Learning Objective

**Action:** Brings together the ideas of what to inspection, how often, and what inspection type to perform.

**Condition:** In a classroom, on-line webinar or in a recorded video format, using information presented in briefing slides and references provided.

**Standard:** The participants will -

- Understand the Knowledge-based condition survey inspection (KBCSI) [a.k.a. Knowledge-based Inspection (KBI)] concept
- Understand why the component – section condition affects condition survey inspection needs
- Understand the five (5) condition zones and how the various condition survey inspection objectives are related to zone
- Match the most appropriate condition survey inspection type to zone
- Set the variables for creating a KBI plan
- Create a KBI plan
References

- BUILDER Support: BuilderSupport@usace.army.mil
KBI – Why?

Concept
• Every building component does not need the same level of inspection scrutiny.

Reality
• Resources (personnel, time, and money) associated with inspections are limited.

Goal
• Maximize the utility per dollar spent on the inspections.
KBI Approach

• Understand the objectives for performing an inspection
• Tailor inspection detail and frequency to target these objectives
• Use the facility knowledge-base of information in BUILDER along with business rule logic to determine:
  • What components to inspect
  • When to inspect those components
  • What type of inspection to perform
Inspection Objectives

- Identify impending failure of components.
- Determine condition of components.
- Determine condition of overall building or systems.
- Establish a condition history for deterioration trends and life cycle calibration.
- Estimate remaining service life for components.
- Determine work candidates for repair or replacement.
- Refine the scope, quantity, and detailed cost for work.
- Perform post-work quality assessments.
Inspection Approaches

• Inspection Types:
  • Direct Rating
  • Distress Survey
  • More Detailed

• Inspection Frequencies:
  • Quarterly
  • Annually
  • 2-5 years
Specific Component-Section Maintenance Life and Service Life are a Function of Condition and Standards.
Component – Section Sustainment and Restoration Needs vs. Condition

*Except PM and E/S Calls
Inspection Type for Specific Condition Zones

- **Zone 1**: Direct Rating w/Sampling*
- **Zone 2**: Distress Survey w/Sampling*
- **Zone 3**: Distress Survey w/Distress Quantity for Entire Section
- **Zone 4**: Direct Rating w/Sampling*
- **Zone 5**: No Inspection

**Condition Index (CSCI)**
Condition Zones

**Zone 1 - Preventive Maintenance (PM) Sustainment Zone**

- Little, if any, corrective work needed
- Periodic Direct Ratings are suffice to check-up and make sure components are not deteriorating faster than expected

**Zone 2 - Corrective Maintenance (CM) Approach Zone**

- Corrective maintenance usually is still not required
- However, an increased focus on preventative maintenance may be needed
- Component is approaching repair optimum point (if repair is applicable)
- Increased planning and awareness may be needed as repair optimum point (sweet spot) draws near
Zone 3 – Corrective Maintenance (CM) Zone

• Zone defined by the repair optimum point, “Sweet Spot”
• Begins one year prior to “Sweet Spot” year
• Zone extends beyond “Sweet Spot” because needs will likely exceed funding in a given year and often work is deferred
• 100% of component – section should be inspected to determine quantity and scope of repair
• However, inspection may be skipped in lieu of a “Just-in-time (JIT)” detailed deficiency field survey (if important and funding is assured). Note: JIT job plan field surveys are not part of BUILDER.
Condition Zones (con’t)

Zone 4 – Missed Opportunity Zone

• Replacement (or major rehab/reconstruction) generally is the most economical option
• This may be due to deferred repair beyond optimum point, or components where repairs are not applicable
• Inspections needed to identify pre-failure condition of components
• Used to refine timing for replacement

Zone 5 – Failed Zone

• Replacement (or major rehab/reconstruction) only viable option
• Condition surveys no longer needed, component has already been identified as failed
Exceptions

Exceptions exist that may warrant a different condition survey strategy for a given component – section:

• Non-maintainable
  • Do not maintain/repair
  • Replace when needed
• Two cases:
  1. Run-to-failure with minimal service disruption
     • Low risk case
     • No condition surveys needed
  2. Replace prior to failure
     • High risk case
     • Perform a condition survey at some point prior to end of service life
     • Additional condition surveys may be scheduled to mitigate disruption risk
Exceptions

• Catastrophic Event
  • Event may affect life – cycle in an unpredictable way
  • Often, some type of a condition survey is needed
• Computerized Maintenance Management System (CMMS) Trend Analysis
  • Service call analysis may flag a problem
  • Condition survey may be needed to verify component – section condition
• Rapid Deterioration Rate or Short Service Life
  • Zones 1 and 2 may be compressed and combined with Zone 3
  • “Sweet Spot” rapidly approaching
Knowledge – based Inspection Planning

- Brings together the ideas of what to inspect, how often, and what inspection type to use.
- Risk – based philosophy
- Consider:
  - Building importance
  - Component – section importance
  - Service life
  - Remaining service life
  - Maintenance life
  - Remaining maintenance life
  - Rate of deterioration
  - Condition zone
  - Condition standards and policies
  - Max interval between inspections
- BUILDER 3 incorporates these into a patented inspection planning process.
Setting Plan Variables

Variables are set within “Standards and Policies”

For a given named standard, go to the “Inspection Triggers” tab to set condition variables.

