

## **1.1. General**

This statement of work outlines mechanical maintenance services to be provided at the Burlington Canal Lift Bridge in Burlington, ON. The bridge and its operation are a critical part of both the channel marine traffic and the highway/pedestrian traffic that straddles the Burlington Canal. It is essential for marine and highway operations that the bridge is maintained in a safe, reliable condition with the bridge being continually available for operation and that any mechanical system failures or malfunctions receive immediate attention and elimination.

Maintenance and repairs are to be provided to extend the life of the mechanical systems and to prevent any unnecessary failures and costly repairs. The program shall prioritize preventative maintenance to replace worn and aging components before they actually fail. Maintenance efforts shall be based on the Bridge Inspection, Evaluation, and Maintenance Manual, published by AASHTO, and other reference documents provided by the owner, including maintenance manuals. The Contractor shall continuously review the bridge mechanical systems and modify maintenance practices, including lubrication or other maintenance intervals, to minimize wear and ensure reliable service. The Contractor shall perform all work in accordance with all applicable local and national rules and regulations.

Maintenance activities shall include periodic verification of the functionality of the integrity of the mechanical systems, oil changes, lubrication, and equipment adjustments. In addition, inspections shall be performed to record equipment deterioration and assess the need for replacement or repair of worn or end of life parts and equipment before they cause system failure or affect bridge operating reliability.

Bridge mechanical system maintenance shall also include 24/7 on-call failure and troubleshooting services during the navigation season. Following notification of a bridge mechanical system failure by the Bridgmaster or representative, the Contractor shall respond and be at the bridge within one hour of the notification by email or phone call.

## **1.2. Summary of Maintenance Efforts**

### **1.2.1. On-Call Services**

- 1.2.1.1. Bridge mechanical system maintenance shall include 24/7 on-call failure and troubleshooting services during the navigation season. Following notification of a bridge mechanical system failure by the Bridgmaster or representative, the Contractor shall respond and be at the bridge within 1-hour of the notification.

### **1.2.2. General Housekeeping**

- 1.2.2.1. Maintain all work areas free of accumulated waste and rubbish. Remove and dispose of debris, used and obsolete material.
- 1.2.2.2. Remove excess lubricant, dust, dirt, and foreign matter from surfaces of all equipment to be maintained by this Contract.

### **1.2.3. General Mechanical Systems Description**

#### **1.2.3.1. Mechanical Systems Operational Description**

##### **1.2.3.1.1. Span Drive Machinery**

The span drive machinery in each tower is driven by two electric motors. Each motor is coupled to an input shaft of the enclosed gear reducer via brake wheel couplings that are provided for the machinery brake mounted between each motor and reducer input. A motor brake wheel is mounted on the non-driven end of each motor for a total of four brakes associated with each span drive. The output shafts of the reducer are coupled to floating shafts that extend east and west to second reduction open gearsets that contain open bevel gear differentials. At each corner the differential provides load sharing between the two pinions that engage spur ring gears that are mounted to each of two counterweight sheaves. Rotation of the motor causes the sheaves to rotate and results in the bridge raising or lowering.

##### **1.2.3.1.2. Auxiliary Drive Machinery**

Auxiliary span drive machinery is provided in the event of a failure of the high-speed main span drive machinery. The auxiliary span drive machinery is comprised of an electric motor face mounted directly to a single input shaft of each reducer. A spline coupling internal to the reducer is used to engage the auxiliary drive.

##### **1.2.3.1.3. Span Support Machinery**

Each end of the lift span and one of the main counterweights is supported by eight trunnion bearings in each tower. Two trunnion bearings straddle mount each of the main counterweight sheaves. Each main sheave has 10 grooves for the wire ropes used to connect the span to the main counterweight. An auxiliary counterweight system is provided to compensate for the transfer of the weight of the counterweight ropes from the movable span side of the main sheaves to the counterweight side as the span is raised.

When the lift span is seated, the live load and imbalance is carried by the live load supports. There are two rocker supports located at the north end of the span to allow for thermal expansion of the span. Two saddle supports are provided at the south end of the bridge that serve to locate the span longitudinally when the span is seated.

Each end of the lift span is equipped with an auxiliary counterweight system to compensate for the transfer of the weight of the counterweight ropes from the movable span side of the main sheaves to the counterweight side as the span is raised. The auxiliary counterweight system consists of an auxiliary counterweight that lowers and raises along the tower columns guided within rails. Each auxiliary counterweight is connected to the lift span via two wire ropes that are supported by the auxiliary counterweight sheave mounted on the tower and then connect back to a central hitch pin at the center of each lift girder.

##### **1.2.3.1.4. Span Lock Machinery**

Mounted on each pier is a span lock machinery assembly. Each assembly consists of a motor, reducer, open gears, bearings, and center crank that actuates a pair of span lock jaws connected by a linkage. The jaws are normally held in the locked position by the external spring and retract when the motors drive the crank in the retracted direction. The jaw on the pier mates with a latch plate mounted on the span. This jaw locks the span in the seated position and prevents undesired lifting of the movable span.

#### 1.2.3.1.5. Traffic Gate Machinery

There is a single barrier gate at each approach to the lift span. There are two warning gates for each approach to the lift span. There is also a pedestrian warning gates at each sidewalk approach.

### 1.2.3.2. Mechanical Systems Functional Description

#### 1.2.3.2.1. Motors

There are eight motors associated with the machinery including two span drive motors and one auxiliary motor in each tower and one span lock motor on each pier. All of the motors are AC electric motors.

