

SECTION 01 10 00 – GENERAL PROJECT REQUIREMENTS

1.01 GENERAL OVERVIEW: ^{A17}The Panama Canal Expansion Program is intended to increase the Transit capacity of the Canal to meet the growing cargo-carrying demand along major international maritime trade routes. The principal component of this program and the object of this Contract is the Third Set of Locks Project, henceforth referred to as the Works. The Works comprise the design and construction of two lock complexes, one on the Atlantic end and the other on the Pacific end of the Canal. ^{A17} ^{A16}Each complex shall consist of the Lock Structures and systems themselves, in addition to the associated buildings, facilities, and other systems required for their operation. The purpose of the Works is to provide a fully operational Transit system for Post-Panamax vessels at each location. ^{A16}

1.02 TOP PROJECT REQUIREMENTS: ^{A17}This Paragraph 1.02 identifies the top requirements for the Works, which may be further specified in other Paragraphs of this Section and in other Sections of the Employer's Requirements. ^{A16} The Contractor shall design, develop specifications, and construct the Works to meet the following top requirements. ^{A17}

- A. **Design Vessel:** The third set of locks shall allow a vessel with the dimensions of the Design Vessel to safely Transit through the Panama Canal in either direction between the Pacific Ocean and the Atlantic Ocean, optimizing both Lockage Time and Cycle Time. The Works shall be designed and constructed to handle vessels of various types, sizes and shapes. ^{A19}However, a 12,000 TEU containership (19 containers across deck) is the Design Vessel [see Section 01 42 16 (*Definitions*)] that shall be considered in the design in accordance with the Employer's Requirements. ^{A19}
- B. **Lockage Objective:** The third set of locks shall raise transiting vessels from the ocean water level (Atlantic Ocean or Pacific Ocean) to the Gatun Lake water level ^{A5}and, subsequently, ^{A5} lower transiting vessels from the Gatun Lake water level to the ocean water level. The lockage, or raising and lowering operations, shall be performed in three consecutive steps using chambers designed and constructed for ^{A5}such ^{A5} purpose.
- C. ^{A16}**Lockage Time and Cycle Time:** Lockage Time and Cycle Time shall be significant factors in the design. The objective shall be to develop an overall design that reduces both times to a minimum, consistent with safe operation and taking into full account the safe movement of Design Vessels into and out of the locks. The design shall minimize individual component operating times in order to maximize throughput. The design shall give utmost priority to minimizing vessel restrictions in order to increase capacity. ^{A16}
 - 1. ^{A16}The maximum Lockage Time is the total time for a complete lockage including movements of the Design Vessel through each lock complex. Lockage Time shall not exceed 154 minutes when using Water-Saving Basins (WSBs) and 133 minutes when not using them. The Cycle Time for Relay Lockages shall not exceed 88 minutes with WSBs or 74 minutes without them. All times shall be for a Design Vessel in fully loaded condition.
 - 2. Calculations of Lockage Time and Cycle Time shall be based on all range of water levels at Gatun Lake and the oceans. Refer to Section 01 81 13, (*Lock Filling and Emptying Systems*). ^{A16}
 - 3. The Contractor shall specifically address the following components of Lockage Time. The Employer recognizes that the times in vessel movement are not totally under the Contractor's control.

