PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

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PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

INTRODUCTION

The proper assessment of the condition of bridge elements is the cornerstone of sound bridge management. Bridge owners nationwide have recognized the benefits of detailed condition assessments through the use of the raw inspection information, expanded performance measures, and bridge management system deterioration forecasting and evaluation.

The goal of the movable bridge element descriptions found herein is to capture the condition of movable bridges in a simple, effective way that can be standardized across the nation while providing the flexibility to be adapted to both large- and small-agency settings. Note that these movable bridge element descriptions are meant to supplement and be used in conjunction with, not redundant to, the previously defined structural elements found in the AASHTO *Manual for Bridge Element Inspection* (MBEI), First Edition, 2013 for fixed (non-movable) bridges.

The movable bridge element descriptions found herein are the first attempt at creating a nationwide standard for the collection of movable bridge element information and designated Bridge Management Elements (BMEs). Prior to drafting these definitions in 2015, several states (including Louisiana, Florida, Maryland, and Washington) had previously drafted various Agency Developed Elements (ADEs) for movable bridge equipment. Agencies are encouraged to continue using or drafting ADEs, as necessary, according to the particular needs of their movable bridge inventory, geography-specific risks (coastal storm, storm surge, seismic, etc.), and bridge management practices.

The inspector should use judgment when assigning element ratings. It is not necessary for the worst (lowest) rated defect to control the full element rating. Also, it is possible for the defect quality to be greater than the element quality. In other words, multiple defects are allowed for each element.

Note that there is some redundancy within the movable bridge elements with regards to discipline (Structural, Mechanical, Electrical) and components (Counterweight, Motor, etc.). This redundancy is unavoidable and in fact desirable due to the multi-disciplinary and complex nature of movable bridges. For example, it is beneficial for both mechanical and electrical inspectors to inspect a motor or a limit switch. It is also beneficial for both structural and mechanical inspectors to inspect a trunnion bearing assemblies, and so on. Inspectors from different disciplines will tend to focus on different aspects of the same component.

These movable bridge element descriptions are not intended to supplant proper movable bridge and element inspection training or the exercise of engineering judgment by the inspector or professional engineer. Reference Chapter 1.3 for Movable Bridge Types.

The following Movable Bridge Bridge Management Elements (BMEs) are included in Part 3:

600 – Movable Bridge Support System Structural, 601 – Movable Bridge Support System Mechanical, 602 – Movable Bridge Balance System Structural, 603 – Movable Bridge Balance System Mechanical, 604 – Movable Bridge Drive System – Mechanical, 605 – Movable Bridge Drive System – Electrical, 606 – Movable Bridge Control System – Mechanical, 607 – Movable Bridge Control System – Electrical, 608 – Movable Bridge Interlocking System – Mechanical, 609 – Movable Bridge Interlocking System – Electrical, 610 – Pier Protection, 611 – Movable Bridge Navigation Guidance System – Electrical, 612 – Movable Bridge Electrical Power System – Electrical, 613 – Movable Bridge Traffic Control System – Mechanical, 614 – Movable Bridge Traffic Control System – Electrical, and 615 – Movable Bridge House.

NOTE: Elements with number "6XX" and defects with number "9XXX" indicate new items that are proposed for review by the Subcommittee on Bridges and Structures technical committee T-18 Bridge Management, Evaluation, and Rehabilitation.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.1 – MOVABLE BRIDGE SUPPORT SYSTEM – STRUCTURAL

Element 600 – Movable Bridge Support System – Structural

Description: Structural facets of the system providing span support in the open, operating, and/or closed positions, excluding elements **previously** defined by the AASHTO Manual for Bridge Element Inspection, First Edition, 2013 for fixed (non-movable) bridges.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of independent support systems for the entire bridge. For example, a single-leaf bascule would have a quantity of one; a double-leaf bascule would have a quantity of two.

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Freckled rust. Corrosion of the steel has initiated.	Section loss is evident or pack rust is present but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (Steel) (1010)	None.	Crack that has self-arrested or has been arrested with effective arrest holes, doubling plates, or similar.	Identified crack that is not arrested but does not warrant structural review.	
Connection (1020)	Connection is in place and functioning as intended.	Loose fasteners or pack rust without distortion is present but the connection is in place and functioning as intended.	Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion but does not warrant a structural review.	
Exposed Rebar (1090)	None.	Present without measurable section loss.	Present with measurable section loss but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Efflorescence/Rust Staining (1120)	None.	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (RC and Other) (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion/Wear (PSC/RC) (1190)	No abrasion or wearing.	Abrasion or wearing has exposed coarse aggregate but the aggregate remains secure in the concrete.	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
Delamination/Spall/Patched Area (1080)	None.	Delaminated. Spall 1 in. or less deep or 6 in. or less in diameter.	Patched area that is sound. Spall greater than 1 in. deep or greater than 6 in. diameter. Patched area that is unsound or showing distress. Does not warrant structural review.	
Distortion (1900)	None.	Distortion not requiring mitigation or mitigated distortion.	Distortion that requires mitigation that has not been addressed but does not warrant structural review.	

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Settlement (4000)	None.	Exists within tolerable limits or arrested with no observed structural distress.	Exceeds tolerable limits but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Scour (6000)	None.	Exists within tolerable limits or has been arrested with effective countermeasures.	Exceeds tolerable limits but is less than the critical limits determined by scour evaluation and does not warrant structural review.	
Damage (7000)	Not applicable.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

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Element 600 Commentary

The element Movable Bridge Support System – Structural includes the structural facets of the system providing span support in the open, operating, and/or closed positions, excluding elements previously defined by the AASHTO *Manual for Bridge Element Inspection*, First Edition, 2013. Typical structural components include:

- Trunnion and bearing assemblies
- Trunnion bearing supports
- Counterweight linkage members
- Live load shoes
- Rolling track girders
- Segmental girders
- Track and tread plates
- Shear or moment lock assemblies,
- Lift-span towers
- Lift span wire ropes and anchorages
- Swing bridge end lifts
- Center wedges.

Inspection and safety covers should be removed during routine inspections. Disassembly of components and measurements should be performed during in-depth inspections.

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CHAPTER 3.2 – MOVABLE BRIDGE SUPPORT SYSTEM – MECHANICAL

Element 601 – Movable Bridge Support System – Mechanical

Description: Mechanical facets of the system providing span support in the open, operating, and/or closed positions.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of independent support systems for the entire bridge. For example, a single-leaf bascule would have a quantity of one; a double-leaf bascule would have a quantity of two.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Movable span support systems operate smoothly. Major mechanical elements are properly adjusted.	Movable span support systems operate with minor flaws, such as light vibration or noise. Equipment may be slightly out of adjustment. Filters or breathers may require replacement. None of the major mechanical elements require remedial action.	Movable span support systems operate with significant flaws, including vibration, noise, or undesirable heating. Auxiliary operating systems may be nonfunctional. Equipment out of adjustment. Filters or breathers may be missing. Major mechanical elements may require short term replacement or adjustment.	Movable span support systems do not operate or operate in an erratic or uncontrolled manner. Various pieces of equipment may be significantly out of adjustment or nonfunctional. Required pieces of equipment may be missing. Major mechanical elements may require immediate replacement.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Lubrication (9001)	Lubricants are fresh, clean, and well-distributed. Oil levels are appropriate.	Lubricants exhibit minor contamination. Oil levels slightly low. Minor lubricant leaks may exist. Application of grease is excessive or barely adequate on major mechanical elements.	Lubricants exhibit moderate contamination. Oil levels low. Moderate lubricant leaks may exist. Application of grease is spotty and inadequate in places on major mechanical elements.	Lubricants exhibit heavy contamination. Oil levels extremely low. Heavy lubricant leaks may exist. Application of grease is inadequate in many places on major mechanical elements.
Wear (Machinery) (9002)	None.	Light wear present. Clearances related to major mechanical elements are within operational limits. No remedial action required.	Moderate wear present. Clearances related to major mechanical elements are near operational limits. Short-term replacement of components may be required.	Heavy wear present. Clearances related to major mechanical elements exceed operational limits. Immediate replacement of components may be required.
Damage (7000)	None.	Minor damage noted such as pitting or scoring. Hoses may exhibit light abrasion. None of the major mechanical elements require remedial action.	Moderate damage such as pitting and scoring with plastic flow. Hoses may exhibit moderate abrasion. Major mechanical elements may require short term replacement or adjustment.	Heavy damage present. Components may be cracked or broken. Overstress of components occurring. Hoses may exhibit heavy abrasion. Major mechanical elements may require immediate replacement.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Alignment (Mechanical) (9003)	Components are aligned within manufacturer's recommended operational tolerances or code requirements. Components exhibit proper contact.	Certain components slightly outside of manufacturers recommended operational tolerances or code requirements. No operational issues noted. None of the major mechanical elements require realignment.	Components outside of manufacturers recommended operational tolerances or code requirements. Some shaft or coupling movement noted during operation. Components may exhibit improper contact. Major mechanical elements may require realignment.	Components well outside of manufacturers recommended operational tolerances or code requirements. Significant shaft or coupling movement noted during operation. Unusual noises noted during operation. Overstress of components occurring. Components may exhibit extremely poor contact. Immediate replacement or realignment of major mechanical elements may be required.
Corrosion (1000)	None.	Minor paint system failure and light corrosion present. None of the major mechanical elements require remedial action.	Spotty paint system failure and moderate corrosion present. Major mechanical elements may require short term replacement.	Extensive paint system failure and heavy corrosion present. Immediate replacement of major mechanical elements may be required.
Connections (1020)	Fasteners and keys are intact, tight, and without corrosion.	Fasteners or keys exhibit minor corrosion. Some fasteners related to major mechanical elements may be loose. No missing fasteners.	Fasteners or keys exhibit moderate corrosion. Fasteners or keys are loose. Some fasteners or keys related to major mechanical elements may be missing. Short-term repair of major mechanical elements may be required.	Fasteners or keys exhibit heavy corrosion. Many Fasteners or keys are loose. Fasteners or keys related to major mechanical elements are missing. Immediate repair of major mechanical elements may be required.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Housekeeping (9004)	The machinery access areas are clean, sanitary, and free of debris and trip or fall hazards. Machinery guards are intact.	The machinery access areas are generally safe, but may have minor debris or inconvenient access. There may be minor mechanical issues related to weather exposure.	The machinery access areas have safety issues. Machinery guards may be out of place. There may be significant issues related to weather exposure. Short term repairs may be required.	The machinery access areas have significant safety issues such as: unsanitary waste, excessive guano, debris, or missing machinery guards. Alternatively, there are unsafe trip or fall hazards or machinery is inadequately protected from weather. Immediate repair may be required.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 601 Commentary