#### 1.2.3.2.2. Brakes

The span drive brake assemblies are spring-set thrustor released drum brakes with additional manual release levers. In each tower two motor brakes are located at shaft extensions on non-driven end of the span drive motors and two machinery brakes are located between the span drive motors and the span drive reducer.

#### Torque Settings (per brake)

Motor Brake: 475 ft-lb

Machinery Brake: 950 ft-lb

#### 1.2.3.2.3. Reducers

There are four reducers associated with the machinery include the one span drive reducer in each tower and one span lock reducer on each pier.

##### 1.2.3.2.3.1. Span Drive Reducers

The span drive reducers are a parallel shaft, double primary input, single auxiliary input, and double output reducers. The primary input shafts are coupled to the span drive motors and each of the output shafts are coupled to floating shafts which drive open gear differentials.

##### 1.2.3.2.3.2. Span Lock Reducers

The span lock reducers are parallel shaft single input, double output reducers. The input is coupled to the span lock motor with one output shaft driving an open gear set and the other output is coupled to electrical control equipment.

#### 1.2.3.2.4. Couplings

##### 1.2.3.2.4.1. Span Drive Motor Couplings

Double engagement grid brake wheel couplings are used as span drive motor couplings and connect the span drive motors to the span drive reducer input shafts. There is a total of four with two in each tower.

1.2.3.2.4.2. Cross Shaft Couplings

Single engagement gear couplings are used to support the floating shafts and transmit torque between the span drive reducer output and open gear differentials. There is a total of eight with four in each tower.

1.2.3.2.4.3. Span Lock Motor Couplings

Double engagement grid couplings are used as span lock motor couplings. The coupling hubs are mounted on the span lock motor and span lock reducer input shafts. There is a total of two with one at each span lock.

1.2.3.2.5. Bearings

1.2.3.2.5.1. Span Drive Bearings

The span drive bearings are grease lubricated bronze bushed plain bearings in pillow block housings. There are four located as a part of each differential gear frame and one at each P1 pinion, for a total of 12 in each tower.

1.2.3.2.5.2. Trunnion Bearings

The trunnion bearings are spherical roller bearings. A pair of bearings support each counterweight sheave trunnion, for a total of eight trunnion bearings in each tower.

1.2.3.2.5.3. Span Lock Bearings

There are 13 bearings associated with each span lock assembly. There are three bronze bushed plain bearings in pillow block housings, one supporting the reducer output shaft and a pair supporting the span lock drive shaft. The center crank and each jaw clamp have a pair of bronze sleeve bushings mounting within them. Each of the two connecting rods have a pair of plain bearings to support the sliding clevis.

1.2.3.2.6. Open Gearing

There are six open spur gearsets associated with each span drive. Each G2 gear is provided with an open bevel differential (equalizer) that is not included in the gearset count. There is one open gearset associated with each span lock assembly.

1.2.3.2.7. Counterweight Sheaves

There are four counterweight sheaves in each tower which support the dead weight of the lift span and main counterweight through the main counterweight ropes. The G1 ring gears are mounted to the sheaves and each sheave is mounted on a trunnion shaft.

1.2.3.2.8. Counterweight Ropes

1.2.3.2.8.1. Main Counterweight Ropes

The main counterweight wire ropes are 2-1/4" diameter wire ropes. Ten ropes pass over each of the eight sheaves and are pinned at one end to the counterweight and at the other end to take-ups on the movable span lift girder.

#### 1.2.3.2.8.2. Auxiliary Counterweight Ropes

The auxiliary counterweight wire ropes are 1" diameter wire ropes. There is a total of eight auxiliary counterweight ropes, two ropes pinned at one end to each auxiliary counterweight and pinned to a rotating hitch pin on the span lift girder at the other end.

#### 1.2.3.2.9. Span Lock Jaw Clamps and Latch Plates

There are two jaw clamps associated with each span lock assembly. The jaw clamps are anchored to the pier through supports and mate with latch plates mounted to the lift span. The jaw clamps prevent the span from lifting without being withdrawn by the span lock machinery. The jaw clamps are connected to the center crank by connecting rods with sliding clevises. The clevises are equipped with springs to provide a clamping force to the lift span in the seated position. When the jaw clamps end the latch plate on the lift span, the springs compress, incrementally providing a force to the latch plates.

#### 1.2.3.2.10. Span Guides

The lift span is provided with upper and lower guide rollers at each corner to maintain the position of the span during operation. Both longitudinal and transverse rollers are provided at the south (fixed) end of the span at the lower location. The other six locations only have transverse guide rollers. The rollers engage guide rails mounted to the towers.

#### 1.2.3.2.11. Counterweight Guides

Each counterweight has an upper and lower guide at each end (east and west). The main counterweight guides are u-shaped steel castings that travel along guide rails mounted to the tower to prevent the counterweight from swinging during span travel. The auxiliary counterweight guides are grooved wheels located at each corner of each counterweight that travel along guide rails mounted to the towers.

#### 1.2.3.2.12. Air Buffers

The bridge is equipped with a system of air buffers to assist in stopping the movable span at the full open and seated position. A pair of buffers are mounted near the top of each tower to stop the span in the full open position. A pair of buffers are mounted adjacent to each end floor beam of the movable span to stop the bridge at the full seated position. Each buffer consists of cylinder with a rod and piston with individual cylinder outlets. The piston compresses air within the chamber as the piston rod is depressed as the span approaches the seated or full open position.

