ELIMINATING SURPRISES

PREDICTIVE MAINTENANCE (PdM)

and

Emergency Power Command Centers (EPCC)

Preventive vs. Predictive

Some think the terms Preventive Maintenance (PM) and Predictive Maintenance (PdM) are similar if not exactly the same. They're not. PM only delays inevitable replacement of components where PdM predicts when replacement is going to be necessary, estimates replacement costs and lays out "cutover" plans. All equipment eventually breaks and it's not just the big stuff…it can be a small sub-component that could compromise the integrity of the larger more visible components and even an entire Emergency Power Supply System (EPSS). A well constructed PdM eliminates most surprises.

Waukesha, WI – 26 December 2015

As much as a million gallons of untreated wastewater flowed into the Fox River after a power failure Wednesday night, The Waukesha Freeman reported Saturday. The incident reportedly began when a tree hit the Waukesha wastewater Treatment Plant's main power feed just after 10:15 p.m. Then, a secondary alternate feed didn't activate when a fuse blew. Emergency backup generators started up, but failed to transfer power.

The plant manager called the situation "unfortunate" and said a similar incident hadn't happened in years, according to the newspaper. Untreated water bypassed to the river for about two hours early in the morning. Generator power was activated about 3 a.m. Thursday, stopping the bypassing of the water, according to the Freeman. The power feed was restored about 7 a.m.

Island Exercise

The last of **7 steps** to verify long term reliability

① Rehearsing a total loss of outside services: water, fuel, power, repair services and communication.

② Your options, and their options: Leave or Defend-in-Place? Time?

③ Questions to ask service providers: Do you have a generator that will enable you to extend services; what is your fuel burn in hours at max load; how are you maintaining it; can I see your service records?

④ What is your Plan B if their Plan B tanks?

Step 1 - Risk Analysis

① An engine/generator is no more important than what's attached to it. It is just one component of the Emergency Power Supply System. Generators/Engines rarely fail, it's the other components - batteries, fuel supply systems, rubber, transfer switches etc. How are they connected, and are there "next level redundancies" in place?

② Age, Parts Availability, SPOOFs, Needed Repairs and Location Issues?

③ Laboratory analysis of all fluids. Do you know the parameters and what the analyses predicts? PdM protocols in place?

Step 1(a) PdM- Starting Batteries

① Enough data was available to predict they could fail within 36 months. Specific Gravity and/or CCA testing are PdM tools.

② NFPA 110 has a paragraph in the appendix suggesting replacements between 24-30 months….whether they've failed or not.

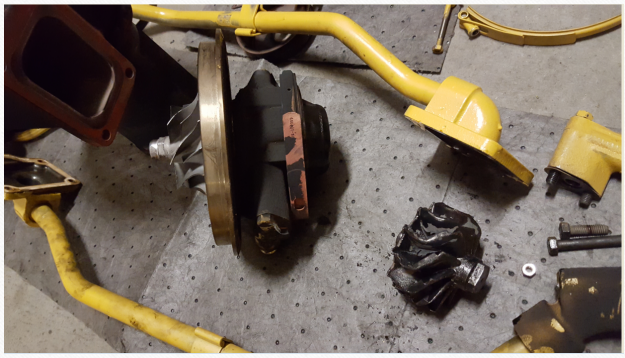
Step 1(b) PdM - Fuel Management

① After battery replacement standards were adopted a fuel analysis standard was added to NFPA 110 because history had shown that fuel issues where the leading cause of failure after the engine had started.

② NFPA 110 appendix added little appreciable help since no parameters were given. ASTM D975 very expensive.

③ Other fluid analysis just as important – coolant and lubricating oil analysis should be added. When are you changing oil?

Turbo Failure Not CAT's fault



Step 1(c) PdM – Cutover and Bypass Plans

① Since everything will eventually have to be replaced before it breaks (hopefully not afterwards), how are you going to continue services with absolutely NO interruptions?

② Would have been nice if cutover plans had been part of the initial design but they probably weren't.

③ Planning for seamless component extraction and insertion while using temporary components has to be part of the plan.

Step 2 – Codes and Regulations

① State

② CMS and/or Deemed Status Agency

③ EPA

④ OSHA

⑤ Insurance Carrier Provisions

⑥ OEM Manuals

⑦ NFPA Standards

Step 3 – Gap Analysis

What, How Much and When?

1. Using information from the Risk Analysis, the "what" is known.
2. "How much" can be a moving target and should be the work product of the commissioning agent working with construction department and facilities
3. "When" should be decided upon and not changed – Delaying a correction eliminates the purpose of the PdM

Step 4 – Metrics/Parameters

1. Coolant Analysis and Change Intervals - PdM
2. Oil Analysis and Change Intervals - PdM
3. Fuel Analysis and Filtering Intervals - PdM
4. Fuel Burn Rates
5. Infrared Tests

Step 5 –Trending

① Parameters Established

② Accumulation of Past EPSS Run Records

③ Reviewing Current EPSS Monthly, Annual and Triennial Records by Professional

NFPA 110 Tightens Down in 2016 Edition

8.5.1 Records shall be created and maintained for all EPSS inspections, operational tests, exercise repairs, and modifications.