The element Movable Bridge Support System – Mechanical includes the mechanical facets of the system providing span support in the open, operating, and/or closed positions. Example components include:

- Trunnion and bearing assemblies
- Counterweight linkage bearing assemblies
- Live load shoes
- Track and tread plates
- Shear or moment lock assemblies
- Swing bridge end lifts
- Swing bridge center wedges.

Inspection and safety covers should be removed during routine inspections. Disassembly of components and measurements should be performed during in-depth inspections.

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CHAPTER 3.3 – MOVABLE BRIDGE BALANCE SYSTEM – STRUCTURAL

Element 602 – Movable Bridge Balance System – Structural

Description: Structural facets of the system providing stability during motion and/or balancing the movable span deadload with counterweights.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main balance systems for the entire bridge.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Freckled rust. Corrosion of the steel has initiated.	Section loss is evident or pack rust is present but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (Steel) (1010)	None.	Crack that has self-arrested or has been arrested with effective arrest holes, doubling plates, or similar.	Identified crack that is not arrested but does not warrant structural review.	
Connection (1020)	Connection is in place and functioning as intended.	Loose fasteners or pack rust without distortion is present but the connection is in place and functioning as intended.	Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion but does not warrant a structural review.	
Exposed Rebar (1090)	None.	Present without measurable section loss.	Present with measurable section loss but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Efflorescence/Rust Staining (1120)	None.	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (RC and Other) (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion/Wear (PSC/RC) (1190)	No abrasion or wearing.	Abrasion or wearing has exposed coarse aggregate but the aggregate remains secure in the concrete.	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
Delamination/Spall/Patched Area (1080)	None.	Delaminated. Spall 1 in. or less deep or 6 in. or less in diameter.	Patched Area Patched area that is sound. Spall greater than 1 in. deep or greater than 6 in. diameter. Patched area that is unsound or showing distress. Does not warrant structural review.	
Distortion (1900)	None.	Distortion not requiring mitigation or mitigated distortion.	Distortion that requires mitigation that has not been addressed but does not warrant structural review.	

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Settlement (4000)	None.	Exists within tolerable limits or arrested with no observed structural distress.	Exceeds tolerable limits but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Damage (7000)	Not applicable.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

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Element 602 Commentary

The element Movable Bridge Balance System – Structural includes the structural facets of the system providing stability during motion and/or balancing the movable span dead load with counterweights. Example components include:

- Counterweights
- Support members which prevent swing-spans from tipping and reduce machinery loads on lift-spans and bascules

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.4 – MOVABLE BRIDGE BALANCE SYSTEM – MECHANICAL

Element 603 – Movable Bridge Balance System – Mechanical

Description: Mechanical facets of the system providing stability during span motion and/or balancing the movable span dead load with counterweights.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main balance systems for the entire bridge. For example, a single-leaf bascule would have a quantity of one; a double-leaf bascule would have a quantity of two.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Movable span balance systems operate smoothly. Major mechanical elements are properly adjusted.	Movable span balance systems operate with minor flaws, such as light vibration or noise. Equipment may be slightly out of adjustment. None of the major mechanical elements require remedial action.	Movable span balance systems operate with significant flaws, including vibration, noise, or undesirable heating. Equipment out of adjustment. Major mechanical elements may require short term replacement or adjustment.	Movable span support systems do not operate or operate in an erratic or uncontrolled manner. Various pieces of equipment may be significantly out of adjustment or nonfunctional. Required pieces of equipment may be missing. Major mechanical elements may require immediate replacement.
Lubrication (9001)	Lubricants are fresh, clean, and well-distributed.	Lubricants exhibit minor contamination. Application of grease is excessive or barely adequate on major mechanical elements.	Lubricants exhibit moderate contamination. Application of grease is spotty and inadequate in places on major mechanical elements.	Lubricants exhibit heavy contamination. Application of grease is inadequate in many places on major mechanical elements.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Wear (Machinery) (9002)	None.	Light wear present. Clearances related to major mechanical elements are within operational limits. No remedial action required.	Moderate wear present. Clearances related to major mechanical elements are near operational limits. Short-term replacement of components may be required.	Heavy wear present. Clearances related to major mechanical elements exceed operational limits. Immediate replacement of components may be required.
Damage (7000)	None.	Minor damage noted such as pitting or scoring. None of the major mechanical elements require remedial action.	Moderate damage such as pitting and scoring with plastic flow. Major mechanical elements may require short term replacement or adjustment.	Heavy damage present. Components may be cracked or broken. Overstress of components occurring. Major mechanical elements may require immediate replacement.
Alignment (Machinery) (9003)	Components are aligned within manufacturer's recommended operational tolerances or code requirements. Components exhibit proper contact.	Certain components slightly outside of manufacturers recommended operational tolerances or code requirements. No operational issues noted. None of the major mechanical elements require realignment.	Components outside of manufacturers recommended operational tolerances or code requirements. Components may exhibit improper contact. Major mechanical elements may require realignment.	Components well outside of manufacturers recommended operational tolerances or code requirements. Unusual noises noted during operation. Overstress of components occurring. Components may exhibit extremely poor contact. Immediate replacement or realignment of major mechanical elements may be required.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Minor paint system failure and light corrosion present. None of the major mechanical elements require remedial action.	Spotty paint system failure and moderate corrosion present. Major mechanical elements may require short term replacement.	Extensive paint system failure and heavy corrosion present. Immediate replacement of major mechanical elements may be required.
Connections (1020)	Fasteners and keys are intact, tight, and without corrosion.	Fasteners or keys exhibit minor corrosion. Some fasteners related to major mechanical elements may be loose. No missing fasteners.	Fasteners or keys exhibit moderate corrosion. Fasteners or keys are loose. Some fasteners or keys related to major mechanical elements may be missing. Short-term repair of major mechanical elements may be required.	Fasteners or keys exhibit heavy corrosion. Many Fasteners or keys are loose. Fasteners or keys related to major mechanical elements are missing. Immediate repair of major mechanical elements may be required.
Housekeeping (9004)	The machinery access areas are clean, sanitary, and free of debris and trip or fall hazards. Machinery guards are intact.	The machinery access areas are generally safe, but may have minor debris or inconvenient access. There may be minor mechanical issues related to weather exposure.	The machinery access areas have safety issues. Machinery guards may be out of place. There may be significant issues related to weather exposure. Short term repairs may be required.	The machinery access areas have significant safety issues such as: unsanitary waste, excessive guano, debris, or missing machinery guards. Alternatively, there are unsafe trip or fall hazards or machinery is inadequately protected from weather. Immediate repair may be required.

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Element 603 Commentary

The element Movable Bridge Balance System – Mechanical consists of those components that provide stability during motion and/or balancing the movable span dead load with counterweights. Example components include:

- Balance wheel assemblies and tracks
- Lift bridge balance chains or auxiliary counterweights
- Span guide assemblies
- Rails

Inspection and safety covers should be removed during routine inspections. Disassembly of components and measurements should be performed during in-depth inspections.