#### 1.2.3.2.13. Centering Devices

Each end of the span is equipped with a centering device. The centering devices consist of a socket mounted on the bridge and a tongue located on the pier. As the bridge approaches the fully seated position, the socket engages the tongue

and centers the bridge in the transverse direction. Wear plates are provided on each side of the tongue.

#### 1.2.3.2.14. Live Load Supports

The span is equipped with a pair of live load supports at each end floor beam which transmit live load from the movable span to the pier. The south (fixed) end of the span has a saddle type arrangement that locates the movable span longitudinally when the bridge seats. The north (expansion) end has a pair of rockers mounted to the movable span that seat against strike plates on the pier.

#### 1.2.3.2.15. Warning and Barrier Gates

The warning and barrier gates are independently operated via machinery located with enclosures. The gate arms are counterweighted. Each enclosure contains a motor that is face mounted to a reducer that outputs to a crank arm. The crank arm actuates the gate arm support shaft with a connecting rod with a rod eye at each end of the connecting rod.

#### 1.2.3.2.16. Span Position Equipment

Span position indicating and skew control equipment is gear driven off the end of the east outboard P1 pinion shaft in each tower. The span position equipment provides feedback to the electrical control systems for bridge operation.

### 1.2.4. Mechanical Maintenance Scope

The scope includes the maintenance of all bridge mechanical systems with the exception of items listed in the following section.

See the section titled *Mechanical Equipment and Systems Scheduled Maintenance* at the end of Annex A for a description of major mechanical equipment and systems to be maintained and a baseline maintenance schedule to be used as a guideline and for tendering purposes. The provided maintenance intervals should be adjusted as necessary based on performance to ensure reliable operation.

The Contractor shall provide routine cleaning, inspection, testing, complete maintenance and service of all the items identified in the section of equipment and systems requiring attention/maintenance. All repair and replacement of parts shall also be included in the Contractor's scope of work.

If the Contractor and/or bridge personnel propose any new installation and/or modification work for the bridge mechanical systems, a written quotation must be provided to the Bridgmaster and approval given by the Bridgmaster for such work to be performed by the Contractor prior to either procurements of materials and equipment or the work proceeding. Note that the scheduling of any and all bridge operating invasive work must be coordinated with and approved by the Bridge Master.

### 1.2.5. Navigational Start Up

Provide 40 hours of technical support to facilitate annual navigational season start up. This shall include ensuring that marine navigational aids,

vehicular/pedestrian traffic control and the bridge systems are operational and functioning in accordance with that defined in the O&M Manual.

#### **1.2.6. Additional Work**

Any work/repairs outside of the contract shall be identified to the Bridgmaster and approval to proceed shall be received prior to carrying out the work. Invoices shall identify the work in detail, listing material and labour, the authorizing officer and date and the specific work order reference number.

A quote together with details of work to be done shall be provided at the time of requesting approval. The Bridgmaster retains the right to disapprove the quote and subcontract the work to a third party.

#### **1.2.7. Exclusions**

Maintenance work for Building Services for the workshop building and tower elevators is excluded from this request. In addition, maintenance the existing standby generators will be performed by others but with basic and routine work, input and coordination with the Maintenance Contractor under this contract as described herein.

#### **1.2.8. Work Completion**

The Contractor shall complete the work as specified. Failure to do so may result in the Contractor being charged for additional shutdown costs, and cost of having the work completed by other forces, and any costs incurred by the PSPC.

### **1.3. Reference Documents**

Mechanical machinery shall be maintained in accordance with the provided documents and with best industry practice. General practice shall follow the inspection and maintenance requirements outlined in the information provided in the following reference documents.

The following is a list of documents made available by PSPC for use in maintaining the mechanical systems.

- .1 Burlington Canal Lift Bridge Mechanical Maintenance Manual
- .2 Burlington Canal Lift Bridge Maintenance Log
- .3 Lubrication Schematic 1 – Span Drive Machinery
- .4 Lubrication Schematic 2 – Span Lock Machinery, Centering Devices, Live Load Supports, and Buffers
- .5 Lubrication Schematic 3 – Tower and Lift Span Machinery

Note that the listed documents are not comprehensive. Other equipment that affect or contribute to the safe and reliable operation of the bridge shall be considered as part of this Contract even if not described in the reference documents. If modifications of the documents are made, the Contractor shall revise and update the documents.

## **1.4. Minimum Standards**

### **1.4.1. General**

- 1.4.1.1. Where applicable, execute work to meet and/or exceed the requirements of the following codes and Specifications:
- 1.4.1.2. Latest edition of the Bridge Inspection, Evaluation, and Maintenance Manual published by the American Association of State highway and Transportation Officials (AASHTO).
- 1.4.1.3. CAN/CSA S6-00 Canadian Highway Bridge Design Code.
- 1.4.1.4. National Building Code of Canada 2015, National Fire Code of Canada 2015, Ontario Building Code 2017 and any other code of provincial or local application.
- 1.4.1.5. Fire Commissioner of Canada, No. FC 301, Standard for Construction Operations, and No. FC 302, Standard for Welding and Cutting, latest version.
- 1.4.1.6. All applicable local and national safety regulations, including the Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Ontario 2018.
- 1.4.1.7. All applicable local and national environmental regulations, including the environmental Protection Act, O. Reg. 127/01 and O. Reg. 153/04.