- a. ^{A10}The time required to close the lock gates (responsibility of the Contractor).
 - b. The time required to enter the lock chambers (responsibility of the Employer).
 - c. The time required to moor the vessel (responsibility of the Employer).
 - d. The time required to fill or empty for Equalization of the lock chambers (responsibility of the Contractor).
 - e. The time required to open the gates (responsibility of the Contractor).
 - f. The time required for unmooring the vessel (responsibility of the Employer).
 - g. The time for the vessel to move from one lock chamber to the next chamber (responsibility of the Employer).
 - h. The time for the vessel to exit the last chamber (responsibility of the Employer). ^{A10}
4. ^{A17}The Employer's required not-to-exceed ^{A17} ^{A14}times for each component of Lockage Time and Cycle Time are detailed in Section 01 92 00 (*Facility Operation*). ^{A16}
- D. ^{A17}**Principal Features:** Each lock complex shall consist of three lock chambers; four lock heads, each lock head shall house two rolling gates; and a chamber filling and emptying (F-E) system comprising a ^{A17} ^{A16}well balanced culvert system, valves, conduits and WSBs (where culverts connect hydraulically with the chambers through ports, and WSBs connect hydraulically with the culverts through conduits). ^{A16}
- E. **Water Savings:** Each lock complex shall provide water savings of at least 59% when Water-Saving Basins (WSBs) are used for lockages, as compared with lockages without WSBs.
- F. ^{A7}**Location, Alignment and Reference Points:** Location and alignment of the lock complexes shall be in accordance with Drawing 5801-4, ^{A7} ^{A17}Volume II, Part 4 (*Requirement Drawings*). Reference points for setting out the Works, as indicated in Sub-Clause 4.7 (*Setting Out*) of the Conditions of Contract are provided on Drawings 5802-2 and 5803-2, Volume VI, Part 1 (*Reference Drawings*). ^{A17}
- G. **Main Dimensions:** The main lock chamber dimensions shall be as follows.
1. The width between the opposite walls of each chamber shall be a minimum of 55 m. The useable width shall be at least 54.4 m. The clearance between the structural walls and the hull of the vessel is for fendering (0.3 m on each side of the chamber).
 2. The minimum water depth in the lock chambers, gate sills, and at the approach structures shall be 18.3 m.

3. ^{A16}The gate configuration used affects chamber length, but the following minimum usable chamber lengths shall apply in each case. ^{A16}
 - a. 427 m chamber length is determined by the internal chamber length dimensions between the inner gates at both ends of the chamber.
 - b. 458 m chamber length is determined by the internal chamber length dimensions between the inner gate at one end and the outer gate at the other end.
 - c. 488 m chamber length is determined by the internal chamber length dimensions between the outer gates at both ends.
- H. **Gatun Lake Retention:** ^{A19}Each lock complex shall retain the Gatun Lake impoundment under all load conditions described in Section 01 81 16 (*Lock Structures*). Borinquen Dams shall retain the Gatun Lake impoundment under all load conditions and other design criteria described in Section 35 73 00 (*Borinquen Dams 2E, 1W, and 2W*). Adequate design solutions shall be provided to guarantee lake retention under all eventualities described in the Employer's Requirements, including, but not limited to, normal operations, collisions, earthquakes, equipment malfunction, and human error. ^{A19}
- I. **Safety and Efficiency:** Each lock complex shall provide for the lockage of vessels between sea level (Atlantic or Pacific) and the elevation of Gatun Lake in a safe and efficient manner, without causing structural damage to vessels or lock facilities. The chambers shall be designed to safely equalize water levels between adjacent chambers and WSBs, in spite of differing volumes or Equalization machinery malfunctions. Volume differences may be caused by differences in chamber lengths or fill levels (due to lake or ocean variances) or a combination of these.
- J. **Service Life:** Each lock complex shall have a functional lifetime of 100 years.
- K. ^{A19}**Required Lane Availability:** Each lock complex shall be operational at least 99.6% of the time during each month. Lane service outages for schedule maintenance, incidental breakdowns and unscheduled maintenance, and emergency repairs shall not exceed 0.4% of the time each month. The Contractor shall assume that outages resulting from Force Majeure will be excluded from the calculation of the required lane availability. ^{A19}
- ^{A11}L. **Flood Protection:** All critical elements of each lock complex shall be protected against flooding.
 1. At the upper level, the maximum water level to be considered for flood-protection design shall be 28.70 m (94.14 ft) PLD. This value includes the associated wave loading.
 2. At all levels, including the upper level, a maximum water level 0.30 m above the level of the lock wall shall be assumed for accidental flooding. ^{A11}

1.03 GENERAL PERFORMANCE CRITERIA:

A. ^{A17}Structure and Intent of the Specifications:

1. **Employer’s Requirements Organization:** Volume II (*Employer’s Requirements*) is divided into four parts, being ^{A17} Part 1 (*Main Performance Requirements*) and Part 2 (*Supplemental Performance Requirements*). As its name implies, Part 1 encompasses the main performance requirements, while other more-specific requirements appear in Part 2.

a. This applies in particular to the electrical requirements and to the control, communication, safety, and security requirements, which are each outlined with a “mother” Section (containing general requirements) in Part 1 and “daughter” Sections (including the specifics) in Part 2. The Sections in Part 1 are presented as umbrella or catchall performance requirements, but the entire specification package has to be read as a whole.