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CHAPTER 3.5 – MOVABLE BRIDGE DRIVE SYSTEM – MECHANICAL

Element 604 – Movable Bridge Drive System – Mechanical

Description: The mechanical components which provide or arrest motion of the span.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main drive systems for the entire bridge. For example, a single-leaf bascule would have a quantity of one; a double-leaf bascule would have a quantity of two.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Movable span operates smoothly. Major mechanical elements are properly adjusted.	Movable span operates with minor flaws, such as light vibration or noise. Equipment may be slightly out of adjustment. Filters or breathers may require replacement. None of the major mechanical elements require remedial action.	Movable span operates with significant flaws, including vibration, noise, or undesirable heating. Auxiliary operating systems may be nonfunctional. Equipment out of adjustment. Filters or breathers may be missing. Major mechanical elements may require short term replacement or adjustment.	Movable span does not operate or operates in an erratic or uncontrolled manner. Various pieces of equipment may be significantly out of adjustment or nonfunctional. Required pieces of equipment may be missing. Major mechanical elements may require immediate replacement.
Lubrication (9001)	Lubricants are fresh, clean, and well-distributed. Oil levels are appropriate.	Lubricants exhibit minor contamination. Oil levels slightly low. Minor lubricant leaks may exist. Application of grease is excessive or barely adequate on major mechanical elements.	Lubricants exhibit moderate contamination. Oil levels low. Moderate lubricant leaks may exist. Application of grease is spotty and inadequate in places on major mechanical elements.	Lubricants exhibit heavy contamination. Oil levels extremely low. Heavy lubricant leaks may exist. Application of grease is inadequate in many places on major mechanical elements.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Wear (Mechanical) (9002)	None.	Light wear present. Clearances related to major mechanical elements are within operational limits. No remedial action required.	Moderate wear present. Clearances related to major mechanical elements are near operational limits. Short-term replacement of components may be required.	Heavy wear present. Clearances related to major mechanical elements exceed operational limits. Immediate replacement of components may be required.
Damage (7000)	None.	Minor damage noted such as pitting or scoring. Hoses may exhibit light abrasion. None of the major mechanical elements require remedial action..	Moderate damage such as pitting and scoring with plastic flow. Hoses may exhibit moderate abrasion. Major mechanical elements may require short term replacement or adjustment.	Heavy damage present. Components may be cracked or broken. Overstress of components occurring. Hoses may exhibit heavy abrasion. Major mechanical elements may require immediate replacement.
Alignment (9003)	Components are aligned within manufacturer's recommended operational tolerances or code requirements. Components exhibit proper contact.	Certain components slightly outside of manufacturers recommended operational tolerances or code requirements. No operational issues noted. None of the major mechanical elements require realignment.	Components outside of manufacturers recommended operational tolerances or code requirements. Some shaft or coupling movement noted during operation. Components may exhibit improper contact. Major mechanical elements may require realignment.	Components well outside of manufacturers recommended operational tolerances or code requirements. Significant shaft or coupling movement noted during operation. Unusual noises noted during operation. Overstress of components occurring. Components may exhibit extremely poor contact. Immediate replacement or realignment of major mechanical elements may be required.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Minor paint system failure and light corrosion present. None of the major mechanical elements require remedial action.	Spotty paint system failure and moderate corrosion present. Major mechanical elements may require short term replacement.	Extensive paint system failure and heavy corrosion present. Immediate replacement of major mechanical elements may be required.
Connections (1020)	Fasteners and keys are intact, tight, and without corrosion.	Fasteners or keys exhibit minor corrosion. Some fasteners related to major mechanical elements may be loose. No missing fasteners.	Fasteners or keys exhibit moderate corrosion. Fasteners or keys are loose. Some fasteners or keys related to major mechanical elements may be missing. Short-term repair of major mechanical elements may be required.	Fasteners or keys exhibit heavy corrosion. Many Fasteners or keys are loose. Fasteners or keys related to major mechanical elements are missing. Immediate repair of major mechanical elements may be required.
Housekeeping (9004)	The machinery access areas are clean, sanitary, and free of debris and trip or fall hazards. Machinery guards are intact.	The machinery access areas are generally safe, but may have minor debris or inconvenient access. There may be minor mechanical issues related to weather exposure.	The machinery access areas have safety issues. Machinery guards may be out of place. There may be significant issues related to weather exposure. Short term repairs may be required.	The machinery access areas have significant safety issues such as: unsanitary waste, excessive guano, debris, or missing machinery guards. Alternatively, there are unsafe trip or fall hazards or machinery is inadequately protected from weather. Immediate repair may be required.

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Element 604 Commentary

The element Movable Bridge Drive System – Mechanical consists of those components which provide or arrest motion of the span. The drive system can be separated into subsystems, as follows:

- Power
    - Electric Motors
    - Hydraulic Pumps
    - Generators
    - Auxiliary Motor
    - Manual Drive
- Power Transmission
    - Shafts
    - Couplings
    - Bearings
    - Operating Wire Ropes
    - Chains
    - Differentials
    - Hydraulic Cylinder
    - Hydraulic Motor
    - Enclosed Gear Boxes
    - Open Gearing
- Brakes/Mechanical Deceleration
    - Motor Brakes
    - Machinery Brake Buffer Cylinders

Inspection and safety covers should be removed during routine inspections. Disassembly of components and measurements should be performed during in-depth inspections.

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CHAPTER 3.6 – MOVABLE BRIDGE DRIVE SYSTEM – ELECTRICAL

Element 605 – Movable Bridge Drive System – Electrical

Description: The electrical components which provide or arrest motion to the span.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of span drive systems for the entire bridge. For example, a single-leaf bascule would typically have a quantity of one; a double-leaf bascule would have a quantity of two.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Bridge electrical drive system operates normally.	Bridge electrical drive system functions adequately with minor indications of issues such as slight motor overloading, speed or torque inconsistencies, or speed variation timing – items not requiring immediate repair or adjustment.	Bridge electrical drive system operating abnormally, either drawing very high current, overheating, operating too fast or too slowly, not changing speeds at appropriate times, or intermittently stopping.	Bridge electrical drive system is not functioning or functioning in such a way to cause severe overheating, tripping of overload devices, or potentially create a hazardous condition by either going too fast or not slowing down under consistent and reliable control.

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Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Accessibility and Labeling (9005)	All covers to electrical enclosures are properly secured in place. Arc fault labeling and working clearances conform to NFPA-70 (NEC) requirements. Electrical equipment and wiring identification labels are in place and legible.	All covers to electrical enclosures are in place, though some fasteners are missing. Not all arc fault labeling is in place. Some working clearances do not conform to NEC requirements. Some equipment or wiring identification labeling is either missing or is not legible.	All covers to electrical enclosures are in place, but many fasteners are missing. Few arc fault labels are in place. Many working clearances do not conform to NEC requirements. Many equipment or wiring identification labels are either missing or are not legible.	One or more covers to electrical enclosures are not in place. There are no arc fault labels on any enclosures. Most working clearances do not conform to NEC requirements. Most equipment or wiring identification labels are either missing or are not legible.
Support and Electrical Terminations (9006)	All electrical equipment is properly supported and all terminations are properly made, are clean, and appear tight.	Some electrical equipment supporting fasteners are loose or missing, but there is no danger of the equipment mounting(s) failing. Some electrical terminations are not clean or have mild corrosion.	Several electrical equipment mounting fasteners are missing and equipment mounting could potentially fail. Some electrical terminations are improperly made, are loose, are dirty, or appear to be overheating.	Electrical equipment supports have failed and electrical equipment is hanging from conduits, wires, or other non-structural elements not designed to support the equipment. Many electrical terminations are improperly made, are loose, are very dirty, have severe corrosion, or appear to be severely overheating.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	No corrosion is present on electrical equipment.	Electric motors, enclosures, raceway, fasteners or clamps exhibit minor corrosion.	Electric motors, enclosures, raceway, fasteners or clamps exhibit moderate corrosion with minor section loss.	Electric motors, enclosures, raceway, fasteners or clamps exhibit heavy corrosion with section loss and a perceived danger of component failure.
Damage (7000)	Electrical components are not damaged.	Electrical components have minor damage that does not affect the intended operation or mounting security of the equipment.	Electrical components have moderate damage that affects the intended operation or mounting security of the equipment, but does not appear to pose an immediate safety concern or risk of system failure.	Electrical components have significant damage that affects the intended operation or mounting security of the equipment such that operating the equipment poses a risk of injury to personnel or further damage to the equipment or structure.
Wear (Electrical) (9002)	Electrical components are not worn and electrical conductor insulation and motor insulation resistance values exceed the minimum values recommended by NETA.	Electrical components exhibit minimal wear that does not affect the intended operation of the equipment. The electrical conductor and motor insulation resistance values measure at the minimum values recommended by NETA.	Electrical components exhibit moderate wear that appears to be beginning to affect the intended operation of the equipment without creating an immediately dangerous condition to the public, bridge personnel, or the bridge. The electrical conductor and motor insulation resistance values measure 50 percent below the minimum values recommended by NETA.	Electrical components exhibit excessive wear that seriously affects the intended operation of the equipment. The electrical conductor and motor insulation resistance values measure less than 50 percent below the minimum values recommended by NETA.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Functional Obsolescence (9008)	All electrical equipment is currently supported by the manufacturer and all replacement parts are readily available.	There are indications that some of the electrical equipment will soon be phased out by the manufacturer or the availability of parts may soon be a problem.	There are indications that some of the electrical equipment has been phased out by the manufacturer and the availability of parts has become a problem.	Most of the electrical equipment is not supported by the manufacturer and no parts are available.
Housekeeping (9004)	All electrical areas and equipment are clean and well organized.	Some of the electrical areas or equipment are dirty, unkempt, or disorganized. The levels of poor upkeep are not yet creating a serious hazard or potentially affecting the equipment's operation.	Many of the electrical areas or equipment are very disorganized or dirty. The levels of poor upkeep are beginning become a concern for fire or electrical shock hazards and may potentially affect the equipment's ability to dissipate heat or permit adequate servicing or inspection.	Most of the electrical areas or equipment are very disorganized or dirty. The levels of poor upkeep create fire or electrical shock hazards and likely affect the equipment's ability to dissipate heat. The electrical equipment cannot be properly accessed for servicing or inspection.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 605 Commentary