### **1.4.2. Mechanical**

The bridge mechanical systems shall be maintained in accordance with the provided reference documents (including the maintenance manual), component manufacturers' instructions, and best industry practices. All provided information shall be used as a guideline and for tendering purposes. The maintenance tasks should be adjusted as necessary to minimize component wear and to ensure reliable operation. As an example, lubrication frequencies must be adjusted based on the lubrication performance during bridge operations over time.

If it is found that the bridge components are not listed or the components on the lubrication schedule are obsolete, the lubrication schedule shall be updated and submitted for review by the Bridge Master.

## **1.5. Coordination and Schedule**

### **1.5.1. Contract Schedule and Coordination**

- 1.5.1.1. Within two weeks after the award of this Contract, the Contractor, in consultation with the Bridgmaster, shall submit a work schedule listing equipment and systems to be inspected, tested, serviced or repaired and the time the work is done. Notify the Bridgmaster of any changes to the maintenance schedule.
- 1.5.1.2. The Bridgmaster reserves the right to modify the work schedule to meet the needs of the situation.
- 1.5.1.3. Register site attendance in log book with the PSPC representative and/or Security Officer on entering and leaving premises.

- 1.5.1.4. The Contractor shall ensure that all the relevant and applicable rules and regulations from Authorities having jurisdiction over the bridge area including highway and the waterway are met and adhered to.

#### **1.5.2. Maintenance Schedule**

- 1.5.2.1. The bridge is normally available for opening 24/7 during the navigable channel operating season from mid-March through December 31 each year.
- 1.5.2.2. The Contractor Shall:
- 1.5.2.3. Provide 24/7 on-call service during the bridge operating navigable season. This on-call service shall require the Contractor to respond to requests for services within 1-hour of notification. The Contractor shall be responsible for troubleshooting, repairing or replacing any item that has failed. This shall include both items that have caused a bridge operating failure or items that have failed but have not caused a bridge outage.
- 1.5.2.4. During the bridge shutdown season from January 1 through mid-March, the Contractor shall perform annual maintenance of the bridge mechanical systems as described in this statement of work. Note that during this bridge outage season, the Contractor is not required to be on-call but to respond on an as needed basis to requests for assistance from the Bridgmaster.

#### **1.5.3. Cooperation with Other Contractors**

The Contractor shall co-operate with other contractors hired by PSPC to perform any work on the bridge not directly related to the maintenance work specified herein. The Contractor shall maintain coordinated timing of maintenance work and adequate space separation to co-operate with other contractors hired by PSPC.

#### **1.5.4. Health and Safety**

The Contractor shall comply to Ontario Health and Safety Regulations.

#### **1.5.5. Cooperation and Protection**

Perform work with minimum disturbance to the operators and normal operation of the lift bridge. The bridge is in operation from mid-March to the end of December of every year. The Contractor shall coordinate with and obtain approval from the Bridgmaster for any required bridge or power outages necessary to perform his work.

The Maintenance Contractor will be granted use of existing bridge facilities with the permission and defined limitations of the Bridgmaster at no cost to the Maintenance Contractor.

#### **1.5.6. Power Shut Downs**

Power shut down shall be kept to a minimum. Scheduled shut downs with stating times and durations shall be requested well in advance and with the approval of the Bridgmaster obtained prior to proceeding with the shutdown. Premium time and cost, if required for any shutdown work, must be submitted and approved by the Bridgmaster prior to proceeding with the work. Note that these unquantified scheduled shutdowns shall not be allowed for in the Maintenance Contractors bid.

### **1.5.7. Meetings**

The Contractor or his representative shall attend monthly meetings at site when notified by the Bridgemaster. Time spent at the meeting is counted towards the committed employee-hours. For tendering purposes, it shall be assumed that a monthly meeting will take place for every month of the contract and each will have a duration of 2-hours.

## **1.6. Parts, Equipment and Tools**

### **1.6.1. General**

The Contractor shall supply all the equipment and tools required for this Contract. All equipment and tools used must be safe, suitable for the purpose intended, and in good condition.

Supply the Bridgemaster with the year, make, model and capacity of Contractor's equipment and calibration certification of all meters and recording instrumentation, if requested.

### **1.6.2. Materials**

Use new materials unless specified otherwise.

Purchase of any special, unstocked materials or equipment by the Contractor for any work under this Contract must be approved by the Bridgemaster prior to the procurement of such material and equipment. A quote with details of the material from the supplier shall be provided at the time of requesting approval. The Bridgemaster retains the right to disapprove the purchase and procure the same material through other channels.

### **1.6.3. Lubricants, Lubricating Equipment, and Tools**

- 1.6.3.1. Use new lubricants unless specified otherwise.
- 1.6.3.2. PSPC will provide the lubricants that the Maintenance Contractor is to use on the equipment. The Contractor shall inform the Bridgemaster of any materials required but not found in stock. The Bridgemaster shall either approve the Contractor to procure the defined stock items or make other arrangements for their procurement if he deems they are necessary for the maintenance of the bridge. Re-stocking of maintenance materials is not considered part of this base contract.
- 1.6.3.3. Purchase of any materials by the Contractor for any work under this Contract must be approved by the Bridgemaster first. A quote with details of the material from the supplier shall be provided at the time of requesting approval. The Bridgemaster retains the right to disapprove the purchase and procure the same material through other channels.
- 1.6.3.4. The Contractor shall supply all Lubricating Equipment (such as grease guns, brushes, sprayers, caulk guns, etc. to apply lubricants) and Tools (such as allen keys, wrenches, etc.) to complete the required lubrication and maintenance of the machinery.
- 1.6.3.5. Use of any lubricant that is not currently in use at the bridge shall be approved by the Bridgemaster prior to use.