b. ^{A19}This section — 01 10 00 (*General Project Requirements*) — in particular, is intended to provide general requirements and an overview of the technical requirements that are covered in detail in other sections. ^{A19} The Contractor shall design, specify, and construct the Works to meet the general performance criteria specified herein, as well as the additional detailed performance and design criteria provided in other Sections of the Employer’s Requirements. ^{A7}

2. ^{A17} (Reserved)

B. (Reserved) ^{A17}

C. ^{A7}**Conceptual Drawings**^{A7}: The conceptual design drawings (refer to Volume VI, Part 1) are general layout drawings of the lock complexes prepared by the Employer to depict the project concept. These conceptual drawings shall not be construed as design drawings for the lock complexes ^{A17}and the Contractor is referred to the final paragraph of Clause 5.1 (*General Design Obligations*) of the Conditions of Contract. ^{A17}

D. ^{A7}**Design for Operations, Safety, and Maintenance**^{A7}:

1. The Contractor shall prepare a design and specifications for the locks that are ^{A5}functional, reliable, and able^{A5} to operate 24 hours a day, every day of the year. Important design objectives are to minimize water used for lockages, minimize staffing requirements, optimize operational efficiency, and keep to a minimum lock downtimes required for maintenance or replacement of operating components.

2. The Contractor shall furnish a design that provides vehicular access to all above-ground structures for maintenance and operation, access for ^{A5}emergency-response^{A5} vehicles, and an overall layout for operating conditions that protects the safety of navigation in the locks and of personnel working on the locks.

3. ^{A16}The Contractor shall design, provide, install, and commission all Plant necessary for control and function of the lock complexes. ^{A16} This shall include, but not be limited to, ^{A5}process-control^{A5} systems (including centralized control

of lock operations); visual, audio, and electronic surveillance systems; command and control communication systems; real-time condition sensors for lock gates, valves, and operating equipment; spare parts; and spare operating equipment for damaged components.

4. The Contractor shall provide ^{A7} designs that ensure durability without loss of functionality throughout the required design life and reduce maintenance requirements to the lowest practical level in terms of required outages, and maintenance and repair costs and consider full life-cycle costs, ^{A7} including spare parts, servicing, maintenance manpower, and Plant (equipment) replacement costs for a minimum of 25 years.
5. The Contractor shall incorporate the following design concepts to ensure that the lock complexes are maintainable:
 - a. Corrosion prevention by design shall be applied during all design phases. ^{A7} Materials shall be selected with corrosion and wear resistance adequate for the environment and service, ^{A7} and dissimilar metals that are near each other shall be protected against galvanic corrosion. Should a corrosion-resistant design element not be available, the susceptibility shall be mitigated with coatings appropriate for the environment, as specified in the Employer Requirements.
 - b. Materials, equipment and components shall be lightweight, whenever possible, in order to minimize manpower needs and cranes for maintenance. Should this not be possible, the facilities shall include fixed Plant (equipment) or built-in structures to support portable Plant equipment (which shall be provided by the Contractor) for handling bulky, heavy, and difficult-to-maneuver items.
 - c. Electronic components shall be protected against power fluctuations and electrical discharges.
 - d. The Contractor shall design systems with sufficient redundancies in critical components, which will allow maintenance and repair without adversely affecting ^{A5} lock-Transit ^{A5} operations. The design shall include features and redundancies to allow routine and preventive Plant maintenance to be accomplished without locks outages. The Contractor shall address these features in the operation and maintenance manuals.
6. The Contractor shall provide all designs to ensure ease of maintenance and provide comfort to maintenance personnel, per the Employer's Requirements addressing but not limited to lighting, ventilation, hygienic and ergonomic requirements (refer to ACP "Norma de Procedimientos de Ergonomía"). This shall include, but not be limited to, features for accommodating the following requirements:
 - a. The need to conduct periodic physical inspections shall be minimized, and Plant status and condition shall, in as far as it is practical, be remotely monitored. Where checking on the health and status of the working Plant is necessary, the Contractor shall incorporate methods of inspection that can be accommodated without the need to power down

neither the Plant under inspection nor the location from where the inspection is to be undertaken.

- b. Systems shall be equipped with externally accessible ports, appropriately protected, for diagnostic hand-held devices, laptops, or both, to the extent that these types of devices are available for such use.
- c. The design shall be made so that routine testing and inspections are either automated ^{A5} or, ^{A5} made through easily accessible testing controls and visual indication, or both.
- d. The design shall be such that recalibration and cleaning requirements are minimized or non-existent. If either recalibration or cleaning is required, the design shall be such that this can be conducted during ^{A5} regularly ^{A5} scheduled maintenance periods.