The element Movable Bridge Drive System – Electrical consists of the electrical components which provide or arrest motion of the span. Example components include:

- Electric motors
- Generators
- Auxiliary motors
- Motor brakes
- Machinery brakes

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.7 – MOVABLE BRIDGE CONTROL SYSTEM – MECHANICAL

Element 606 – Movable Bridge Control System – Mechanical

Description: The mechanical components that modify or control the power to move or arrest the span, or serve as the command interface between the human operator and the machine, allowing the operator to direct the bridge to open and close.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main control systems for the entire bridge. For example, both single-leaf and double-leaf bascules would typically have a quantity of one.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Movable span control system operates smoothly. Major mechanical elements are properly adjusted.	Movable span control system operates with minor flaws, such as light vibration or noise. Equipment may be slightly out of adjustment. Manual or hydraulic levers may be slightly difficult to move. None of the major mechanical elements require remedial action.	Movable span control system operates with significant flaws, including vibration, noise, or undesirable heating. Equipment out of adjustment. Manual or hydraulic levers may be very difficult to move. Major mechanical elements may require short term replacement or adjustment.	Movable span control system does not operate or operates in an erratic or uncontrolled manner. Various pieces of equipment may be significantly out of adjustment or nonfunctional. Required pieces of equipment may be missing. Major mechanical elements may require immediate replacement.
Lubrication (9001)	Lubricants are fresh, clean, and well-distributed.	Lubricants exhibit minor contamination. Application of grease is excessive or barely adequate on major mechanical elements.	Lubricants exhibit moderate contamination. Application of grease is spotty and inadequate in places on major mechanical elements.	Lubricants exhibit heavy contamination. Application of grease is inadequate in many places on major mechanical elements.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Wear (Mechanical) (9002)	None.	Light wear present. Clearances related to major mechanical elements are within operational limits. No remedial action required.	Moderate wear present. Clearances related to major mechanical elements are near operational limits. Short-term replacement of components may be required.	Heavy wear present. Clearances related to major mechanical elements exceed operational limits. Immediate replacement of components may be required.
Damage (7000)	None.	Minor damage noted such as pitting or scoring. Cables may exhibit light abrasion. None of the major mechanical elements require remedial action.	Moderate damage such as pitting and scoring with plastic flow. Cables may exhibit moderate abrasion. Major mechanical elements may require short term replacement or adjustment.	Heavy damage present. Components may be cracked or broken. Overstress of components occurring. Cables may exhibit heavy abrasion. Major mechanical elements may require immediate replacement.
Alignment (9003)	Components are aligned within manufacturer's recommended operational tolerances or code requirements. Components exhibit proper contact.	Certain components slightly outside of manufacturers recommended operational tolerances or code requirements. No operational issues noted. None of the major mechanical elements require realignment.	Components outside of manufacturers recommended operational tolerances or code requirements. Some shaft or coupling movement noted during operation. Components may exhibit improper contact. Major mechanical elements may require realignment.	Components well outside of manufacturers recommended operational tolerances or code requirements. Significant shaft or coupling movement noted during operation. Unusual noises noted during operation. Overstress of components occurring. Components may exhibit extremely poor contact. Immediate replacement or realignment of major mechanical elements may be required.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Minor paint system failure and light corrosion present. None of the major mechanical elements require remedial action.	Spotty paint system failure and moderate corrosion present. Major mechanical elements may require short term replacement.	Extensive paint system failure and heavy corrosion present. Immediate replacement of major mechanical elements may be required.
Connections (1020)	Fasteners and keys are intact, tight, and without corrosion.	Fasteners or keys exhibit minor corrosion. Some fasteners related to major mechanical elements may be loose. No missing fasteners.	Fasteners or keys exhibit moderate corrosion. Fasteners or keys are loose. Some fasteners or keys related to major mechanical elements may be missing. Short-term repair of major mechanical elements may be required.	Fasteners or keys exhibit heavy corrosion. Many Fasteners or keys are loose. Fasteners or keys related to major mechanical elements are missing. Immediate repair of major mechanical elements may be required.
Housekeeping (9004)	The machinery access areas are clean, sanitary, and free of debris and trip or fall hazards. Machinery guards are intact.	The machinery access areas are generally safe, but may have minor debris or inconvenient access. There may be minor mechanical issues related to weather exposure.	The machinery access areas have safety issues. Machinery guards may be out of place. There may be significant issues related to weather exposure. Short term repairs may be required.	The machinery access areas have significant safety issues such as: unsanitary waste, excessive guano, debris, or missing machinery guards. Alternatively, there are unsafe trip or fall hazards or machinery is inadequately protected from weather. Immediate repair may be required.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 606 Commentary

The element Movable Bridge Control System – Mechanical includes the mechanical components that modify or control the power to move or arrest the span, or serve as the command interface between the human operator and the machine, allowing the operator to direct the bridge to open and close. Example components include:

- Mechanical and hydraulic control levers
- Actuators
- Limit switches and supports
- Instrument drives, including:
    - Gearboxes
    - Shafts
    - Couplings
- Cables designed to govern the operation of the movable span

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.8 – MOVABLE BRIDGE CONTROL SYSTEM – ELECTRICAL

Element 607 – Movable Bridge Control System – Electrical

Description: The electrical components supplying, modifying, or controlling the electrical power to electric motors that move the span, or serve as the command interface between the human operator and the machine, allowing the operator to direct the bridge to open and close.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of control systems for the entire bridge. For example, both single-leaf and double-leaf bascule bridges would typically have a quantity of one.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Bridge electrical control system operates normally.	Bridge electrical control system functions adequately with minor issues such as minor indication inconsistencies—items not requiring immediate repair or adjustment.	Bridge electrical control system is operating abnormally, with some indicators not working or operating erratically; or some control switches operating inconsistently. Operation is repeatable and fundamentally stable.	Bridge electrical control system not functioning or functioning in such a way as to potentially create a hazard due to poor or inconsistent control.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Accessibility and Labeling (9005)	All bridge electrical control panels, operator interfaces, switches, indicators, and other electrical control elements are labeled as to the devices function or scale as appropriate. All electrical control elements can be accessed for use, inspection, and servicing without the need for special equipment or removal of clutter or debris.	Most bridge electrical control panels, switches, indicators, and other electrical control elements are labeled as to the devices function or scale as appropriate. Most electrical control elements can be accessed for use, inspection, and servicing without the need for special equipment or removal of clutter or debris.	Several bridge electrical control panels, switches, indicators, and other electrical control elements are not labeled as to the devices function or scale as appropriate. Several electrical control elements cannot be accessed for use, inspection, and servicing without the need for special equipment or removal of clutter or debris.	Most of the bridge electrical control system components are not labeled. Access to the electrical control equipment is very difficult, requiring special equipment and removal of clutter and debris.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Support and Electrical Terminations (9006)	All bridge electrical control equipment is properly supported and all terminations are properly made, are clean, and appear tight.	Some bridge electrical control equipment supporting fasteners are loose or missing, but there is no danger of the equipment mounting(s) failing. Some electrical terminations are not clean or have mild corrosion.	Several bridge electrical control equipment mounting fasteners are missing and equipment mounting could potentially fail. Some electrical terminations are improperly made, are loose, are dirty, or appear to be overheating.	Bridge electrical control equipment supports have failed and electrical equipment is hanging from conduits, wires, or other non-structural elements not designed to support the equipment. Many electrical terminations are improperly made, are loose, are very dirty, have severe corrosion, or appear to be severely overheating.
Corrosion (1000)	No corrosion is present on bridge electrical control equipment.	Bridge electrical control system components exhibit minor corrosion.	Bridge electrical control system components exhibit moderate corrosion with minor section loss.	Bridge electrical control system components exhibit heavy corrosion with section loss and a perceived danger of component failure.
Damage (7000)	Bridge electrical control components are not damaged.	Bridge electrical control components have minor damage that does not affect the intended operation or mounting security of the equipment.	Bridge electrical control components have moderate damage that affects the intended operation or mounting security of the equipment, but does not appear to pose an immediate safety concern or risk of system failure.	Bridge electrical control components have significant damage that affects the intended operation or mounting security of the equipment such that operating the equipment poses a risk of injury to personnel or further damage to the equipment or structure.

