Predictive Maintenance for Movable Bridges
May, 2008

Stutson Street Bridge
2005 AISC National Award Winner
GOALS

- Guide to Bridge Preservation
- Maintaining Operational Reliability
- Maximize Returns on Capital Program Expenditures
What is Predictive Maintenance?

Three Approaches to Maintenance:

- **Reactive:** Fix it when it breaks (100%)*
- **Preventative:** Fix it before it breaks (regardless of condition) (27%)
- **Predictive:** Monitor wear and Fix it just before it breaks (15%)

* Cost Basis – Reliability Centered Maintenance
How Does Predictive Maintenance Work?

1) Establish Criteria for Acceptable Risk
2) Identify the critical components in the system which cause a negative outcome if they fail
3) Measure the condition of the critical components (utilize NBIS Inspection Program data)
4) Establish repair points for critical components
5) Monitor condition
6) Execute maintenance repairs (routinely)
Acceptable Risk?

What Is Acceptable?

- Is a 1 hour Highway outage acceptable?
- Is a 1 day Highway outage acceptable?
- Is a 1 week Highway outage acceptable?
- What is the likelihood of USCG fines?

Is public safety impacted by bridge component failure?

Is DOT staff safety impacted by bridge component failure?

What is the financial impact of unplanned repairs?
Identify Critical Components

- Define the critical components
  - Limit switches, gears, bearings, gates etc.
- Perform a field survey

Poor Limit Switch Mounting

Wedge Drive Mechanical Failure
Establish Existing Condition

- Perform a field survey to establish existing condition
- Identify appropriate method of inspection
- Review Bridge inspection program requirements
- Develop supplemental inspection requirements as required (special forms)
- Develop a database for each structure
Establish Repair points

**Mechanical**

*Bearing clearance, gear tooth backlash, lubricant condition, etc.*

**Electrical**

*Dranetz power survey of drive system, insulation resistance readings (various points in the system)*

**Structural**

*Impacts on drive systems (joints)*

**Safety Systems**

*Gates, interlocks, etc.*
Points of Repair

*Bearing Life is a function of measured shaft vibration and/or bearing clearance.*

Rotating Equipment Failures Due To:
- Alignment
- Over Lubrication
- Improper Lubrication
Points of Repair

Electrical Insulation Failure

- Heat
- Moisture

Life

Temperature Rise

40 Yr. Life

Nominal 10°C 20°C 30°C 40°C
Monitor Condition

- Obtain Field inspection data – Update database
- Calculate remaining life for each critical component
- Update life calculations based upon experience by structure.
Convert Data to Maintenance Actions

- Prepare maintenance directives based upon data
- Monitor maintenance performance (spot checks)
- Update maintenance record for each structure (actions and costs)
Annual Report Card

- Review of each structure
- Condition assessment
- Maintenance actions and costs
- System Accountability
Discussions