- 7. The Contractor shall carry out all design work so as to reduce the environmental impact of possible breakdowns or failures and shall also include measures to mitigate any such impact. The design shall address Plant reliability and the probability of failure, together with the economic costs of mitigation.

- 8. ^{A19}(Reserved)^{A19}

- 9. The Contractor shall develop and submit an operation and maintenance plan to address these features.

E. ^{A7}**Suitability of Plant (Equipment)**^{A7}:

- 1. All components and equipment of electronic, electrical, mechanical, and hydraulic systems shall be suitable for the conditions prevailing at the Site. The Contractor shall provide temperature-controlled and/or humidity-controlled environments as recommended by the manufacturer or as indicated in the programme for the building.
- 2. ^{A19}Degrees of protection against the intrusion of foreign substances, such as dirt, water, and particles, shall be provided by enclosures for all electrical components such as motors, cubicles, junction boxes, switches, sockets, and miscellaneous electrical devices, as required in the Employer's Requirements.^{A19}
- 3. Equipment installed with anti-condensation heaters shall be provided with suitable safeguards to permit operation without damage should the heaters be left on continuously.

F. ^{A7}**Appurtenances**^{A7}: The Contractor shall provide all features required for the overall operation and maintenance of the third set of locks, including, but not limited to, the following:

- 1. ^{A16}The Contractor shall provide all operation facility buildings and shall efficiently locate the various buildings, staging areas, access roads, Crossunders, and parking facilities to achieve efficient operations and low maintenance requirements.^{A16} The Contractor shall include unused outdoor spaces in the layout. These unused outdoor spaces shall consist of a concourse or esplanade area adjacent to the locks, graded to provide visibility and access for operation

and maintenance of the Lock Structures and landscaped to provide pervious vegetated areas around roadways and buildings where appropriate.

2. The Contractor shall develop a strategy for emergency access to both sides of each lock complex in the event of flooding or the loss of the lock gates, including in the layout a description of emergency access and egress routes.
3. ^{A7}The Contractor shall provide passengers elevators for the locks control houses and special-purpose personnel elevators for access to the Crossunders.^{A7}
4. The Contractor shall provide public areas with access provisions for persons with disabilities.
5. The Contractor shall provide specialized parking for persons with disabilities in all parking areas.
6. ^{A5}The Contractor shall provide all appurtenances required for a complete job.^{A5}
7. ^{A16}Safety and protection features for the locks shall include provisions for and identify appropriate location of safety rails, machinery and equipment supports, power and communication lines and poles, marine fender systems, and other related appurtenances.^{A16}

G. ^{A7}**Aesthetic Design**^{A7}:

1. The ^{A5}structures for the third set of locks^{A5} shall blend in with the setting. The structures shall have neat and clean lines and shall adhere to functionality, efficiency, and conformance to the programme as described in the Employer's Requirements.
2. ^{A7}The design shall utilize architectural techniques and resources, including solar orientation, prevailing winds and landscape features to provide occupant comfort, energy-efficient buildings, and functionality of the locks resulting in efficient operations and low maintenance requirements.^{A7}
3. ^{A5}The structures shall be contemporary and shall incorporate artistic use of color, materials, and textures combination.^{A5}
4. Machinery, equipment, and service areas shall be concealed from public view ^{A5}(i.e., from visitors on foot in main circulation areas, passenger on decks of vessels transiting the locks, and Employer's personnel in the area)^{A5} by using landscape elements, architecturally designed screens, or both. However, where regulations or standards allow and if safety is not compromised, large transparent windows may be used for the machinery rooms in order to facilitate supervision and machinery maintenance.
5. ^{A16} (Reserved) ^{A16}
6. ^{A5}Aesthetic measures shall be consistent with and appropriate for the purpose of the locks and shall in no way compromise their safety, integrity, or function.^{A5}