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Wear (Electrical) (9002)	Bridge electrical control components are not worn and electrical conductor insulation resistance values exceed the minimum values recommended by NETA.	Bridge electrical control components exhibit minimal wear that does not affect the intended operation of the equipment. The electrical conductor insulation resistance values measure at the minimum values recommended by NETA.	Bridge electrical control components exhibit moderate wear that appears to be beginning to affect the intended operation of the equipment without creating an immediately dangerous condition to the public, bridge personnel, or the bridge. The electrical conductor insulation resistance values measure 50 percent below the minimum values recommended by NETA.	Bridge electrical control components exhibit excessive wear that seriously affects the intended operation of the equipment. The electrical conductor insulation resistance values measure less than 50 percent below the minimum values recommended by NETA.
Functional Obsolescence (9008)	The bridge electrical control equipment is currently supported by the manufacturer and all replacement parts are readily available. The technology of the electrical equipment is adequate for the installed purpose(s).	There are indications that some of the bridge electrical control equipment will soon be phased out by the manufacturer or the availability of parts may soon be a problem. The technology of the electrical equipment is marginally adequate for the installed purpose(s) and better technology is available.	There are indications that some of the bridge electrical control equipment has been phased out by the manufacturer and the availability of parts has become a problem. The technology of the electrical equipment is dated and no longer considered appropriate for the application.	Most of the bridge electrical control equipment is not supported by the manufacturer and no parts are available. The technology of the electrical equipment is considered antiquated and could even be dangerous to the public, bridge personnel, or equipment in the installed configuration.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 607 Commentary

The element Movable Bridge Control System – Electrical consists of the electrical components supplying, modifying, or controlling the electrical power to electric motors that move the span, or serve as the command interface between the human operator and the machine, allowing the operator to direct the bridge to open or close. Example components include:

- Operator interfaces
- Control switches
- Safety interlock bypasses
- Position indication equipment, indicating:
    - Lights
    - Limit switches
    - Pressure switches
- Linear transducers
- Relays
- Programmable controllers
- Programmable sensors

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.9 – MOVABLE BRIDGE INTERLOCKING SYSTEM – MECHANICAL

Element 608 – Movable Bridge Interlocking System – Mechanical

Description: All mechanical elements of the main interlocking system.

Classification: BME

Units of Measurement: each

Quantity Calculation: Number of main interlocking systems for the entire bridge.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Movable span interlocking systems operate smoothly. Major mechanical elements are properly adjusted.	Movable span interlocking systems operate with minor flaws, such as light vibration or noise. Equipment may be slightly out of adjustment. None of the major mechanical elements require remedial action.	Movable span interlocking systems operate with significant flaws, including vibration, noise, or undesirable heating. Equipment out of adjustment. Major mechanical elements may require short term replacement or adjustment.	Movable span interlocking systems do not operate or operate in an erratic or uncontrolled manner. Various pieces of equipment may be significantly out of adjustment or nonfunctional. Required pieces of equipment may be missing. Major mechanical elements may require immediate replacement.
Lubrication (9001)	Lubricants are fresh, clean, and well-distributed.	Lubricants exhibit minor contamination. Application of grease is excessive or barely adequate on major mechanical elements.	Lubricants exhibit moderate contamination. Application of grease is spotty and inadequate in places on major mechanical elements.	Lubricants exhibit heavy contamination. Application of grease is inadequate in many places on major mechanical elements.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Wear (Mechanical) (9002)	None.	Light wear present. Clearances related to major mechanical elements are within operational limits. No remedial action required.	Moderate wear present. Clearances related to major mechanical elements are near operational limits. Short-term replacement of components may be required.	Heavy wear present. Clearances related to major mechanical elements exceed operational limits. Immediate replacement of components may be required.
Damage (7000)	None.	Minor damage noted such as pitting or scoring. None of the major mechanical elements require remedial action.	Moderate damage such as pitting and scoring with plastic flow. Major mechanical elements may require short term replacement or adjustment.	Heavy damage present. Components may be cracked or broken. Overstress of components occurring. Major mechanical elements may require immediate replacement.
Alignment (Mechanical) (9003)	Components are aligned within manufacturer's recommended operational tolerances or code requirements. Components exhibit proper contact.	Certain components slightly outside of manufacturers recommended operational tolerances or code requirements. No operational issues noted. None of the major mechanical elements require realignment.	Components outside of manufacturers recommended operational tolerances or code requirements. Some shaft or coupling movement noted during operation. Components may exhibit improper contact. Major mechanical elements may require realignment.	Components well outside of manufacturers recommended operational tolerances or code requirements. Significant shaft or coupling movement noted during operation. Unusual noises noted during operation. Overstress of components occurring. Components may exhibit extremely poor contact. Immediate replacement or realignment of major mechanical elements may be required.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Minor paint system failure and light corrosion present. None of the major mechanical elements require remedial action.	Spotty paint system failure and moderate corrosion present. Major mechanical elements may require short term replacement.	Extensive paint system failure and heavy corrosion present. Immediate replacement of major mechanical elements may be required.
Connections (1020)	Fasteners and keys are intact, tight, and without corrosion.	Fasteners or keys exhibit minor corrosion. Some fasteners related to major mechanical elements may be loose. No missing fasteners.	Fasteners or keys exhibit moderate corrosion. Fasteners or keys are loose. Some fasteners or keys related to major mechanical elements may be missing. Short-term repair of major mechanical elements may be required.	Fasteners or keys exhibit heavy corrosion. Many Fasteners or keys are loose. Fasteners or keys related to major mechanical elements are missing. Immediate repair of major mechanical elements may be required.
Housekeeping (9004)	The machinery access areas are clean, sanitary, and free of debris and trip or fall hazards. Machinery guards are intact.	The machinery access areas are generally safe, but may have minor debris or inconvenient access. There may be minor mechanical issues related to weather exposure.	The machinery access areas have safety issues. Machinery guards may be out of place. There may be significant issues related to weather exposure. Short term repairs may be required.	The machinery access areas have significant safety issues such as: unsanitary waste, excessive guano, debris, or missing machinery guards. Alternatively, there are unsafe trip or fall hazards or machinery is inadequately protected from weather. Immediate repair may be required.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 608 Commentary

The element Movable Bridge Interlocking System – Mechanical consists of mechanical components that monitor bridge motion and regulate the sequence of movable span operation. Examples components include:

- Mechanical trip mechanisms, including:
  - Cams
  - Levers
  - Plungers;
- Limit switches and supports
- Instrumentation drives, including:
  - Gearboxes
  - Shafts
  - Couplings

Not all movable bridges have an interlocking system and rely instead on operator training, experience, and skill for the proper and safe operation of the bridge systems.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.10 – MOVABLE BRIDGE INTERLOCKING SYSTEM – ELECTRICAL

