

## SECTION 01 93 00 — <sup>A16</sup>MAINTENANCE SERVICES<sup>A16</sup>

**1.01 SUMMARY:** This section shall only apply if Provisional Sum No. 5 and/or Provisional Sum No. 6 is instructed in accordance with Sub-Clause 13.5 [*Provisional Sums*], and identifies the requirements for the Contractor to provide lock Maintenance Services after receipt of the Taking-Over Certificate. This entails providing all the maintenance for the Pacific and Atlantic lock complexes (as the case may be) during a three-year period following receipt of the Taking-Over Certificate under an all-inclusive approach, including, but not limited to, maintenance personnel, training, spare parts, materials, equipment, and documentation. It also entails registering all maintenance requirements, work orders, service calls, and related transactions into the enterprise asset management system (EAMS) provided by the Employer. Excluded from this all-inclusive maintenance approach are the janitorial, grounds-keeping, and grounds-maintenance services and maintenance (such as cleaning, painting, and pest control) required for buildings, facilities, and equipment provided by the Employer.

### **1.02** <sup>A16</sup>REFERENCES:<sup>A16</sup>

#### **A. Autoridad del Canal de Panamá (ACP) Publications:**

Manual de Seguridad y Salud Ocupacional (2000)

Manual de Seguridad de la División de Esclusas  
(2004)<sup>A10</sup>

### **1.03 REQUIREMENTS:**

**A. Systems to be Serviced:** <sup>A17</sup> If Provisional Sum No.5 and/or Provisional Sum No. 6 is instructed in accordance with Sub-Clause 13.5 [*Provisional Sums*], then after receipt of the Taking-Over Certificate, the Contractor shall provide, at the Atlantic lock complex and at the Pacific lock complex, Maintenance Services (as the case may be) for the following systems including, but not limited to, equipment, machinery, apparatus, components, materials, and related accessories,<sup>A17</sup>

1. Filling and emptying systems (including trash screens, culverts, conduits, ports, Water-Saving Basins, culvert and conduit valves and their operating machinery, seals, dewatering bulkheads, and other ancillary equipment);
2. <sup>A17</sup>Lock systems (including lock chambers, lock heads, lock gate trackways and bearings, and lock wall appurtenances);<sup>A17</sup>
3. Lock gate systems (including gates, rolling wagons, operating machinery, seals, and other ancillary equipment);
4. Control systems;
5. Electrical systems;
6. Lighting systems;
7. Foam/water fire-fighting systems;
8. Bridgeways;

9. Lock gate Recess closures;
  10. Communication systems;
  11. <sup>A17</sup>Culvert and chamber maintenance closure system;<sup>A17</sup>
  12. Other systems designed and installed by the Contractor.
- B. <sup>A16</sup>**Maintenance Documentation Package:**
1. <sup>A17</sup>**General:**
    - a. If Provisional Sums No. 5 and 6 are not exercised, the Contractor shall deliver a maintenance-documentation package for all systems listed, including, but not limited to, those listed under Subparagraph 1.03 A. that comply with the requirements of 1.03 B. of this section before the Taking-Over Certificate is issued.<sup>A17</sup>
    - b. If Provisional Sums No. 5 and/or 6 are <sup>A17</sup>instructed in accordance with Sub-Clause 13.5 [Provisional Sums], then the Contractor shall deliver, before the issue of the Taking-Over Certificate, a maintenance-documentation package for all systems listed, including, but not limited to, those listed under Subparagraph 1.03 A.<sup>A17</sup> The final documentation package shall be submitted to the Employer's Representative at least 182 days before the end of the three-year maintenance period. The maintenance experience gained during this period shall be taken into account for the development of the failure-analyses and maintenance procedures that will compose the documentation package. If changes are required after the submission of the final version of the maintenance documentation package, the Contractor shall submit them as amendments at the end of the three-year maintenance period. The documentation package shall consist of the following independent and interrelated study and documents.<sup>A16</sup>
  2. <sup>A16</sup>**Maintenance Study:**<sup>A16</sup>
    - a. **Fault-Tree Analysis:** <sup>A16</sup>A fault-tree analysis shall be made for each system. This analysis shall identify all the basic lowest-level component failures that could cause an operational failure of the main machinery or system, which in turn, could cause an operational failure.<sup>A16</sup> The analysis shall include a top-event failure definition, a consistent and clear event nomenclature, identification of minimum failure cut sets, graphical branch arrangement with logical-gate connections, and occurrence probability calculations.
    - b. **Failure-Mode, Effects, and Criticality Analysis (FMECA):** An FMECA shall be made for all the lowest-level-component failures identified from the fault-tree analysis. The FMECA analysis shall incorporate all potential failure modes, effects, and causes. This analysis shall be presented in a tabular form showing the main system, sub-system, component, functional failure, fault mode, fault effect and criticality, and the possible root causes.