H. ^{A7}**Environmentally Responsible Design**^{A7}:

1. The Contractor shall provide designs, specifications, and construction that minimize adverse effects on the exterior environment; enhance the quality of the indoor environment; and minimize the consumption of energy, water, construction materials, and other resources.
2. The Contractor shall take into account the impact of construction activities on the environment and existing infrastructure. This shall include the control of:
 - a. Noise and vibration during construction.
 - b. Rainwater runoff.
 - c. Groundwater lowering and dewatering of excavations (the Contractor shall be aware that there is a risk that existing structures may settle as a consequence of groundwater lowering and shall make all necessary provisions to avoid damage to existing facilities).
 - d. Industrial and other types of runoff.
 - e. Excess excavation material (which shall be disposed of).
 - f. Erosion.
 - g. Dust.
3. ^{A17}The Employer has conducted salinity intrusion studies and modeling and has concluded that salinity intrusion is within acceptable levels when water savings with the use of WSBs are within 59% to 64% as compared to without the use of WSBs. If the Contractor's design results in a higher water saving percentage, the Contractor shall demonstrate that the requirements specified below for the minimum recommended salinity standard for Gatun Lake water quality is still maintained. The minimum required average annual value, measured at a distance of 1,000 meters from the lock Knuckle at both locks, for the action level standard shall be no more than 50% of the maximum standard value; that is to say 250 mg/L for total dissolved solids (TDS), 385 µS/cm for conductivity and 115 mg/L for chloride. For water quality and salinity studies refer to Volume VI, Part 4 (*Environmental*).^{A17}

I. ^{A16}**Expansion (Fourth Set of Locks)**: Though there are no plans at this time for the design and construction of a fourth set of locks, the design of the Works shall take into account that a fourth set may be built in the future.^{A16}

1. The layout and alignment in the Contractor's design drawings shall, therefore, specifically ensure that they accommodate the location of the Water-Saving Basins, culverts, gates, approach structures, control buildings, Crossunders, and other elements so as not to obstruct the possible construction and future operation of a fourth set of locks.^{A7} To this end, the Contractor shall develop a design that allows for the efficient and cost-effective construction of a fourth set of locks of a similar layout (mirror image), including Water-Saving Basins, accesses, and other principal and supplementary features. ^{A17}The ^{A17} Contractor's design shall

permit the ^{A7}construction of a fourth set of locks with the third set of locks in full operation with no interference to it.^{A7}

2. The ^{A17}Contractor's ^{A17} design shall include details explaining how the fourth set of locks ^{A7}could^{A7} be built minimizing the distance between chamber centerlines to allow the use of the same navigational approach channels. ^{A7}The Contractor shall verify the constructability of the fourth set of locks only within the framework and extent of allowing it to be built as close as possible to the third set of locks, without causing interference with ongoing operations during its construction.^{A7}
3. ^{A5}Utilities and accessories that are manufactured and installed under this Contract shall be sized only for the third set of locks.^{A5}
4. ^{A4}(deleted text)^{A4}

1.04 ^{A16}WORK TO BE PERFORMED BY THE CONTRACTOR: The Works include all geotechnical, civil, structural, hydraulic, hydrogeological, mechanical, electrical, control-system, electronic, and environmental design, specification and construction work, in addition to all appurtenant work as required for a complete job.^{A16}

A. ^{A16}**The Locks:**^{A16} The Works covered under this Contract shall consist of the design and construction of the Atlantic lock complex and the Pacific lock complex, in accordance with the Employer's Requirements and other Contract documents.

1. ^{A17}**Principal Features:** The Works shall be executed according to the requirements ^{A17}^{A16}specified for the following principal features. The following is a summary of requirements, which are further detailed in other Sections of the Employer's Requirements:^{A16}

a. ^{A16}**Filling and Emptying (F-E) Systems:** The F-E system for the lock chambers shall be a side F-E system, bottom filling is not acceptable. The following main hydraulic elements shall comprise these systems:^{A16}

- 1) **Culverts:** ^{A8}The culverts shall be continuous at both sides of the lock chambers.^{A8} They shall extend from the lake to the ocean end of each lock complex.
- 2) **Ports:** The culverts shall connect with the corresponding Lock chambers through the side walls by means of ports, located at the bottom of the lock walls, which shall provide a well-balanced F-E function.
- 3) ^{A8}**Water-Saving Basins (WSBs):**^{A8} ^{A19}The Employer's conceptual design was prepared by "Consorcio Post-Panamax" (CPP). For information purposes, the Employer's conceptual design is included in Volume VI (*Reference Documents*), under Part 5 (*Conceptual Design of Post-Panamax Locks (Pacific)*), Part 6 (*Update of Pacific Locks Conceptual Design and Harmonization of Atlantic Locks Conceptual Design*), and in the conceptual design drawings included in Part 1 (*Reference Drawings*). The Employer's conceptual design shows the WSBs