The creation of condition standards and policies was addressed in a previous lesson.
Setting Plan Variables (con’t)

- Sets the condition index lower boundaries for each zone.

- Sets the maximum time between inspections for each zone.

- For each zone, establishes the number of inspections to target and schedule.

- A re-inspection factor, if a past inspection finds deterioration is more than expected, this will trigger a re-inspection to confirm condition state and degradation trends.
Policies are used to determine which set of inspection standards to apply to the inventory.

<table>
<thead>
<tr>
<th>Facility Mission Dependency Index (MDI)</th>
<th>Component Importance Index</th>
<th>Standard</th>
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</thead>
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<tr>
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<td>Suggested (EXMPL)</td>
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<td>Default (EXMPL)</td>
</tr>
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</table>
Generating a Knowledge – based Inspection Plan

Click on “Inspection Schedule”

Click on “Generate” to create a new plan. Note: Any existing plan will be overwritten.

Plan can be exported to “Excel”
# Knowledge – based Inspection Plan

## Knowledge-Based Inspection Scheduling (TM)

### Knowledge-Based Inspection (TM) Schedule for IL - Illinois Site for 2013

<table>
<thead>
<tr>
<th>Building Name</th>
<th>System Name</th>
<th>Component Name</th>
<th>Section Name</th>
<th>Inspection Type</th>
<th>Inspection Reason</th>
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</thead>
<tbody>
<tr>
<td>703 LAB, PME</td>
<td>D50 ELECTRICAL</td>
<td>D5020 LIGHTING &amp; BRANCH WIRING</td>
<td>D502001 BRANCH WIRING General</td>
<td>Distress Survey with Quantity</td>
<td>Interval Exceeded</td>
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<tr>
<td>5M NK SHP ACFT GEN PUMP</td>
<td>D10 HVAC</td>
<td>D1000 ELECTRICAL &amp; BRANCH WIRING</td>
<td>D100001 BRANCH WIRING General</td>
<td>Distress Survey with Quantity</td>
<td>Interval Exceeded</td>
</tr>
<tr>
<td>5N SPI SHP ACFT GEN PUMP</td>
<td>C10 INTERIOR FINISHES</td>
<td>C1000 FLOOR FINISHES</td>
<td>1FL C1000 FLOOR TIPPIGS AND TRAFFIC MEMBRANES Paint</td>
<td>Distress Survey</td>
<td>Inspections Required</td>
</tr>
<tr>
<td>203 PRISMP &amp; EQUIP BSE</td>
<td>B30 SUPERSTRUCTURE</td>
<td>B3000 FLOOR CONSTRUCTION</td>
<td>2FL B30001 STRUCTURAL FRAME Beam/Grider - Metal</td>
<td>Direct Rating</td>
<td>Inspections Required</td>
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<tr>
<td>341 DH ANNIVDT</td>
<td>D20 PLUMBING</td>
<td>D2000 Sanitary Waste</td>
<td>D200003 FLOOR DRAINS General</td>
<td>Distress Survey with Quantity</td>
<td>Inspections Required</td>
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<tr>
<td>550 H/SHIP, AUTOMOTIVE</td>
<td>D20 PLUMBING</td>
<td>D2000 PLUMBING FIXTURES</td>
<td>D200003 PLUMBING Fixtures General</td>
<td>Distress Survey with Quantity</td>
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<tr>
<td>881 YOUTH CEN</td>
<td>D40 FIRE PROTECTION</td>
<td>D4020 FIRE PROTECTION</td>
<td>D402001 FIRE PROTECTION</td>
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<td>161 TIRE, CONT</td>
<td>B30 SUPERSTRUCTURE</td>
<td>B3000 FLOOR CONSTRUCTION</td>
<td>6FL B30001 STRUCTURAL FRAME Beam/Grider - Metal</td>
<td>Direct Rating</td>
<td>Inspections Required</td>
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<td>235 HQ GROUP</td>
<td>D30 HVAC</td>
<td>D3040 DISTRIBUTION SYSTEMS</td>
<td>D304001 DISTRIBUTION SYSTEM</td>
<td>Distress Survey</td>
<td>Inspections Required</td>
</tr>
<tr>
<td>100 ELEC PWR STN BLDG</td>
<td>D10 HVAC</td>
<td>D1000 TERMINAL &amp; PACKAGE UNITS</td>
<td>D100001 PACKAGE UNITS A/C Unit, Computer Room - Air Cool, 8 ton</td>
<td>Distress Survey</td>
<td>Inspections Required</td>
</tr>
</tbody>
</table>
Knowledge – based Inspection Plan

Inspection Type Summary

Knowledge Based Inspection (TM) Schedule for IL - Illinois Site for 2013

- Distress Survey with Quantity: 413 (47%)
- Distress Survey: 351 (40%)
- Direct Rating: 124 (14%)
Key Points to Remember

- KBI identifies the detail and frequency of inspections for component-sections.
- Condition, building/system importance, and other attributes are used for the inspection plan.
- Attribute variables are set via “Standards and Policies.”
- Condition survey planning and M&R planning go hand-in-hand.
- It is a recommended plan to START the inspection scheduling process.
- May also want to consider grouping inspections together.
- The KBI approach improves inspection value.
QUESTIONS