- c. **Reliability-Centered-Maintenance (RCM) Analysis:** An RCM analysis shall be made for all the failure root causes identified from the FMECA analysis. This RCM analysis shall incorporate operational experience and shall identify the optimal planned maintenance tasks required to restore or maintain the operating systems to its inherent safety and reliability design level based upon the operating requirements of the new locks. The RCM analysis shall identify the lowest-level component failures based on concepts of failure distribution and progression so that the components can be classified based on the type of optimum maintenance to be implemented, as follows.
  - 1) **Run-to-Failure Maintenance:** A component whose failure distribution is unpredictable and does not show any failure progression, such that the failure occurs without any warning or measurable parameter.
  - 2) **Fixed-Time Maintenance:** A component whose failure distribution is predictable, regardless of the failure progression, such that the component can be replaced on a fixed-time schedule just before a failure occurs.
  - 3) **Condition-Based Maintenance:** A component whose failure progression is measurable and predictable regardless of the failure distribution, such that a fixed-time inspection can be performed that provides predictive information of when the failure **might** occur.
- 3. <sup>A16</sup>**Maintenance Master Manual:**<sup>A16</sup> The Contractor shall provide a comprehensive maintenance manual compendium that incorporates all the above-mentioned analysis and includes the following manuals.
  - a. <sup>A16</sup>**Preventive Maintenance Manual:** The Contractor shall provide a complete preventive maintenance manual based upon the optimum planned maintenance tasks identified through the RCM analysis. The manual shall include:
    - 1) **Inspections.** All the essential-care and predictive-condition-based inspections that are necessary, indicating the frequencies, procedures, and the equipment and materials required for such inspections. The procedures shall indicate what **to inspect** and how to inspect **it**, and the information that should be included in the inspection reports.
    - 2) **Periodic Maintenance Tasks:** For all the preventive tasks listed, the manual shall indicate the frequencies, task descriptions, tools, spare parts, and materials required to perform the preventive task.
    - 3) **Lubrication Data:** The manual shall include the following data:
      - a) A table showing recommended lubricants for specific temperature ranges and applications.

