Facility Equipment Maintenance System (FEM)
2012 Locks Maintenance Workshop
Puducah, KY
29 February 2012

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LRD Regional FEM Coordinator
24 May 2011
HQs Utilization, Maintenance Management Initiative

Goals
- Increase reliability
- Availability
- Operational Effectiveness
- Maintenance Efficiency

- 16+ Years
- ER1130-2-500
- 29 Years
- ER1130-2-303
### Run-to-failure maintenance

**Corrective Maintenance**
- Breakdown maintenance

### Fix it before it breaks

**Preventive Maintenance**
- Schedule maintenance
  - Historical maintenance
  - Calendar based maintenance

### If it Isn't broke, don't fix it

**Predictive Maintenance**
- Condition based maintenance

### Fix it at the right time

**Proactive Maintenance**
- Prognostic maintenance
  - Reliability Centered maintenance

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**Relative Failure Rate**

<table>
<thead>
<tr>
<th>Maintenance Type</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
</table>
| Corrective       | - High risk of secondary failure  
                 - High production downtime  
                 - Has Overtime Costs  
                 - Potential Safety Hazards  
                 - Maintenance is performed in controlled manner  
                 + No condition monitoring related costs  
                 + Maintenance is performed when convenient  
                 + Equipment life is extended | - Machines are not 'over maintained' |
| Preventive       | - Machines are repaired when there are no faults  
                 - Repair often causes more harm than good  
                 - There are still 'unscheduled' breakdowns  
                 - Potential Safety Hazards  
                 - Equipment life is extended  
                 - Reduced downtime  
                 - Reduced overall maintenance costs  
                 + Improved equipment reliability  
                 + Fewer failures, thus fewer secondary failures | + Fewer catastrophic failures  
                 + Greater control over stored parts and costs  
                 + Unexpected machinery failure should be reduced |
| Predictive       | - High investment costs  
                 - Additional skills required  
                 - Equipment life is extended  
                 + Unexpected breakdown is reduced  
                 + Parts are ordered when needed  
                 + Maintenance is performed when convenient  
                 + Equipment life is extended | - Additional time invested upfront  
                 - Requires a change in philosophy from management and down |
| Proactive        | - High investment costs  
                 - Additional skills required  
                 - Additional time invested upfront  
                 - Requires a change in philosophy from management and down  
                 - Equipment life is extended  
                 - Reduced downtime  
                 - Reduced overall maintenance costs | - High investment costs  
                 - Additional skills required |

Ref: DoD Guidebook “Condition Based Maintenance Plus”, May 2008
Review of FEM

- Asset
  - PM Plan
  - Job Plan

Routine Work Order

Non-Routine Work Order

- Asset
  - Failure Code
LRD FEM Status Overview

- The last LRD District that received initial FEM Training was 22 months ago, earliest was 32 months ago

- ~167,000 Work Orders, 95.1% are Routine
LRD WOs >120 Days

- Labor: 980 (30%)
- Money: 846 (26%)
- Environmental: 622 (19%)
- Process: 543 (17%)
- Others: 271 (8%)

Total: 2,481
### 3.1 FEM utilization milestones (reference LRD FEM PgMP, 10 October 2010)

The following schedule applies to all business lines and repair parties in FEM:

For **non-routine maintenance**, within **1 year** of deployment of FEM:
- For all non-routine work orders, the Local Work Type will be selected that represents the purpose of the Work Order.
- Use of failure reporting is required on all work orders.
- While non-routine work orders will vary in terms of time to completion or repair, it is expected that actual labor and material data will be recorded upon close-out of the non-routine work order.

For **routine maintenance**, within **2 years** of FEM deployment:
- All job plans and PMs will be created and logged.
- All work orders should be completed after 120 days.
- The closed work order should include recorded, actual labor and material data.

Within **3 years** after the deployment of FEM, the asset hierarchy in FEM must align with the OCA effort for all assets with a condition code of C, D or F. Furthermore, assets with C, D or F condition codes must also have a correlating non-routine work order as well. Lastly, whenever OCA condition codes change FEM must be updated to reflect such changes.

Within **5 years** after the deployment of FEM, districts will canvas and identify historical maintenance records for replaced/repaired critical assets (critical assets are identified in Appendix H) and create a FEM non-routine work order for those assets. This action will assist risk and reliability activities for OCA.
Repair Station Non Routine Work Orders