Element 609 – Movable Bridge Interlocking System – Electrical

Description: The electrical components, logic devices, and circuitry which monitor bridge motion and regulate the sequence of movable span operation. A functioning interlocking system should prevent unsafe order of operations. Not all movable bridge have electrical interlock systems, some instead rely on human operator training, experience, and skill for proper and safe span operation. Inspectors do not inspect software code.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of interlocking systems for the entire bridge. For example, as single-leaf bascule would typically have a quantity of one; a double-leaf bascule would typically have a quantity of two.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Bridge electrical interlock systems operate normally.	Bridge electrical interlock systems function adequately with minor issues such as minor paint system failure or corrosion – items not requiring repair or adjustment.	Bridge electrical interlock systems function, but conditions have degraded to the point where maintenance is needed to prevent failure and maintain reliability.	Bridge electrical interlock systems are not functioning or are functioning erratically. In most cases, it is vital that these systems be repaired or replaced immediately since they usually protect the public, or bridge personnel from injury. These systems may also protect the bridge from damage.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Support and Electrical Terminations (9006)	All bridge electrical interlock system equipment is properly supported and all terminations are properly made, are clean, and appear tight.	Some bridge electrical interlock system equipment supporting fasteners are loose or missing, but there is no danger of the equipment mounting(s) failing. Some electrical terminations are not clean or have mild corrosion.	Several bridge electrical interlock system equipment mounting fasteners are missing and equipment mounting could potentially fail. Some electrical terminations are improperly made, are loose, are dirty, or appear to be overheating.	Bridge electrical interlock system equipment supports have failed and electrical equipment is hanging from conduits, wires, or other non-structural elements not designed to support the equipment. Many electrical terminations are improperly made, are loose, are very dirty, have severe corrosion, or appear to be severely overheating.
Corrosion (1000)	No corrosion is present on bridge electrical interlock system equipment.	Bridge electrical interlock system components exhibit minor corrosion.	Bridge electrical interlock system components exhibit moderate corrosion with minor section loss.	Bridge electrical interlock system components exhibit heavy corrosion with section loss and a perceived danger of component failure.
Damage (7000)	Bridge electrical interlock system components are not damaged.	Bridge electrical interlock system components have minor damage that does not affect the intended operation or mounting security of the equipment.	Bridge electrical interlock system components have moderate damage that affects the intended operation or mounting security of the equipment, but does not appear to pose an immediate safety concern or risk of system failure.	Bridge electrical interlock system components have significant damage that affects the intended operation or mounting security of the equipment such that operating the equipment poses a risk of injury to personnel or further damage to the equipment or structure.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Wear (Electrical) (9002)	Bridge electrical interlock system components are not worn and electrical conductor insulation resistance values exceed the minimum values recommended by NETA.	Bridge electrical interlock system components exhibit minimal wear that does not affect the intended operation of the equipment. The electrical conductor insulation resistance values measure at the minimum values recommended by NETA.	Bridge electrical interlock system components exhibit moderate wear that appears to be beginning to affect the intended operation of the equipment without creating an immediately dangerous condition to the public, bridge personnel, or the bridge. The electrical conductor insulation resistance values measure 50 percent below the minimum values recommended by NETA.	Bridge electrical interlock system components exhibit excessive wear that seriously affects the intended operation of the equipment. The electrical conductor insulation resistance values measure less than 50 percent below the minimum values recommended by NETA.
Functional Obsolescence (9008)	The bridge electrical interlock system equipment is currently supported by the manufacturer and all replacement parts are readily available. The technology of the electrical equipment is adequate for the installed purpose(s).	There are indications that some of the bridge electrical interlock system equipment will soon be phased out by the manufacturer or the availability of parts may soon be a problem. The technology of the electrical equipment is marginally adequate for the installed purpose(s) and better technology is available.	There are indications that some of the bridge electrical interlock system equipment has been phased out by the manufacturer and the availability of parts has become a problem. The technology of the electrical equipment is dated and no longer considered appropriate for the application.	Most of the bridge electrical interlock system equipment is not supported by the manufacturer and no parts are available. The technology of the electrical equipment is considered antiquated and could even be dangerous to the public, bridge personnel, or equipment in the installed configuration.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 609 Commentary

The element Movable Bridge Interlocking System – Electrical consist of electrical components, logic devices, and circuitry that monitor bridge motion and regulate the sequence of movable span operation. Examples components include:

- Limit switches and wiring
- Detectors, sensors, and wiring which indicate the position of moving parts
- Position indicating equipment
- Limit switches
- Pressure switches
- Linear transducers
- Software and/or hardware in Programmable Logic Controllers dedicated to sequence of operations control
- Lockout systems that prevent other types of operations if an auxiliary manual operating system is being used
- Conductors
- Conduit and supports
- Raceways
- Enclosures

Not all movable bridges have an interlocking system and rely instead on operator training, experience, and skill for the proper and safe operation of the bridge systems.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.11 – PIER PROTECTION – STRUCTURAL

Element 610 – Movable Bridge Navigation Guidance System – Structural

Description: Structural components of the main navigation system.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main navigation guidance systems for the entire bridge. Typically one, regardless of movable bridge type.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Freckled rust. Corrosion of the steel has initiated.	Section loss is evident or pack rust is present but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (1010)	None.	Crack that has self-arrested or has been arrested with effective arrest holes, doubling plates, or similar.	Identified crack that is not arrested but does not warrant structural review.	
Connection (1020)	Connection is in place and functioning as intended.	Loose fasteners or pack rust without distortion is present but the connection is in place and functioning as intended.	Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion but does not warrant a structural review.	
Exposed Rebar (1090)	None.	Present without measurable section loss.	Present with measurable section loss but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Efflorescence/Rust Staining (1120)	None.	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (RC and Other) (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion/Wear (PSC/RC) (1190)	No abrasion or wearing.	Abrasion or wearing has exposed coarse aggregate but the aggregate remains secure in the concrete.	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
Delamination/Spall/Patched Area (1080)	None.	Delaminated. Spall 1 in. or less deep or 6 in. or less in diameter.	Patched Area Patched area that is sound. Spall greater than 1 in. deep or greater than 6 in. diameter. Patched area that is unsound or showing distress. Does not warrant structural review.	
Distortion (1900)	None.	Distortion not requiring mitigation or mitigated distortion.	Distortion that requires mitigation that has not been addressed but does not warrant structural review.	
Settlement (4000)	None.	Exists within tolerable limits or arrested with no observed structural distress.	Exceeds tolerable limits but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Decay/Section Loss (1140)	None.	Affects less than 10 percent of the member section.	Affects 10 percent or more of the member but does not warrant structural review.	the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Check/Shake (1150)	Surface penetration less than 5 percent of the member thickness regardless of location.	Penetrates 5%–50 percent of the thickness of the member and not in a tension zone.	Penetrates more than 50 percent of the thickness of the member or more than 5 percent of the member thickness in a tension zone. Does not warrant structural review.	
Crack (Timber) (1160)	None.	Crack that has been arrested through effective measures.	Identified crack that is not arrested but does not require structural review.	
Split/Delamination (Timber) (1170)	None.	Length less than the member depth or arrested with effective actions taken to mitigate.	Length equal to or greater than the member depth but does not require structural review.	
Scour (6000)	None.	Exists within tolerable limits or has been arrested with effective countermeasures.	Exceeds tolerable limits but is less than the critical limits determined by scour evaluation and does not warrant structural review.	
Damage (7000)	Not applicable.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 610 Commentary

The navigation guidance system channels the travel path of an approaching vessel from the open channel through the bridge opening and consists of the structural components of the fendering and pier protection devices, as well as the channel clearance envelope—horizontal and vertical. Examples include:

- Fenders
- Rub strips
- Dolphins
- Cells
- Clearance boards

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.12 – MOVABLE BRIDGE NAVIGATION GUIDANCE SYSTEM – ELECTRICAL

Element 611 – Movable Bridge Navigation Guidance System – Electrical

Description: Electrical elements of the navigation guidance system.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main navigation guidance systems for the entire bridge. Typically one, regardless of movable bridge type.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Bridge navigation guidance systems operate normally.	Bridge navigation guidance systems function adequately with minor issues such as minor paint system failure or corrosion – items not requiring repair or adjustment.	Bridge navigation guidance systems function, but conditions have degraded to the point where maintenance is needed to prevent failure and maintain reliability.	Some of the bridge navigation guidance system components are not functioning or are functioning erratically. These systems are vital to waterway navigation safety and must be operational whenever vision is reduced.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Support and Electrical Terminations (9006)	All bridge navigation guidance system equipment is properly supported and all terminations are properly made, are clean, and appear tight.	Some bridge navigation guidance system equipment supporting fasteners are loose or missing, but there is no danger of the equipment mounting(s) failing. Some electrical terminations are not clean or have mild corrosion.	Several bridge navigation guidance system equipment mounting fasteners are missing and equipment mounting could potentially fail. Some electrical terminations are improperly made, are loose, are dirty, or appear to be overheating.	Bridge navigation guidance system equipment supports have failed and electrical equipment is hanging from conduits, wires, or other non-structural elements not designed to support the equipment. Many electrical terminations are improperly made, are loose, are very dirty, have severe corrosion, or appear to be severely overheating.
Corrosion (1000)	No corrosion is present on bridge navigation guidance system equipment.	Bridge navigation guidance system components exhibit minor corrosion.	Bridge navigation guidance system components exhibit moderate corrosion with minor section loss.	Bridge navigation guidance system components exhibit heavy corrosion with section loss and a perceived danger of component failure.
Damage (7000)	Bridge navigation guidance system components are not damaged.	Bridge navigation guidance system components have minor damage that does not affect the intended operation or mounting security of the equipment.	Bridge navigation guidance system components have moderate damage that affects the intended operation or mounting security of the equipment, but does not appear to pose an immediate safety concern or risk of system failure.	Bridge navigation guidance system components have significant damage that affects the intended operation or mounting security of the equipment.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 611 Commentary

The electrical navigation guidance system consists of:

- Raceway
- Conductors
- Lights
- Signs
- Horns
- Sirens
- Gauges designed to provide safe passage for marine vessels

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.13 – MOVABLE BRIDGE ELECTRICAL POWER SYSTEM – ELECTRICAL

Element 612 – Movable Bridge Power System – Electrical

Description: All electrical elements of the electrical power system.