- b) Charts with schematic diagrams of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- 4) **Predictive Maintenance Tasks:** The manual shall include procedures for retrieving data from field sensors or for manually obtaining field data; for analyzing the data; and for deciding if preventive maintenance, adjustment, or corrective maintenance is required.<sup>A16</sup>
- b. <sup>A16</sup>**Corrective Maintenance Manual:** The Contractor shall provide a complete corrective maintenance manual based upon the component failures that are identified through the fault-tree analysis and that could occur through normal use, design improvement changes, accidents, or human error. This manual shall include:
  - 1) **Technical Data for Maintenance Instructions:** All job instructions shall provide references as required to an appendix section of the maintenance documentation package that provides technical data in support of the maintenance activity. This data shall include:
    - a) **Troubleshooting Procedures:** The manual shall include troubleshooting procedures for each system, subsystem, equipment, apparatus, component, assembly, subassembly, and related accessory.
    - b) **Troubleshooting Guides and Diagnostic Techniques:** The Contractor shall include step-by-step procedures to promptly isolate the cause of typical malfunctions. The Contractor shall clearly describe why the check is performed and what conditions are to be sought. The Contractor shall identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
    - c) **Wiring Diagrams and Control Diagrams:** Wiring diagrams and control diagrams shall be provided and shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. The Contractor shall provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, the Contractor shall number electrical and electronic wiring, pneumatic control tubing, and the terminals for each type in a manner identical to actual installation-configuration and numbering.
    - d) Other data as required.
  - 2) **Corrective Procedures:** All the required corrective procedures for each identified failure. Each corrective procedure shall

include instructions for disassembly, replacement or repair, lubrication, [overhaul](#), [reassembly](#), and commissioning before placing back in service, etc. The procedure shall include dimensions, parameter settings, required tolerances or torques, adjustments, calibrations, and any other requirement that must be achieved for optimum performance. The procedures shall also indicate all the necessary equipment, tools, spare parts, and materials required to perform the listed repairs.<sup>A16</sup>

c. **Original Equipment Manufacturer (OEM) Maintenance Manuals:**

The Contractor shall provide all the OEM maintenance manuals for all the commercial systems, equipment, and components that are covered under this documentation package. The submission of the OEM maintenance manuals does not release the Contractor from his responsibility to perform the required analyses and submit documents that constitute the documentation package.

d. <sup>A16</sup>**Spare Part Logistics Manual:** The Contractor shall provide a complete and comprehensive manual that identifies all the logistical requirements associated with the procurement, minimum levels, storage, and preservation of spare parts required to perform the preventive and corrective maintenance tasks. Regarding the required spare parts, the manual shall include: a spare parts list [with their prices and manufacturers, including point of contact, mailing addresses, telephone numbers, and e-mail addresses](#). The Contractor shall further detail the parts and spare parts for each system, subsystem, equipment, apparatus, component, assembly, subassembly, and related accessory, to include part identification; part location in drawings and manuals; part replacement procedures; part specification; main characteristics of parts (including but not limited to serial number and catalog number); part manufacturer (including address, telephone, fax, e-mail, and point of contact); and price. Spare parts and supplies that have a long lead time to obtain shall be so identified. The manual shall classify all spare parts in one of the following categories.

- 1) **Parts Identification:** Provide identification and coverage for all parts of each system, subsystem, equipment, apparatus, component, assembly, subassembly, and related accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that cross-references the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, component, assembly,

subassembly, attachment, or accessory, such as typically shown in a master parts catalog.

- 2) **Parts Classification:** The manual shall classify, for each system, all spare parts in one of the following categories.<sup>A16</sup>

a) **Proprietary Specification:** These are spare parts that have an OEM proprietary design and must be purchased directly from the OEM using a part number or a specified description.

b) **Technical Specification:** These are spare parts that can be purchased through any similar manufacturer, authorized distributor, or supplier utilizing a manufacturer part number and/or a technical specification. The spare parts and supplies shall be identified by model and make, plus the OEM's part number designation. (Reference numbers used by intermediaries for part designations are not required.)

c) **General Specification:** These are spare parts that can be purchased from any supplier or manufacturer utilizing a technical specification or manufacturing prints, shop drawings, or sketches with sufficient detail to permit its procurement without further documentation. The Contractor shall provide in an electronic format acceptable to the Employer's Representative all prints or drawings required for procurement.