8.5.2 Records required in 8.5.1 shall be made available to the authority having jurisdiction on request.

8.5.3 The record shall include:

(1) The data of the maintenance report
(2) Identification of the servicing personnel
(3) Notation of any unsatisfactory condition and the corrective action taken, including parts replaced
(4) Testing of any repair in the time recommended by the manufacturer

8.5.4 Record shall be maintained for a period of time defined by the facility management or by the authority having jurisdiction.

Step 6 – Staff and Contractor Training

① Certificate Programs for Compliance to State and NFPA 110 Standards. *(NFPA 110, 8.4.8 EPSS components shall be maintained and tested by a qualified person(s).)*

② Are your EPOs and remote annunciators being checked annually? Infrared testing of each exhaust port?

③ ATS starting circuits can be verified without starting engine. Every month.

Step 7 - Island Exercise

The **last of 7 steps** to verify long term reliability

① Total loss of outside services: water, fuel, power, repair services and communication (See NFPA 110 for paragraph on spare parts.)

② Your options, and their options: Leave or Defend-in-Place? For how long?

③ Questions to ask service providers: Do you have a generator that will enable you to extend services; what is your fuel burn in hours at max load; how are you maintaining it; can I see your service records?

④ What is your Plan B in case their Plan B tanks, and how often is it rehearsed?

Emergency Power Command Center (EPCC)

- Document Storage
- Report Review and Plan Development Dynamic – **Collecting data and interpreting data are two different things.**
- **Trending**
- Action Plans
- Knowledge Transfer
- Surveyor Portal

EPSS Description:
Electrical Single Lines and Risers
Specifications and Sequence of Operations
Fuel System Diagram
Fault and Coordination Study
Arc Flash (NFPA 70E) Documentation
Commissioning and Acceptance Testing Reports

Electrical Component Inventory (OEM Manuals If Available):
Generators
Circuit Breakers
Parallel Gear
ATS
UPS

Fuel System Component Inventory:
Main Tank(s)
Pumping System Single Lines
Day Tanks
Electrical and Manual Control Diagrams and Instructions

Electrical Load Profiles and Fuel Burn Analysis:
Current 30-Day Load Analysis
EPS Fuel Burn Analysis For Each Generator Set

Contractual:
Current Service and Fuel Delivery Contracts
Technician Training Certificates and CDL
Liability Insurance Certificates
Peak Shaving/DR/Load Sharing Agreements

Maintenance and Testing Reports:
Weekly, Monthly, Annual and Triennial (MGI "PDF Filler" Formats Available)
Loadbanks
Fuel, Oil and Coolant Lab Analysis
Infrared and Invasive Testing
Contractor Reports – Regular and Repair Orders
RFPs for Service (MGI Recommended Formats Available)

Alternate Equipment Maintenance (AEM)

- **AEM is now allowed**. Be carefully of promoting pencil whipping – e.g when accepting weekly inspections vs. testing of a generator set.
- **Predictive Maintenance** must be used to verify effectiveness.
- An **EPCC** must be used to control the process.
- **Warranties** must be considered.

The EPSS is a candidate for an AEM according to the CMS

Alternative Equipment Maintenance (AEM)

"The AEM item is something that bugs me, because when you look at it, it's basically saying everything you've done that is good, is now in question. I tell people to put together a group of experts within their department and evaluate the current PM's. If they seem to satisfactorily keep the equipment operating over time, continue to use them as AEM's. The bad thing is that 'High Risk' items must be maintained to "manufacture's recommendations", this is where 'common sense' does not prevail." Anonymous

AEM Decision Chart (Quandary)

Test Item	OEM Manual	NFPA 110	CMS or Other	Insurance Company	Present Protocol
Weekly Run	Probably	No	Yes/No	Yes/No	Yes/No
EPO	Maybe	No	No	Maybe	No
Oil	Probably	No	No	No	Yes
Fuel	Maybe	Yes	Yes	Maybe	Yes
ATS – 3 year	Maybe	Yes	No	Maybe	Yes/No
Megger	Yes	No	No	Maybe	No

Emergency Power Supply System (EPSS)

NFPA 110, 3.3.4: *A complete functioning EPS system* [generator] *coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power.*

MGI Advisory Services

Dan Chisholm, Sr.

www.mgi-epss.com

http://www.mgi-epss.com/mgi-emergency-power-command-center-epcc/

http://www.mgi-epss.com/education/

Dan.Chisholm@mgi-epss.com

407.421.7189