacement sprayers and fan motors should be readily available in order to quickly respond to a spontaneous failure in these locations.

e. The final four failure modes are associated with the pumps in both the chilled water supply and the industrial cooling water supply. The chilled water supply ranks higher due to the fact that in the event of no chilled water there will be no heat removed from the room and therefore would lead to computer failure. This is an immediate effect versus the industrial cooling water system which will affect the efficiency of the chiller and possibly lead to a failure over time. Therefore, if a priority were to be in place, the chilled water pump should take precedence. In either case, the recommendations for both pumps are the same. Along with the manufacture's recommended pm in place for rebuilding the pump and periodic inspections, then a vibration analysis and an electrical test on the motor could be conducted at a semi-annual basis. In the event of a spontaneous failure the redundant pump can be transferred over while the failed pump is repaired. It should be noted however, that if the power supply is disrupted to the first pump then there is a possibility that the second pump will also be unable to start. This means there better be a separate power feed line to the secondary pumps.