- e. <sup>A16</sup>**Drawings Revisions:** The Contractor shall include as part of the maintenance documentation package all new drawings and revisions to the as-built drawings resulting from changes to any of the systems made during the three-year maintenance period. The Contractor shall submit these drawings for review to the Employer's Representative 225 days before the end of the three-year maintenance period, in order for them to be included in the final submission of the maintenance documentation package. If any changes to drawings are made after the Employer's Representative review, the revised drawings shall be submitted as an amendment to the maintenance documentation package at the end of the three-year maintenance period.<sup>A16</sup>

- f. <sup>A16</sup>**Warranty Information:** The Contractor shall list and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or in the Contract in order to keep warranties in force. The Contractor shall include the following information in the warranty submittal.

- 1) The Defects Notification Period shall be in accordance with Clause 11 (Defects Liability) of the Conditions of Contract.

- 2) **Equipment/Product Warranty Document:** The Contractor shall furnish to the Employer's Representative a bound and

indexed document containing the written warranties for Plant and Materials that have extended warranty periods (those which exceed the Contract's Defect Notification Period) and a complete listing of such Plant and Materials. The Plant and Materials list shall state the [section of the Employer's Requirements that is](#) applicable to the Plant or Materials, duration of the warranties therein, start and ending date of the warranties, and the points of contact for fulfillment of the warranties. The Contractor shall execute the equipment/product warranty document and deliver it to the Employer's Representative prior to the issue of the Performance Certificate. The warranties shall include a written commitment from the Plant/Material guarantor (supplier/manufacture) to acknowledge that warranties shall be executed in favor of the Employer immediately after the Defects Notification Period.

- 3) **Equipment Warranty Tags and Guarantor's Local Representative:** The Contractor shall furnish with each warranty, the name, address, and telephone number of the guarantor's representative nearest to the location where the Plant and Materials are installed. The guarantor's representative, upon request of the Employer's unit representative, shall honor the warranty during the extended warranty period and shall provide the services prescribed by the terms of the warranty. At the time of installation, the Contractor shall tag each item of warranted equipment with a durable, oil- and water-resistant tag approved by the Employer's Representative. The Contractor shall attach the tag with copper wire and spray [the tag](#) with a clear silicone waterproof coating. The Contractor shall leave the date of acceptance and quality control's signature blank until the issuance of the Performance Certificate. The tag shall show the information shown in Table No. 1, included at the end of this Section.<sup>A16</sup>

4. <sup>A16</sup>**Maintenance Master Schedule:** The schedule shall list all recommended maintenance jobs that may be scheduled. The Contractor shall consider the manufacturer's recommended maintenance, inspections, tests, and adjustments and submit as many typical annual schedules as required to define a maintenance program for the life of the systems [in order to](#) ensure proper and economical operation while minimizing corrective maintenance. Each maintenance job scheduled shall refer to its corresponding job instruction. The schedule shall include all major maintenance work required during the life of the systems.<sup>A16</sup>

C. **Locks Systems Maintenance:**

1. **Scope:** The Contractor shall provide [Maintenance Services](#) to the systems listed in Subparagraph 1.03 A. during the required three-year period. <sup>A17</sup>The purpose of all [Maintenance Services](#) is to maintain the systems, throughout this period, so that they will perform equally or better than what was demonstrated during the required Tests on Completion. During this period, the Contractor shall provide all labor, supervision, parts, and materials for routine and particular maintenance



and repair to the systems identified in Subparagraph 1.03 A. and others which are part of the Works **that** were designed and installed by the Contractor.<sup>A17</sup>

2. **Lane Availability:** Maintenance Services shall be planned and executed in such a manner as to have a lane availability **for each lock complex** of not less than that specified in Subparagraph 1.02 K. of Section 01 10 00 (*General Project Requirements*).<sup>A17</sup> For planning purposes, the sum of all expected out-of-service time for any one system, calculated as a consequence of the execution of the optimal-planned maintenance tasks (refer to Subparagraph 1.03 B.2.a.) and the corrective-maintenance tasks described in Subparagraph 1.03 B.2.b., directly or indirectly resulting in a lane being out of service shall be taken into account in calculating lane availability.<sup>A17</sup> For the purposes of this calculation, a lane is considered out of service when maintenance functions take control of the lane and lockages cannot be carried out in the lane in accordance with the operational requirements in the Contract. Lane availability (in percent) shall be calculated as follows:<sup>A16</sup>