1.6.3.6. Use of lubricants supplied by PSPC shall comply with applicable environmental rules and regulations. Specifically use of wire rope lubricant. If an environmentally friendly wire rope lubricant is selected by PSPC, complete removal of the existing wire rope lubricant may be necessary based on compatibility of the wire rope lubricants. Removal and installation of wire rope lubricant shall comply with all applicable environmental rules and regulations and is considered Additional Work and cost to the contract.

#### **1.6.4. Replacement Parts**

In cases where items are found to have worn out or are damaged beyond repair, the Contractor shall source and replace the item. Where possible the contractor shall use replacement parts by the manufacturer of the original part. Replacement parts are considered Additional Work and cost to the contract.

If an original part is not available, replacement parts by another manufacturer may be used with written approval from PSPC. The Contractor should recommend a replacement. The cost of the procurement and installation of the replacement part is not included in this contract. PSPC retains the right to appoint the Contractor or a separate agent for the procurement and installation of any identified replacement part.

#### **1.6.5. Spare Parts**

The Contractor shall provide a list of recommended spare parts to be stocked on site within one month after award of this Contract. The list shall include the name, part/catalogue number and supplier/manufacturer of each of the spare parts. As a basis for the preparation of this list the Contractor shall use the latest Maintenance Manuals for the bridge.

### **1.7. Personnel**

#### **1.7.1. Mechanical Experience**

1.7.1.1. The contractor shall be qualified journeyman or millwright in the maintenance and servicing of heavy machinery such as open gearing, bearings, couplings, and enclosed gear reducers.

#### **1.7.2. Subcontractor**

1.7.2.1. Immediately after the award of the contract, the Contractor shall provide the Bridgemaster with the name and address of any sub-contractors intended to be used for routine maintenance as part of the Contract.

1.7.2.2. The Contractor may hire subcontractors, with the approval of the Bridgemaster, for one-time maintenance work. The requirement of this document in its entirety applies to the subcontractor's work and employees.

1.7.2.3. A quote from subcontractor's together with details of work to be done shall be provided at the time of requesting approval. The Bridgemaster retains the right to reject any subcontractor and procure the same service or services through other channels.

#### **1.7.3. Contractor's Employees**

- 1.7.3.1. All Contractors employees shall be neatly and properly attired for the work to be performed. Personal protective equipment, including safety footwear, is mandatory at all times.
- 1.7.3.2. All Contractor employees shall abide by non-smoking restrictions. Smoking is only allowed in designated areas.

## **1.8. Documentation of Systems**

### **1.8.1. Site Documents**

- 1.8.1.1. File and maintain the following documents on site at the bridge
  - 1.8.1.1.1. The contract documents.
  - 1.8.1.1.2. Test and inspection reports and a log book.
  - 1.8.1.1.3. Up-to-date documentation for the operation and maintenance of the bridge. These documents should be properly bound, catalogued and filed and readily available for maintenance work. The documents should include but not limited to:
    - 1.8.1.1.3.1. All mechanical drawings updated with the latest revision. Both hard copies and digital copies should be properly filed at site with the Bridgemaster. All new drawings shall be produced in CAD (computer aided drafting) and in .dwg format. Shop drawings and catalogue cut-sheets of new equipment shall also be included and filed in hard copy and electronic form.
      - 1.8.1.1.3.1.1. All operation and maintenance manuals existing and new, properly bound in binders.
      - 1.8.1.1.3.1.2. All programs for the PLC (programmable logic controller), drives, and digital/analogue controllers shall be backed up and hard copies shall be printed out. Both digital and hard copies shall be filed at site and provided to the Bridgemaster.
- 1.8.1.2. All the documents mentioned above shall remain the property of PSPC and not be removed from site throughout the Contract and at the end of the Contract.

## **1.9. Premises Security and Security Clearances**

- 1.9.1. Maintain premises security during work; close and lock gates, windows and doors on completion of work.
- 1.9.2. Only designated employees of the Contractor and approved subcontractors are allowed at site. The Bridgemaster reserves the right to reject access to the bridge premises to anyone associated with this contract.
- 1.9.3. The contractor shall submit his name, address and date of birth and the name, address and date of birth of all employees who will be required to work in the above-mentioned facility, occupied premises, to the PSPC representative immediately following notification of contract award.

## **1.10. Fees and Permits**

- 1.10.1. The Contractor shall pay all fees required to obtain permits or certificates and shall make all arrangements with local utilities for isolation, grounding and re-energizing of electrical power, if such requirements are required to carry out the maintenance work.

**1.11. Right to Use Other Forces**

1.11.1. PSPC retains the right to appoint the Contractor or other agent for procurement of maintenance or for Additional Work. PSPC reserves the right to use their own, or any other forces of their choosing, to make any alterations on the bridge if they so desire.

**1.12. Maintenance Manuals**

1.12.1. As directed and scheduled by PSPC during the tendering process, the bidder shall participate in a site visit to the bridge. During the site visit, the Bidder will have the opportunity to interrogate all maintenance related documentation held at the bridge to assess its completeness and as a basis for their bid.

1.12.2. Following award of the contract the Contractor shall review the existing reference documents and, where maintenance information is missing, obtain maintenance manuals of the systems and equipment. Where manufacturer's maintenance information is unavailable, the Contractor shall document the maintenance/service required in the form of updated manuals to be submitted to the Bridgmaster for approval.

