CHAPTER 2.9 – PREDICTED COMPONENTS LIFE

2.9.1 PREDICTED COMPONENT LIFE FOR HYDRAULIC AND ELECTRICAL COMPONENTS

For hydraulic and electrical components, it is at times difficult to make objective condition evaluations based upon visual inspection. Hydraulic and electrical components are frequently sealed units which require considerable engineering expertise and time consuming functional testing to evaluate their condition. For these types of components there are two methods which may be used to inspect and make decisions for numeric condition evaluation coding:

Engineering evaluation: The responsible owner agency may design an appropriate inspection and testing program for the hydraulic or electrical system internal components of each individual movable bridge. This program should be carried out by experienced fluid power or electrical engineers or licensed hydraulic system mechanics or electricians who meet the qualifications of Section 2.4 for lead inspectors.

Predicted life: Agencies may opt to use a predicted life system of numeric condition evaluation, where each hydraulic and/or electrical component is assigned a predicted useful life. The condition evaluation code of each component starts at "excellent" when the component is new and reduces progressively as the component ages. The inspection team can assign a condition code based on the percentage of predicted life expended at the time of inspection.

The major requirements of this system are as follows:

- **Component life** may be obtained by one of two methods. Values may be selected from Table 2.9.1-1 and Table 2.9.1-2 which lists a conservative predicted life for various classes of hydraulic and electrical components on movable bridges.
- **Component labels** are required on all hydraulic and/or electrical equipment evaluated by the predicted life method. Component labels should be permanently attached weather-proof, heat resistant metal or plastic, engraved, stamped or indelibly printed, and laminated tags or plaques which provide the following minimum information: tag number, bridge number, component name, date of manufacture, date of installation, and date of last engineering evaluation type inspection.
- **Numeric condition evaluation coding** can be based upon simple component age computation from the tag data and date of inspection. Components should be deemed to have the following condition ratings based upon age:

  Excellent: less than 15 percent of predicted life expended.
  Good: 15 percent to 35 percent of predicted life expended.
  Fair: 35 percent to 65 percent of predicted life expended.

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Table 2.9.1-2 is based upon Reference 81 Table 2, modified somewhat based upon responses from experienced movable bridge industry representatives during peer review of the draft manual. The second method is to perform a component life evaluation (based upon the methods contained in Reference 81, 85 and 86) for individual components and substitute the values determined by this study for the Table 2.9.1-1 and 2.9.1-2 values.

No data was available in Reference 81 for motor starters or contactors, and the predicted life of these components is based on the data for switchgear busses. Electrical components generally have very long lives based on their electrical performance. Mechanical life of moving parts is typically the controlling factor. For components exposed to weather, corrosion is a factor. In the aggressive environment typical at many movable bridges, it is possible for components to fail due to corrosion without any electrical activity at all. The reason that low usage components have shorter lives is that corrosion has time to form on parts which are not used frequently, and the presence of corrosion will accelerate mechanical wear. Structures which open less than 400 times a year may be expected to have less than one opening per day during portions of the year and therefore have more opportunity for corrosion to form.

Similar logic applies to hydraulic components. The data presented for hydraulic components is based upon data gathered from industry sources and may be modified by owners if they maintain records of component performance data on their bridges.

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Poor: 65 to 85 percent of predicted life expended.
Severe: more than 85 percent of predicted life expended.

Hydraulic and/or electrical components that are rated "critical" by either of the above two methods are by definition prone to failure in the near future. Owner agencies should consider the following corrective actions:

- Replace or rebuild the critical rated component(s).
- Order the replacement part and monitor the condition of the existing component until replacement is accomplished.
- Perform an engineering evaluation that includes sufficient performance testing of the component(s) to allow revising the predicted component life. The revised predicted life of a component by this method should not exceed a 50 percent increase in the predicted life shown in the table.

For some existing bridges, there may be some difficulty in determining the age of in-service components. Components should be assumed to be of bridge original installation unless other documents are available showing the component to be a replacement part. Components for which no age data can be obtained should generally be assumed to be not less than 25 years of age, since the majority of existing movable bridges nationwide were built prior to 1970. Individual owners who have data concerning the age of their inventory may develop specific guidelines which are based on the average age of their bridges. Note that asbestos is a risk for components fabricated prior to 1985.

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Table 2.9.1-1 – Predicted Hydraulic Component Life

COMPONENT TYPE	PREDICTED LIFE FOR STATED CONDITIONS (IN YEARS)					
	LOW USAGE Less than 400 openings per year		AVERAGE USAGE 400 to 4000 openings per year		HIGH USAGE More than 4000 openings per year	
	W/O Fluid Testing	With Fluid Testing per Chapter 2.10	W/O Fluid Testing	With Fluid Testing per Chapter 2.10	W/O Fluid Testing	With Fluid Testing per Chapter 2.10
Accumulators and Reservoirs	28	42	36	55	24	36
Pumps and Motors or Rotary Actuators[1]	24	36	30	45	20	30
Cylinders[1]	16	24	20	30	12	18
Operating Valves and Hydraulic System Sensors other than electromechanical limit switches[1]	20	30	25	38	16	24
Welded pipe or Flanged pipe with O-Rings[2]	36	55	36	55	24	36
Tubing (except flare fittings)[2]	15	22	15	22	10	15
Flexible Hoses[1,2]	5	7	5	7	3	5

1. If systems have history of contamination or overheating a 50% reduction in the tabulated values should be assumed for components subject to accelerated wear of seals, O-rings, and other soft parts which can be easily damaged by grit or varnish accumulation.
2. Pipe, tubing and flexible hoses do not experience an increase in deterioration due to infrequent use.

Table 2.9.1-2 – Predicted Electrical Component Life

COMPONENT TYPE	PREDICTED LIFE FOR STATED CONDITIONS (IN YEARS)					
	LOW USAGE Less than 400 openings per year		AVERAGE USAGE 400 to 4000 openings per year		HIGH USAGE More than 4000 openings per year	
	Open to Environment	Closed Room or Sealed Unit	Open to Environment	Closed Room or Sealed Unit	Open to Environment	Closed Room or Sealed Unit
Motors, Generators and Circuit Breakers[3]	30	60	35	70	25	50
Brushes in DC Brush-Type Motors/Generators	8	16	10	20	6	12
Limit Switches	3	5	4	6	3	5
Motor Starters and Contactors	24	48	30	60	20	40
Open Wiring[3]	18	36	20	40	16	32
Wiring in Conduit[3]	20	40	30	60	25	50
Wiring Terminals	16	32	20	40	14	28

3. Motors, generators, wiring and other components which depend on insulation integrity for reliability will be adversely affected by overheating. Such components should be rated poor or critical if they have a history of overheating regardless of remaining life, due to the potential for failure and/or electrical fire.