**Lane availability = [(total time – time lane is out of service) ÷ total time.] x 100**

3. **Training:** During this period, the Contractor shall be required to provide training to the Employer's Personnel **who** will be designated to take over the lock maintenance after the Performance Certificate is issued.<sup>A17</sup> The Contractor shall update such training as necessary during the 3-year **Maintenance Service** period.<sup>A17</sup>
4. **Documentation and Reporting:** During this period, the Contractor shall document and report all maintenance requirements (service calls; work orders for: preventive, predictive, and corrective maintenance; down time reports; equipment history; etc.) in a format that can be easily inputted into the enterprise asset management system (EAMS) provided by the Employer. See Subparagraph 1.04 D. The Contractor shall present a monthly report to the Employer's Representative that shall include, but not be limited to, the status of locks equipment; equipment availability; delays on account of equipment failures; calculated lane availability; preventive, predictive, and corrective maintenance action reports; equipment maintenance costs; inventory turn over ratio and costs; manpower usage and requirements; etc.<sup>A17</sup> The monthly calculated lane availability shall be based on 720 hours or 43,200 minutes for a month of 30 days. See Subparagraph 1.03 C.2.<sup>A17</sup>
5. **Safety:** During this period, the Contractor shall abide by the Employer's Manual de Seguridad y Salud Ocupacional and Manual de Seguridad de la División de Esclusas while performing maintenance work.
6. **Manuals:**<sup>A16</sup> The Contractor shall incorporate into the operation and maintenance manuals any changes in operations and maintenance procedures developed during this period.<sup>A16</sup>
7. **Inventory:**<sup>A17</sup> In order to prevent delays and expedite replacements, the Contractor shall maintain an adequate stock of parts, maintenance equipment, and Materials for routine and particular maintenance and for site repairs. The Contractor shall restock the parts, maintenance equipment, and Materials



inventory at the end of the three-year maintenance period before turning the inventory over to the Employer.<sup>A17</sup>

- a. <sup>A16</sup>It will be the choice of the Employer (at [the discretion of the Employer's Representative](#)) to require that spare parts be new or refurbished by the original manufacturer.<sup>A16</sup>
  - b. The Employer will provide storage facilities through its "División de Compras, Almacenes e Inventarios" (FAA). <sup>A17</sup>The Contractor shall provide secure storage space for the site inventory.<sup>A17</sup>
  - c. **Transfer to the Employer:** <sup>A17</sup>Upon [completion](#) of the maintenance period, the Contractor shall restock the parts, maintenance equipment, and Materials inventory and turn over the complete stock of parts, maintenance equipment, and Materials to the Employer.<sup>A17</sup> Warranty on spare parts shall be no less than one year starting on the date of transfer of parts to the Employer. Electronic digital products shall be transferred to the Employer with the latest firmware or a specific firmware revision at the choice of the Employer. The Contractor shall transfer any parts maintenance agreement (PMA) or vendor-managed unused stock of parts and Materials to the Employer. The inventory turned over to the Employer at this time shall include:
    - 1) <sup>A16</sup>Depending on which number is larger, at least two (one per lock complex) or 10% (of the total number of the main system, main equipment, or main sub-component) replacements of critical lowest-level components or assemblies. A critical component or assembly is one that is identified as subject to a run-to-failure event and whose absence would have a high impact on the safe operation of the locks and [on](#) the lane availability referred to in Subparagraph 1.02 K. (*Availability*) of Section 01 10 00 (*General Project Requirements*), or both.<sup>A16</sup>
    - 2) A 1-year supply of any item or spare part that is contained in the spare part logistics manual mentioned in Subparagraph 1.03 C.1.d.4), that is not readily available in the local market, that may require replacement at least 3 times a year, or that has expected yearly consumption costs of \$1,000.00 or more.
    - 3) Items with very long lead items based on the RCM analysis.
8. <sup>A16</sup>**Technical Support Plan:** A technical support plan shall be developed by the Contractor to provide continuous and prompt response to the Employer in case of malfunctioning, doubts on operation or maintenance, or any other consultation of a technical nature related to the equipment.
  9. <sup>A17</sup>**Maintenance Equipment and Spare Parts:** [During the three-year maintenance period, the Contractor shall retain such Goods, maintenance equipment, spare parts, and other items, as are required for the Contractor to fulfill his obligations under the Contract. These Goods shall be kept according to instructions issued by Employer's Representative in designated storage facilities](#)