1.12.3. All maintenance manuals shall remain on site throughout the contract period and at the end of the contract. These manuals shall remain as PSPC property and be available to PSPC staff.

**1.13. Guarantees**

1.13.1. The Contractor shall guarantee any materials used and any work executed by him or his appointed sub-contractor, for a period of one year from the date of completion of the work.

**1.14. Existing Services**

1.14.1. Protect and maintain existing active services and facilities. Use existing services at no cost for maintenance of those items that are not covered under this contract.

**1.15. Monthly and Annual Maintenance Report**

**1.15.1. Monthly Maintenance Report**

A monthly Work Report summarizing the work done and the employee hours spent at site should also be submitted.

.1 Time spent for this inspection and writing of the report shall be charged as Maintenance hours.

.2 It shall be included as Item 1 Committed hours or billed as non-emergency service if the committed number of hours in that month has been exceeded

**1.15.2. Annual Maintenance Report**

The Contractor shall produce an annual mechanical inspection report for each fiscal year during the terms of this Contract. In case PSPC chooses to hire a third party to do an annual inspection, the Contractor shall co-operate with the third party to produce the Annual Inspection Report. In this case, no separate annual

report is required. Unless otherwise arranged and approved by PSPC, the Annual Inspection Report shall be due at the end of April of each year during the terms of this Contract.

In the event that PSPC decides that a third party performs the bridge mechanical maintenance inspection, the Contractor shall provide the necessary support for the third party to perform their inspection work.

The report shall include:

- .1 Major mechanical work and modification completed during the year.
- .2 Items of concerns and items identified by the Bridgmaster for special attention.
- .3 Recommendations
- .4 Reports of Tests and Inspection done by the Contractor and third party.
- .5 Photographs and drawings.

Time spent for this inspection and writing of the report shall be charged as Maintenance hours.

It shall be included as Item 1 Committed hours or billed as non-emergency service if the committed number of hours in that month has been exceeded

#### **1.16. Final Inspection**

- 1.16.1. The Contractor shall provide a final inspection of the mechanical systems within two months of the end of the Maintenance Contract. The final inspection shall be coordinated for inspection in the presence of PSPC Representative. Time spent for this inspection shall be charged as maintenance hours. It shall be included as committed hours or billed as non-emergency service, if the committed number of hours in that month has been exceeded.
- 1.16.2. All deficiencies known to the Bridgmaster and not rectified during the execution of the contract, and those deficiencies uncovered during the final inspection, shall be corrected prior to the Maintenance Contract closeout.

## 1.17. Mechanical Equipment and Systems Scheduled Maintenance

### 1.17.1. Scheduled Lubrication and Inspection

Maintenance tasks listed in this section shall be performed according to the schedule. Upon completion of each maintenance task a record should be made in a log to document completion, by whom, and if any notes apply to the component (loose bolt, uneven wear, noises during operation, leaking seal, etc.). Notes that warrant corrective action or further scheduled maintenance should be brought to the attention of the Bridgmaster and scheduled accordingly.

Sample log checklists are located in Section 8 of the Mechanical Maintenance Manual.

It is recommended to perform Annual scheduled maintenance to coincide with the start of the operational season (late February/early March).

### 1.17.2. 6-Month Maintenance & Inspection

#### 1.17.2.1. Motors

1.17.2.1.1. Check the mounting bolts.

#### 1.17.2.2. Brakes

1.17.2.2.1. The brakes at this bridge should be checked for wear and satisfactory operation.

1.17.2.2.2. Check and adjust the thruster reserve stroke as necessary (motor brake reserve stroke = 0.8"; machinery brake reserve stroke = 0.8").

1.17.2.2.3. The brake assemblies should be kept clean and free of debris.

1.17.2.2.4. Check brake wheels for corrosion and remove as necessary with Emory cloth.

1.17.2.2.5. The brake thruster seals should be inspected for signs of leaks. Any leaks should be addressed immediately with the consultation of both the engineering staff and the manufacturer.

#### 1.17.2.3. Reducers

1.17.2.3.1. Check the oil level.

1.17.2.3.2. Grease shaft seals as shown in lubrication schematic.

1.17.2.3.3. Replace breather as necessary.

1.17.2.3.4. Look for cracks at the feet of the housing.

1.17.2.3.5. Check for loose mounting bolts. If the bolts are loose, movement may be detectable when looking at the reducer feet during operation. Tighten any loose bolts.

1.17.2.3.6. Clean accumulated debris.

1.17.2.3.7. Monitor the reducer during operation of the machinery to detect the presence of abnormal vibration or noise.

1.17.2.3.8. Check for leaks at shafts.

#### 1.17.2.4. Couplings

1.17.2.4.1. Check for loose fasteners and torque fasteners per manufacturer's recommendations if necessary.

1.17.2.4.2. Inspect keys and keyways for cracks.

1.17.2.4.3. Listen for abnormal noises from the couplings during operation.

- 1.17.2.4.4. Inspect seals and gaskets for damage or leakage.
- 1.17.2.4.5. Grease as shown in Lubrication Schematic.
- Note that the coupling purge plugs should be removed when adding lube. At each lubrication fitting, pump grease until all old grease is purged and fresh grease pushes out the port. Clean up old excess grease in the area and re-install the plugs.
- 1.17.2.4.6. Clean any excess grease.
  