Classification: BME

Units of Measurement: lump sum

Quantity Calculation: Electrical power system for the entire bridge.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Bridge electrical power system operates normally.	Bridge electrical power system functions adequately with minor issues such as minor voltage drops, minor paint system failure or corrosion – items not requiring immediate repair or adjustment.	Bridge electrical power systems function, but some components have begun to deteriorate to the point that there is reduced confidence of the system's long-term reliability. Power system voltage drops are causing high operating currents or overheating. Power system is marginally sized. Marginal overheating is observed, but is still within specifications.	Bridge electrical power systems are not functioning or functioning in such a way as to potentially create a hazard due to overheating equipment, exposed conductors, or improper repairs. Power system voltage drops are causing under-voltage shutdowns. Power system is severely undersized.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Accessibility and Labeling (9005)	All covers to electrical power enclosures are properly secured in place. Arc fault labeling and working clearances conform to NFPA-70 (NEC) requirements. Electrical equipment and wiring identification labels are in place and legible.	All covers to electrical power enclosures are in place, though some fasteners are missing. Not all arc fault labeling is in place. Some working clearances do not conform to NEC requirements. Some equipment or wiring identification labeling is either missing or is not legible.	All covers to electrical power enclosures are in place, but many fasteners are missing. Few arc fault labels are in place. Many working clearances do not conform to NEC requirements. Many equipment or wiring identification labels are either missing or are not legible.	One or more covers to electrical power enclosures are not in place. There are no arc fault labels on any enclosures. Most working clearances do not conform to NEC requirements. Most equipment or wiring identification labels are either missing or are not legible.
Support and Electrical Terminations (9006)	All bridge electrical power equipment is properly supported and all terminations are properly made, are clean, and appear tight.	Some bridge electrical power equipment supporting fasteners are loose or missing, but there is no danger of the equipment mounting(s) failing. Some electrical terminations are not clean or have mild corrosion.	Several bridge electrical power equipment mounting fasteners are missing and equipment mounting could potentially fail. Some electrical terminations are improperly made, are loose, are dirty, or appear to be overheating.	Bridge electrical power equipment supports have failed and electrical equipment is hanging from conduits, wires, or other non-structural elements not designed to support the equipment. Many electrical terminations are improperly made, are loose, are very dirty, have severe corrosion, or appear to be severely overheating.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	No corrosion is present on bridge electrical power equipment.	Bridge electrical power system components exhibit minor corrosion.	Bridge electrical power system components exhibit moderate corrosion with minor section loss.	Bridge electrical power system components exhibit heavy corrosion with section loss and a perceived danger of component failure.
Damage (7000)	Bridge electrical power components are not damaged.	Bridge electrical power components have minor damage that does not affect the intended operation or mounting security of the equipment.	Bridge electrical power components have moderate damage that affects the intended operation or mounting security of the equipment, but does not appear to pose an immediate safety concern or risk of system failure.	Bridge electrical power components have significant damage that affects the intended operation or mounting security of the equipment such that operating the equipment poses a risk of injury to personnel or further damage to the equipment or structure.
Wear (Electrical) (9002)	Bridge electrical power components are not worn and electrical conductor insulation resistance values exceed the minimum values recommended by NETA.	Bridge electrical power components exhibit minimal wear that does not affect the intended operation of the equipment. The electrical conductor insulation resistance values measure at the minimum values recommended by NETA.	Bridge electrical power components exhibit moderate wear that appears to be beginning to affect the intended operation of the equipment without creating an immediately dangerous condition to the public, bridge personnel, or the bridge. The electrical conductor insulation resistance values measure 50 percent below the minimum values recommended by NETA.	Bridge electrical power components exhibit excessive wear that seriously affects the intended operation of the equipment. The electrical conductor insulation resistance values measure less than 50 percent below the minimum values recommended by NETA.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Functional Obsolescence (9008)	The bridge electrical power equipment is currently supported by the manufacturer and all replacement parts are readily available. The technology of the electrical equipment is adequate for the installed purpose(s).	There are indications that some of the bridge electrical power equipment will soon be phased out by the manufacturer or the availability of parts may soon be a problem. The technology of the electrical equipment is marginally adequate for the installed purpose(s) and better technology is available.	There are indications that some of the bridge electrical power equipment has been phased out by the manufacturer and the availability of parts has become a problem. The technology of the electrical equipment is dated and no longer considered appropriate for the application.	Most of the bridge electrical power equipment is not supported by the manufacturer and no parts are available. The technology of the electrical equipment is considered antiquated and could even be dangerous to the public, bridge personnel, or equipment in the installed configuration.
Housekeeping (9004)	All electrical areas and equipment are clean and well organized.	Some of the electrical areas or equipment are dirty, unkempt, or disorganized. The levels of poor upkeep are not yet creating a serious hazard or potentially affecting the equipment's operation.	Many of the electrical areas or equipment are very disorganized or dirty. The levels of poor upkeep are beginning to become a concern for a fire hazard and may potentially affect the equipment's ability to dissipate heat or permit adequate servicing or inspection.	Most of the electrical areas or equipment are very disorganized or dirty. The levels of poor upkeep are a fire hazard and likely affect the equipment's ability to dissipate heat. The electrical equipment cannot be properly accessed for servicing or inspection.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 612 Commentary

The electrical power system consists of those components that provide electrical power to the bridge. These components include:

- Short circuit and over-current protective devices
- Disconnect switches
- Motor control centers
- Switchgear
- Panel boards
- Grounding
- Conductors
- Raceways
- Pull boxes
- Junction boxes
- Wiring to include:
    - Submarine cable
    - Droop cable
    - Aerial cable.

Covers should be removed during routine inspections. Wire insulation should be tested during in-depth inspection. Disassembly of components should be performed during in-depth inspections.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.14 – MOVABLE BRIDGE TRAFFIC CONTROL SYSTEM – MECHANICAL

Element 613 – Movable Bridge Traffic Control System – Mechanical

Description: All mechanical elements of the main traffic control system.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main traffic control systems for the entire bridge.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Traffic control systems operate smoothly. Major mechanical elements are properly adjusted.	Traffic control systems operate with minor flaws, such as light vibration or noise. Equipment may be slightly out of adjustment. None of the major mechanical elements require remedial action.	Traffic control systems operate with significant flaws, including vibration, noise, or undesirable heating. Auxiliary operating systems may be nonfunctional. Equipment out of adjustment. Major mechanical elements may require short term replacement or adjustment.	Traffic control systems do not operate or operate in an erratic or uncontrolled manner. Various pieces of equipment may be significantly out of adjustment or nonfunctional. Required pieces of equipment may be missing. Major mechanical elements may require immediate replacement.
Lubrication (9001)	Lubricants are fresh, clean, and well-distributed. Oil levels are appropriate.	Lubricants exhibit minor contamination. Oil levels slightly low. Minor lubricant leaks may exist. Application of grease is excessive or barely adequate on major mechanical elements.	Lubricants exhibit moderate contamination. Oil levels low. Moderate lubricant leaks may exist. Application of grease is spotty and inadequate in places on major mechanical elements.	Lubricants exhibit heavy contamination. Oil levels extremely low. Heavy lubricant leaks may exist. Application of grease is inadequate in many places on major mechanical elements.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Wear (Mechanical) (9002)	None.	Light wear present. Clearances related to major mechanical elements are within operational limits. No remedial action required.	Moderate wear present. Clearances related to major mechanical elements are near operational limits. Short-term replacement of components may be required.	Heavy wear present. Clearances related to major mechanical elements exceed operational limits. Immediate replacement of components may be required.
Damage (7000)	None.	Minor damage noted such as pitting or scoring. Hoses may exhibit light abrasion. None of the major mechanical elements require remedial action.	Moderate damage such as pitting and scoring with plastic flow. Hoses may exhibit moderate abrasion. Major mechanical elements may require short term replacement or adjustment.	Heavy damage present. Components may be cracked or broken. Overstress of components occurring. Hoses may exhibit heavy abrasion. Major mechanical elements may require immediate replacement.
Alignment (Mechanical) (9003)	Components are aligned within manufacturer's recommended operational tolerances or code requirements. Components exhibit proper contact.	Certain components slightly outside of manufacturers recommended operational tolerances or code requirements. No operational issues noted. None of the major mechanical elements require realignment.	Components outside of manufacturers recommended operational tolerances or code requirements. Some shaft or coupling movement noted during operation. Components may exhibit improper contact. Major mechanical elements may require realignment.	Components well outside of manufacturers recommended operational tolerances or code requirements. Significant shaft or coupling movement noted during operation. Unusual noises noted during operation. Overstress of components occurring. Components may exhibit extremely poor contact. Immediate replacement or realignment of major mechanical elements may be required.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Minor paint system failure and light corrosion present. None of the major mechanical elements require remedial action.	Spotty paint system failure and moderate corrosion present. Major mechanical elements may require short term replacement.	Extensive paint system failure and heavy corrosion present. Immediate replacement of major mechanical elements may be required.
Connections (1020)	Fasteners and keys are intact, tight, and without corrosion.	Fasteners or keys exhibit minor corrosion. Some fasteners related to major mechanical elements may be loose. No missing fasteners.	Fasteners or keys exhibit moderate corrosion. Fasteners or keys are loose. Some fasteners or keys related to major mechanical elements may be missing. Short-term repair of major mechanical elements may be required.	Fasteners or keys exhibit heavy corrosion. Many Fasteners or keys are loose. Fasteners or keys related to major mechanical elements are missing. Immediate repair of major mechanical elements may be required.
Housekeeping (9004)	The machinery access areas are clean, sanitary, and free of debris and trip or fall hazards. Machinery guards are intact.	The machinery access areas are generally safe, but may have minor debris or inconvenient access. There may be minor mechanical issues related to weather exposure.	The machinery access areas have safety issues. Machinery guards may be out of place. There may be significant issues related to weather exposure. Short term repairs may be required.	The machinery access areas have significant safety issues such as: unsanitary waste, excessive guano, debris, or missing machinery guards. Alternatively, there are unsafe trip or fall hazards or machinery is inadequately protected from weather. Immediate repair may be required.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 613 Commentary