at the Site or at other locations in the possession of the Employer. The Works shall not be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 (*Taking Over of the Works*) until the maintenance equipment and spare parts specified below have been delivered to the designated storage facilities, i.e., these items shall be included in the total base price stated in the Schedule of Project Elements and Prices. Refer to Section 01 92 00.13 (*Dry Outages*) for Dewatering / Pumping Systems requirements.

a. **Maintenance Equipment:**

- 1) **Gate Recess Closures:** The Contractor shall provide gate Recess closure assemblies that are able to effectively seal off from the lock chamber any of the gate Recesses in the lock complexes. One set of each different size and type of gate Recess closure assemblies is required for the Pacific lock complex and one set of each different size and type of gate Recess closure assembly is required for the Atlantic complex. Refer to Section 01 81 19 (*Lock Gates*) for Recess closures.
- 2) **Locks Gate Recess Dewatering / Pumping System:** The Contractor shall provide at least two sets of a portable dewatering / pumping systems for dry gate Recess maintenance outages. This system shall fit and work properly in any of the gate Recesses of either the Pacific lock complex or the Atlantic lock complex. Refer to Section 01 81 19 (*Lock Gates*) for Recess dewatering / pumping system requirements.
- 3) **Culvert and Conduit Bulkheads:** The Contractor shall provide at least four culvert and four conduit maintenance bulkheads of each type and size for each lock complex to allow for valve removal and maintenance. Refer to Section 01 81 23 (*Culvert and Conduit Valves*) for requirements.
- 4) **Culvert or Conduit Valve Pit Dewatering Pump System:** The Contractor shall provide at least two sets of a portable pumping / dewatering systems for dry culvert or dry conduit valve pit maintenance outages. This system shall fit and work properly in any of the culvert or conduit valves pits of either the Pacific lock complex or the Atlantic lock complex. Refer to Section 01 81 23 (*Culvert and Conduit Valves*) for requirements.
- 5) **Culvert Dewatering Pump System:** The Contractor shall provide at least one set of a portable pumping/dewatering system for dry culvert maintenance outages. This system shall fit and work properly in any of the culvert levels of either the Pacific lock complex or the Atlantic lock complex. Refer to Section 01 81 23 (*Culvert and Conduit Valves*) for requirements.
- 6) **Maintenance Closure System:** If Provisional Sum No. 4 of Section 01 10 00 (*General Project Requirements*) is exercised, the Contractor shall provide at least one complete maintenance closure system with all its components and accessories to allow

for the dewatering of the Atlantic or Pacific lock chambers in accordance with Section 01 81 19 (*Lock Gates*), Subparagraph 1.03 Y.