- 1.17.2.5. Span Drive and Span Lock Bearings
  - 1.17.2.5.1. Check condition of the cap and mounting bolts, and tighten if required.
  - 1.17.2.5.2. Lubrication fittings should be checked to ensure that they are not plugged and are operating properly.
  - 1.17.2.5.3. Remove any accumulated debris from in and around all bearings. Clean debris and excess lubricant from these areas at the 6-month inspection interval as a minimum. Adjust the frequency based on the amount of debris accumulation.
  - 1.17.2.5.4. Monitor the bearings during operation of the machinery to detect the presence of abnormal vibration or noise.
  
- 1.17.2.6. Span Position Equipment
  - 1.17.2.6.1. Lubricate the Span Position Equipment per the Lubrication Schematic.
  - 1.17.2.6.2. Check for loose mounting bolts.
  
- 1.17.2.7. Trunnion Bearings
  - 1.17.2.7.1. Check condition of the cap and mounting bolts, and tighten to manufacturer specified torque if required.
  - 1.17.2.7.2. Lubrication fittings should be checked to ensure that they are not plugged and are operating properly.
  - 1.17.2.7.3. Remove any leaked lubricant at the inboard bearing housing seal.
  - 1.17.2.7.4. Remove any accumulated debris from in and around all bearings.
  - 1.17.2.7.5. Monitor the bearings during operation of the machinery to detect the presence of abnormal vibration or noise.
  
- 1.17.2.8. Open Gearing
  - 1.17.2.8.1. Visually check the condition of the gear teeth. Observe for broken teeth or signs of abnormal wear to the teeth.
  - 1.17.2.8.2. Lubricate the gears per the Lubrication Schematic.
  - 1.17.2.8.3. Remove any accumulated debris from in and around all gears. Clean debris and excess lubricant from these areas at the 6-month inspection interval as a minimum. Adjust the frequency based on the amount of debris accumulation.
  - 1.17.2.8.4. Monitor the gears during operation of the machinery to detect the presence of abnormal vibration or noise.
  
- 1.17.2.9. Counterweight Sheaves
  - 1.17.2.9.1. Lubricate wire ropes grooves with wire rope lubricant. Clean any old/dried lubricant from the rope grooves.

- 1.17.2.9.2. Visually check for any cracks or signs of distress to the sheaves.
- 1.17.2.10. Main and Auxiliary Counterweight Ropes
  - 1.17.2.10.1. The entire length of the wire ropes should be lubricated including where the ropes enter the sockets at their ends.
  - 1.17.2.10.2. If surface corrosion is noted on the wire ropes, lubrication frequency should be increased.
- 1.17.2.11. Auxiliary Counterweight System
  - 1.17.2.11.1. Lubricate the Auxiliary Counterweight components per the Lubrication Schematic.
  - 1.17.2.11.2. Observe the auxiliary counterweight throughout operation for any abnormal noises or movement.
  - 1.17.2.11.3. Check for any loose bolts and fasteners and torques as necessary.
- 1.17.2.12. Span Lock Jaw Clamps and Latch Plates
  - 1.17.2.12.1. Lubricate the Jaw Clamps and Latch Plates per the Lubrication Schematic.
  - 1.17.2.12.2. Check for any loose bolts and fasteners and torques as necessary.
  - 1.17.2.12.3. Monitor the jaw clamp and latch plate operate through a bridge seating sequence and during a span lock operation to release the jaw clamps. Observe for abnormal noise or movement during operation. Adjust the span locks if needed per the span lock adjustment procedure in the supplemental maintenance section of this manual.
- 1.17.2.13. Span Guides
  - 1.17.2.13.1. Check mounting bolts.
  - 1.17.2.13.2. Grease guide rollers per the Lubrication Schematic.
- 1.17.2.14. Counterweight Guides
  - 1.17.2.14.1. Check mounting bolts.
  - 1.17.2.14.2. Grease guide rails.
- 1.17.2.15. Air Buffers
  - 1.17.2.15.1. Observe the upper and lower air buffers during operation for abnormal sounds and any other abnormal evidence. Lubricate the air buffers as needed until the buffer rod descends freely.
  - 1.17.2.15.2. Check mounting bolts.
  - 1.17.2.15.3. Check the exhaust piping for loose connections or signs of leaks.
- 1.17.2.16. Centering Devices
  - 1.17.2.16.1. Check for loose mounting bolts.
  - 1.17.2.16.2. Lubricate all contacting surfaces.
- 1.17.2.17. Live Load Supports
  - 1.17.2.17.1. Check for loose mounting bolts.
  - 1.17.2.17.2. Verify rockers are able to rotate freely and hang vertically when the bridge raises.

- 1.17.2.18. Cable Reel
  - 1.17.2.18.1. Lubricate the Cable Reel per the Lubrication Schematic.
  - 1.17.2.18.2. Check anchor bolts.
  - 1.17.2.18.3. Remove any accumulated debris in the surrounding area.
  
- 1.17.2.19. Warning and Barrier Gates
  - 1.17.2.19.1. Observe gates during operation for abnormal sounds and movement.
  - 1.17.2.19.2. Remove any accumulated debris from the interior and exterior of the gate housing.
  - 1.17.2.19.3. Check for loose mounting bolts.
  - 1.17.2.19.4. Lubricate the gate arm bearings and rod eyes. Clean excess lubricant and any accumulated debris.
  - 1.17.2.19.5. Check for signs of leakage from the reducer. If leakage is noted, check oil level and add as necessary.
  - 1.17.2.19.6. Visually inspect the condition of the Rotary Cam Limit Switch (RCLS) chain.
  