The mechanical traffic control systems consist of those components that serve to manage and control traffic flow through a movable bridge span and to stop and store vehicles safely during bridge operations. These components include the mechanical operating systems for:

- Traffic gates
- Resistance gates
- Impact attenuators

Inspection and safety covers should be removed during routine inspections. Disassembly of components should be performed during in-depth inspections.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.15 – MOVABLE BRIDGE TRAFFIC CONTROL SYSTEM – ELECTRICAL

Element 614 – Movable Bridge Traffic Control System – Electrical

Description: All electrical elements of the main traffic control system.

Classification: BME **Units of Measurement**: each

Quantity Calculation: Number of main traffic control systems for the entire bridge.

Condition State Definitions

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Operation (9000)	Electrical components of the bridge traffic control systems operate normally.	Electrical components of the bridge traffic control systems function adequately with minor issues such as minor paint system failure or corrosion – items not requiring repair or adjustment.	Electrical components of the bridge traffic control systems function, but conditions have degraded to the point where maintenance is needed to prevent failure and maintain reliability.	Some of the bridge traffic control systems electrical components are not functioning or are functioning erratically. These systems are vital to the safety of pedestrians and the motoring public and must be operational unless trained and properly equipped flaggers are controlling traffic or the roadway is closed.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Support and Electrical Terminations (9006)	All bridge traffic control system equipment is properly supported and all terminations are properly made, are clean, and appear tight.	Some bridge traffic control system equipment supporting fasteners are loose or missing, but there is no danger of the equipment mounting(s) failing. Some electrical terminations are not clean or have mild corrosion.	Several bridge traffic control system equipment mounting fasteners are missing and equipment mounting could potentially fail. Some electrical terminations are improperly made, are loose, are dirty, or appear to be overheating.	Bridge traffic control system equipment supports have failed and electrical equipment is hanging from conduits, wires, or other non-structural elements not designed to support the equipment. Many electrical terminations are improperly made, are loose, are very dirty, have severe corrosion, or appear to be severely overheating.
Corrosion (1000)	No corrosion is present on bridge traffic control system equipment.	Bridge traffic control system components exhibit minor corrosion.	Bridge traffic control system components exhibit moderate corrosion with minor section loss.	Bridge traffic control system components exhibit heavy corrosion with section loss and a perceived danger of component failure.
Damage (7000)	Bridge traffic control system components are not damaged.	Bridge traffic control system components have minor damage that does not affect the intended operation or mounting security of the equipment.	Bridge traffic control system components have moderate damage that affects the intended operation or mounting security of the equipment, but does not appear to pose an immediate safety concern or risk of system failure.	Bridge traffic control system components have significant damage that affects the intended operation or mounting security of the equipment.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 614 Commentary

The electrical traffic control system consists of:

- Raceway
- Conductors
- Equipment
- Enclosures on the bridge directly related in controlling vehicle and pedestrian traffic on the bridge

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

CHAPTER 3.16 – MOVABLE BRIDGE HOUSE

Element 615 – Movable Bridge House

Description: Operator's house, machinery house, or other type of house that is integral to the structure or operation of a movable bridge.

Classification: BME

Units of Measurement: each

Quantity Calculation: Number of houses

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Weatherproofing (9011)	House is weatherproof with no leaks. Roof, windows, and seals appear to be in good condition.	House weatherproofing has begun deteriorating, but no leaks are apparent.	Light water intrusion or evidence of recent light water intrusion is observed, but does not immediately risk damaging the structure, mechanical, or electrical equipment.	Water intrusion or evidence of recent water intrusion is significant and risks damaging the structure, mechanical, or electrical equipment.
House Mechanical Defect (9012)	The Heating, ventilation, air conditioning (HVAC) system and plumbing are functioning properly with no significant deterioration observed.	Deterioration of the HVAC and plumbing systems is observed, but the systems are expected to continue to operating properly.	The HVAC and/or plumbing systems are not functioning properly and this condition is not currently interfering with the ability for the bridge staff to safely and comfortably operate the bridge.	The HVAC and/or plumbing systems are not functioning properly and this condition is interfering with the ability for the bridge staff to safely and comfortably operate the bridge.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
House Electrical Defect (9013)	The house electrical system, including receptacles and lighting, are functioning properly with no significant deterioration observed.	Deterioration of the house electrical system is observed, but the systems are expected to continue to operating properly.	The HVAC and/or plumbing systems are not functioning properly and this condition is not currently interfering with the ability for the bridge staff to safely and comfortably operate the bridge.	The HVAC and/or plumbing systems are not functioning properly and this condition is interfering with the ability for the bridge staff to safely and comfortably operate the bridge.
Corrosion (1000)	None.	Freckled rust. Corrosion of the steel has initiated.	Section loss is evident or pack rust is present but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (Steel) (1010)	None.	Crack that has self-arrested or has been arrested with effective arrest holes, doubling plates, or similar.	Identified crack that is not arrested but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Connection (1020)	Connection is in place and functioning as intended.	Loose fasteners or pack rust without distortion is present but the connection is in place and functioning as intended.	Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion but does not warrant a structural review.	

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Exposed Rebar (1090)	None.	Present without measurable section loss.	Present with measurable section loss but does not warrant structural review.	
Efflorescence/Rust Staining (1120)	None.	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	
Cracking (RC and Other) (1130)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion/Wear (PSC/RC) (1190)	No abrasion or wearing.	Abrasion or wearing has exposed coarse aggregate but the aggregate remains secure in the concrete.	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
Delamination/Spall/Patched Area (1080)	None.	Delaminated. Spall 1 in. or less deep or 6 in. or less in diameter.	Patched Area Patched area that is sound. Spall greater than 1 in. deep or greater than 6 in. diameter. Patched area that is unsound or showing distress. Does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Distortion (1900)	None.	Distortion not requiring mitigation or mitigated distortion.	Distortion that requires mitigation that has not been addressed but does not warrant structural review.	serviceability of the element or bridge.
Settlement (4000)	None.	Exists within tolerable limits or arrested with no observed structural distress.	Exceeds tolerable limits but does not warrant structural review.	
Decay/Section Loss (1140)	None.	Affects less than 10 percent of the member section.	Affects 10 percent or more of the member but does not warrant structural review.	
Check/Shake (1150)	Surface penetration less than 5 percent of the member thickness regardless of location.	Penetrates 5%–50 percent of the thickness of the member and not in a tension zone.	Penetrates more than 50 percent of the thickness of the member or more than 5 percent of the member thickness in a tension zone. Does not warrant structural review.	
Crack (Timber) (1160)	None.	Crack that has been arrested through effective measures.	Identified crack that is not arrested but does not require structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge, or a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Split/Delamination (Timber) (1170)	None.	Length less than the member depth or arrested with effective actions taken to mitigate.	Length equal to or greater than the member depth but does not require structural review.	

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Defect	Condition State			
	1	2	3	4
	GOOD	FAIR	POOR	SEVERE
Damage (7000)	Not applicable.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

Element 615 Commentary

The element Movable Bridge House includes operator's house, machinery house, or other type of occupied structure that is integral to the operation of the movable bridge. Examples of components include:

- Weatherproofing
- House mechanical, including:
    - Heating
    - Ventilation
    - Air conditioning
    - Plumbing
- House electrical, including:
    - Receptacles
    - Lighting
- House structure, including:
    - Roof
    - Walls
    - Beams
    - Columns
    - Foundations
- House architectural features