- 7) **Locks Chamber Dewatering / Pumping Systems:** The Contractor shall provide at least one set of a transportable pumping/dewatering system to fit and work properly in either the Atlantic or Pacific lock complexes. Refer to Section 01 92 00.13 (*Dry Outages*) for dewatering / pumping systems requirements.<sup>A17</sup>

b. **Spare Parts:**

- 1) **Locks Gate Wagons:** One set of each type and size shall be provided for the new Pacific lock complex and one set of each type and size for the new Atlantic lock complex. One set consists of all the rolling wagons required for any size gate.
- 2) **Locks Gate Gear Drives:** One set of each type and capacity shall be provided for the new Pacific lock complex and one set of each type and capacity for the new Atlantic lock complex.
- 3) **Spare Culvert Valves Sets:** One spare culvert valve assembly set shall be provided for the Pacific lock complex and 1 set shall be provided for the Atlantic lock complex. Additionally, 1 set of spare conduit valve assemblies shall be provided for the Pacific lock complex and 1 set shall be provided for the Atlantic lock complex. Each spare valve assembly set shall include all components required for complete replacement of any corresponding valve in the system including, but not limited to, the valve body and all required operating machinery. Refer to Section 01 81 23 (*Culvert and Conduit Valves*) for requirements of culvert valve sets.<sup>A16</sup>

**1.04 SUBMITTALS:**

A. **Staffing and Qualifications:**

1. <sup>A16</sup>The Contractor shall submit the corresponding information for all supervisors, technicians, and laborers required for the period of maintenance and repair support.<sup>A16</sup>
2. <sup>A10</sup>The Contractor shall submit, to the Employer's Representative, the staffing requirements, experience, and qualifications of the Contractor's Personnel who will develop the maintenance documentation package. In case this task is to be subcontracted, the Contractor shall submit documentation of the proven experience and capacity of the Subcontractor to carry out this work.<sup>A10</sup>

B. **Training and Transition Plans:**

1. <sup>A16</sup>At least 1 year before the end of the three-year period of maintenance responsibility by the Contractor, the Contractor shall submit, to the Employer's Representative, a plan for the transition of the maintenance and repair function.

The plan shall include a 182-day transition period before the end of the three-year maintenance period, in order to facilitate the Employer taking over the entire maintenance and repair function. The Contractor shall also submit, to the Employer's Representative, a training plan to support all transitions.<sup>A16</sup>

C. <sup>A16</sup>**Maintenance Documentation Package:**

1. The Contractor shall submit, to the Employer's Representative for review, a final draft of the maintenance documentation package at least 273 days before the end of the three-year maintenance period.
2. The final revised version of the maintenance documentation package shall be submitted prior to the start of the 182-day transition period (referred to in Subparagraph 1.04 B.2. above) so that copies of the documentation package can be used for the training plan. Refer also to Section 01 79 00 (*Demonstration and Training*).<sup>A16</sup>
3. The Contractor shall submit 10 complete and identical copies of the final revised version of the maintenance documentation package, unless otherwise approved by the Employer's Representative.<sup>A10</sup>

D. <sup>A16</sup>**Enterprise Asset Management System (EAMS):** It is the intent of the Employer to have installed, within the next three years, an enterprise asset management system (EAMS) to manage the condition of all of its existing assets including those under construction such as the Works under this Contract.

1. **Assets Maintenance Documentation:** Without prejudice to requirements specified elsewhere and in addition to the aforementioned maintenance plan data, the Contractor shall submit the following information in a format approved by the Employer's Representative and shall input this information into the EAMS.

a. **Job Plans:**

- 1) Job plan number.
- 2) Job description.
- 3) Safety plan.
- 4) Labor list.
- 5) Materials list.
- 6) Tools list.

b. **Root Cause Analysis:**

- 1) Failure codes and descriptions.
- 2) Cause codes and descriptions.
- 3) Resolution codes and descriptions.