<table>
<thead>
<tr>
<th>Work Order</th>
<th>Description</th>
<th>Reported Date</th>
<th>Asset</th>
<th>Crew</th>
<th>Lead</th>
<th>Status</th>
<th>LW Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-9564</td>
<td>Upper &amp; Lower 600 Bottom Gate Latchers</td>
<td>03/17/2010 4:56:14:PM</td>
<td>H4LOHL02</td>
<td>PEWARS-MA</td>
<td>H40RXGPB</td>
<td>CLOSE</td>
<td></td>
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<tr>
<td>H4LOE10-3283</td>
<td>Replacement nut end Tension Bar</td>
<td>03/15/2010 4:25:3:PM</td>
<td>H4LOEL</td>
<td>PEWARS-WC</td>
<td>H4ORXGPB</td>
<td>CLOSE</td>
<td></td>
</tr>
<tr>
<td>10-7389</td>
<td>Man Basket (Bantam Crane)</td>
<td>03/09/2010 2:22:26:PM</td>
<td>H4LOHDCAS</td>
<td>PEWARS-ME</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>09-7331</td>
<td>600 PUMPOUT REPLACE FLOATING MOD...</td>
<td>03/05/2010 7:9:19:PM</td>
<td>H4LOPL02</td>
<td>PEWARS</td>
<td>CLOSE</td>
<td></td>
<td></td>
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<tr>
<td>09-7330</td>
<td>600 PUMPOUT SCREEN BARS (SEE LONG...)</td>
<td>03/05/2010 6:49:22:PM</td>
<td>H4LOPL02</td>
<td>PEWARS</td>
<td>CLOSE</td>
<td></td>
<td></td>
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<td>09-7329</td>
<td>600 PUMPOUT HYDRAULIC PIPE WORK (SEE LONG...)</td>
<td>03/05/2010 6:29:34:PM</td>
<td>H4LOPL02</td>
<td>PEWARS</td>
<td>CLOSE</td>
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<td></td>
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<tr>
<td>09-7326</td>
<td>600 PUMPOUT GATE REPAIR (SEE LONG...)</td>
<td>03/05/2010 5:25:56:PM</td>
<td>H4LOPL02</td>
<td>PEWARS</td>
<td>CLOSE</td>
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<td>10-2738</td>
<td>Land wall filling valve and operating machine...</td>
<td>01/12/2010 6:38:39:PM</td>
<td>H4LM2LVTFL</td>
<td>PEWARS</td>
<td>H4ORWJRML</td>
<td>CLOSE</td>
<td>BP</td>
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<tr>
<td>10-4763</td>
<td>East Branch Lake - Repair #1 Gate Stem &amp; ...</td>
<td>11/09/2009 8:58:46:PM</td>
<td>H4NEDG</td>
<td>PEWARS</td>
<td>CLOSE</td>
<td></td>
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<tr>
<td>H4LS09-1839</td>
<td>Cable reels</td>
<td>08/23/2009 12:26:18:PM</td>
<td>H4SLDC</td>
<td>PEWARS-ME</td>
<td>CLOSE</td>
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<tr>
<td>11-1322</td>
<td>LA 9 ELECTRIC HYDRAULIC PUMPS</td>
<td>06/16/2009 1:57:17:PM</td>
<td>H4L9XC</td>
<td>PEWARS-MA</td>
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<td>11-1319</td>
<td>LA 9 DEWATER LOCK CHAMBER/REPAIR/...</td>
<td>06/15/2009 5:54:41:PM</td>
<td>H4L9L01S</td>
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<tr>
<td>11-1318</td>
<td>LK7 RENOVATE DS GATE GATE MACHINE</td>
<td>06/15/2009 5:33:38:PM</td>
<td>H4L7L01GS</td>
<td>PEWARS-MA</td>
<td></td>
<td></td>
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</table>
**Work Order: Replacement Nut End Tension Bar**
Copy Paste Example of Work Detail in Work Order

Replacement nut end Tension Bar

CELRP-EC-NC 2 April 2010

MEMORANDUM FOR: Files

SUBJECT: Emsworth L/D, Ohio River ' Repair Diagonal (Tension Bar) on DSLW Gate

1. An emergency inspection was conducted on the DSLW gate at Emsworth on 12 March 2010. The downstream diagonal that runs from the top quoin end to the bottom middle end of the gate was broken. The break was just below the top nut on the diagonal. Steve Stoltz, Bob Burstynowicz, Jim Williams and Bob McGreavey inspected the break. The chamber was closed until the inspection could determine if the gate could be used for operation.

2. A decision was made to continue using the gate until the Repair Party could replace the broken end of the diagonal. The lock personnel were instructed to open and close the gate as slow as possible to avoid flexing the gate when swinging in the water.

3. The Repair Party replaced the top 9-1/2 feet of the diagonal during two 8-hour shutdowns on 30-31 March 2010. The nut on top of the diagonal was tightened with a crane using a wrench. The old section that was removed where the break occurred will be tested to determine if the material meets the specifications on the drawings (ASTM A592 Grade F). The labor and plant used are listed below:

Labor:
Jack Kinneman
Ron Heise
Graph Showing All Repair Party Work Orders by Location
Current Efforts

- QA/QC – Job Plans, Preventive Maintenance Plans, Work Orders that are in FEM
- Fleet and Repair Station: Review/Build Asset Hierarchy, Job and Preventive Maintenance Plans
- Process for Inspections
- Build relationship between OCA and FEM
Make FEM work for U
Questions?

- National FEM Support SharePoint Website -
  Status of FEM database
  Library of FEM Manuals
  Links to FEM Production (Internet and Citrix) and Training Database (Citrix)

- LRD FEM SharePoint Website –
  LRD FEM PgMP, updates, links.