- 1.17.2.20. Span Position Equipment
  - 1.17.2.20.1. Observe span position equipment during operation for abnormal sounds and movement.
  - 1.17.2.20.2. Remove any accumulated debris from around gears, reducers, bearings, and U-joints.
  - 1.17.2.20.3. Check for loose mounting bolts.
  - 1.17.2.20.4. Lubricate per the Lubrication Schematic.
  - 1.17.2.20.5. Check for signs of leakage from the reducers. If leakage is noted, check oil level and add as necessary.
  
- 1.17.3. Annual Maintenance & Inspection
  - 1.17.3.1. Motors
    - 1.17.3.1.1. Perform all actions listed for 6-month inspection.
    - 1.17.3.1.2. Visually observed shaft bearing seals and grease bearings as shown in the Lubrication Schematic.
  
  - 1.17.3.2. Brakes
    - 1.17.3.2.1. Perform all actions listed for 6-month inspection.
    - 1.17.3.2.2. Document torque setting for brakes.
    - 1.17.3.2.3. Check brakes to ensure that they are holding torque.
    - 1.17.3.2.4. Check brake shoes for appropriate thickness.
    - 1.17.3.2.5. Inspect the integrity of the brake linkage assembly.
    - 1.17.3.2.6. Inspect the brake hand release mechanism to ensure that it is functional.
    - 1.17.3.2.7. Check the safety interlock limit switches for proper function.
    - 1.17.3.2.8. Check brake wheel/brake pad clearance with brake hand released using feeler gages.
    - 1.17.3.2.9. Check brake wheel/brake pad clearance with brake set using feeler gages. There should be zero clearance.

1.17.3.3. Reducers

- 1.17.3.3.1. Perform all actions listed under the 6-month inspection.
- 1.17.3.3.2. Clean and spot paint exterior surfaces to address deterioration.

1.17.3.4. Couplings

- 1.17.3.4.1. Perform all actions listed for the 6-month inspection.
- 1.17.3.4.2. If there are indications of an issue with the couplings, then disassemble them for inspection. For the span drive floating shaft couplings, this will require supporting the floating shaft by other means.
- 1.17.3.4.3. Clean and spot paint exterior surfaces to address deterioration.

1.17.3.5. Span Drive and Span Lock Bearings

- 1.17.3.5.1. Perform all actions listed for the 6-month inspection.
- 1.17.3.5.2. Purge the bearing grease annually at each lubrication fitting, pump grease until all old grease is purged and fresh grease pushes out around the shaft. Clean up old excess grease in the area.
- 1.17.3.5.3. Clean and spot paint exterior surfaces to address deterioration.
- 1.17.3.5.4. If there are indications of abnormal wear or if the bearing is not accepting grease, consider internal inspection.

1.17.3.6. Span Position Equipment

- 1.17.3.6.1. Perform all actions listed for the 6-month inspection.

1.17.3.7. Trunnion Bearings

- 1.17.3.7.1. Perform all actions listed for the 6-month inspection.
- 1.17.3.7.2. Clean and spot paint exterior surfaces to address deterioration.
- 1.17.3.7.3. Perform vibration testing annually at each bearing. The bearing manufacturer (SKF) has developed vibration analysis technology for bearings of this type that is non-invasive. According to SKF, it can be used to accurately predict bearing failures by examining the high frequency vibrations and Spectrally Emitted Energy (SEE®) that occur within the bearing during operation. This inspection work is considered Additional Work and cost to the contract.

1.17.3.8. Open Gearing

- 1.17.3.8.1. Perform all actions listed for the 6-month inspection.
- 1.17.3.8.2. Remove any old/dried lubricant in the roots of the gears.

1.17.3.9. Counterweight Sheaves

- 1.17.3.9.1. Perform all actions listed for the 6-month inspection.
- 1.17.3.9.2. Clean any old/dried lubricant from the rope grooves.

1.17.3.10. Main and Auxiliary Counterweight Ropes

- 1.17.3.10.1. Inspect for signs of corrosion or discoloration, and carefully inspect for any rust color on ropes.
- 1.17.3.10.2. Inspect for deterioration, broken wires, and flat spots in the rope and the terminations.
- 1.17.3.10.3. Inspect wire rope terminations for paint deterioration and corrosion. Correct as necessary.

1.17.3.11. Auxiliary Counterweight System

1.17.3.11.1. Perform all actions listed for 6-month inspection.

1.17.3.12. Span Lock Jaw Clamps and Latch Plates

1.17.3.12.1. Perform all actions listed for 6-month inspection.

1.17.3.12.2. Inspect the integrity of the span lock linkage assembly.

1.17.3.13. Span Guides

1.17.3.13.1. Perform all actions listed for 6-month inspection.

1.17.3.14. Counterweight Guides

1.17.3.14.1. Perform all actions listed for 6-month inspection.

1.17.3.15. Air Buffers

1.17.3.15.1. Perform all actions listed for 6-month inspection.

1.17.3.16. Centering Devices

1.17.3.16.1. Perform all actions listed for 6-month inspection.

1.17.3.17. Live Load Supports

1.17.3.17.1. Perform all actions listed for 6-month inspection.

1.17.3.18. Cable Reel

1.17.3.18.1. Perform all actions listed for 6-month inspection.

1.17.3.19. Warning and Barrier Gates

1.17.3.19.1. Perform all actions listed for 6-month inspection.

1.17.3.20. Span Position Equipment

1.17.3.20.1. Perform all actions listed for 6-month inspection.