- c. **Preventive Maintenance:**
    - 1) PM identifier.
    - 2) PM short description.
    - 3) PM long description.
    - 4) Asset number.
    - 5) Frequency in days, hours, events, etc.
  - d. **Equipment Meters:**
    - 1) Meter label.
    - 2) Reading units of measure.
  - e. **Spare Parts:**
    - 1) Equipment number.
    - 2) Spare part number.
    - 3) Quantity needed.
    - 4) Description.
2. **Maintenance Transactions Information:** The Contractor shall input all maintenance related information, including transactions that occur from the first day after the Taking-Over Certificate is issued, in accordance with any such EAMS. The transactions shall include all down-time reports; service calls; work orders for preventive, predictive and corrective maintenance; equipment history and replacement reports; and other related information required by the EAMS.
3. **Maintenance Program:** The Contractor shall input into the EAMS the maintenance job instructions and all other required input, to ensure that the EAMS is fully documented and effective for implementing the recommended maintenance program.

#### 1.05 PAYMENT FOR MAINTENANCE SERVICES:

- A. Payment for Maintenance Services will be on a monthly basis.
  - 1. If Provisional Sum No. 5 is instructed in accordance with Sub-Clause 13.5 [Provisional Sums], then the monthly installment for Atlantic lock-Maintenance Services shall be calculated as 1/36th of the USD amount in item 2.3.5 of the Schedule of Project Elements and Prices required under Volume V, Part 9 (*Price Proposal*) (as adjusted by Subparagraph 1.05 B. below).
  - 2. If Provisional Sum No. 6 is instructed in accordance with Sub-Clause 13.5 [Provisional Sums], then the monthly installment for Pacific lock-Maintenance Services shall be calculated as 1/36th of the USD amount in item 2.3.6 of the

Schedule of Project Elements and Prices required under Volume V, Part 9 (*Price Proposal*) (as adjusted by Subparagraph 1.05 B. below).

- B. Monthly installment for the Atlantic lock-Maintenance Services and/or Pacific lock-Maintenance Services set out in Subparagraph 1.05 A. shall be adjusted to account for the actual lane availability (as defined in Subparagraph 1.03 C.2.). Monthly payments will be adjusted as follows:

$$\begin{array}{l} \text{adjusted} \\ \text{monthly} \\ \text{installment for} \\ \text{the relevant} \\ \text{Maintenance} \\ \text{Service} \end{array} = \begin{array}{l} \text{monthly} \\ \text{installment} \\ \text{of the} \\ \text{relevant} \\ \text{Maintenance} \\ \text{Service as set} \\ \text{out in} \\ \text{Paragraph} \\ \text{1.05 A.} \end{array} \times \left( \frac{\text{actual lane availability}}{\text{required lane availability}} \right)^6$$

- C. Should the actual lane availability of either lock complex exceed the lane availability required under Subparagraph 1.02 K. of Section 01 10 00 (*General Project Requirements*), the adjusted monthly payment shall not be greater than the monthly installment as calculated for the Atlantic lock-Maintenance Services and/or Pacific lock-Maintenance Services set out in Subparagraph 1.05 A.

| <b>TABLE NO. 1: EQUIPMENT/PRODUCT EXTENDED WARRANTY TAG</b> |  |                         |  |                                    |  |
|---|--|-------------------------|--|------------------------------------|--|
| Type of Equipment/Product:                                  |  |                         |  |                                    |  |
| Warranty Period:  |  | From:<br>day/month/year |  | To:<br>day/month/year              |  |
| Contract No.:   |  |                         |  |                                    |  |
| Inspector's Signature:                                      |  |                         |  | Acceptance Date:<br>day/month/year |  |
| <b>Contractor:</b>  |  |                         |  |                                    |  |
| Name:   |  |                         |  |                                    |  |
| Address:  |  |                         |  |                                    |  |
| Telephone:  |  |                         |  |                                    |  |
|   |  |                         |  |                                    |  |
| <b>Warranty Contact:</b>                                    |  |                         |  |                                    |  |
| Name:   |  |                         |  |                                    |  |
| Address:  |  |                         |  |                                    |  |
| Address:  |  |                         |  |                                    |  |

**END OF SECTION**



**THIS PAGE NOT USED**