west of the lock chambers in the Atlantic locks and east of the lock chambers in the Pacific locks (refer to Sub-Clause 5.1 (*General Design Obligations*) of the Conditions of Contract). The design and construction and alignment of the WSBs shall, however, be the full responsibility of the Contractor and shall comply with the Contract.^{A19 A17} The WSBs may be placed in other arrangements, provided they are within the third and fourth lane footprints shown on Drawings 5802-27 and 5803-54, Volume II, Part 4 (*Requirement Drawings*), and meet the alignment requirements under Subparagraph 1.02 F.^{A17}

- 4) **Conduits:** Each WSB shall be linked to the culverts by means of conduits.

b. **Lock Chambers and Lock Heads:**

- 1) **Lock-Wall Structures:** The lock walls shall be designed using the anticipated load conditions and considering that the locks will have to be dewatered for maintenance. The lock walls shall be designed to provide ^{A7}low^{A7} life-cycle cost, taking into consideration the excavations, site conditions, and design loads required to accommodate the full range of operating and maintenance conditions. The requirements shall be coordinated with the requirements of the filling and emptying systems, the fender system and other appurtenances.
- 2) **Lock Floors:** The lock floors shall be designed to provide^{A7} low^{A7} life-cycle cost, taking into consideration the excavations, site conditions, and design loads required to accommodate the full range of operating and maintenance conditions.
- 3) ^{A16}**Lock Heads:** Each lock complex shall have four lock heads (LH). The lock heads shall be numbered from 1 to 4, starting from LH-1, the upper level lock head adjacent to Gatun Lake to LH-4, the lower level lock head adjacent to the ocean. The lock heads shall be designed to provide low life-cycle cost, taking into consideration the excavations, site conditions, and design loads required to accommodate the full range of operating and maintenance conditions. Each lock head shall be designed to house two rolling gates. The gate Recesses shall function as dry docks when dewatered for gate maintenance using closure devices such as floating caissons or stop logs.^{A16}
- 4) ^{A16}**Additional Bearing Surfaces for Rolling Gates:** At the upper and lower levels of each locks facility, the Contractor shall include one additional bearing surface for relocation of the rolling gates for chamber dewatering. See 01 81 19 for rolling gate relocation requirements.^{A16}
 - (i) ^{A16}**Lower Level (Seaside) Bearing Surface at Each Lock Facility:** Shall serve to support and provide the bearing surface for the outer lock gates when used as

- chamber dewatering caissons (maintenance purposes). The additional gate bearing surface in the lower level shall be located downstream of the lowermost gate.^{A16}
- (ii) ^{A16}**Upper Level (Lakeside) Bearing Surface at Each Lock Facility:** Shall serve to support and provide the bearing surface for the outer lock gates when used as chamber dewatering caissons (maintenance purposes). The additional gate bearing surface in the upper level shall be located upstream of the uppermost gate.^{A16}
- c. **Approach Structures:** The lock design shall incorporate approach structures, which shall function as transition (staging) areas between each narrow lock entrance and the wider access channel or lake. Approach structures shall facilitate the entrance maneuvers of vessels and shall include provisions to safely moor vessels in the event of an emergency. The lock approach structures shall be provided with a fender system and bottom protections.^{A16} The Contractor shall design the approach structures as part of the Works.^{A16 A17} The physical work to execute and complete the approach structures in accordance with such design is the subject of Provisional Sums 1 through 3, which may be instructed by the Employer's Representative.^{A17}
- d. ^{A16}**Lock Operating Gates:** Pedestrian passage shall be allowed on all the rolling gates. Lock operating gates shall be protected against Site-specific corrosion.^{A16 A17} Vehicular traffic across the lock chamber shall be possible at the lake end and the sea end of each lock complex. If the proposal indicates the use of the gates for vehicular traffic, bridgeways shall be provided as specified. The Contractor shall design, construct and test all locks gates and operating equipment complete with all components and accessories in accordance with Section 01 81 19 (*Lock Gates*).
- (Deleted text)^{A17}
- e. **Culvert and Conduit Valves:** ^{A19}Valves shall be designed, constructed, tested and commissioned to be suitably sized and appropriate for the operating conditions and requirements for culverts and conduits.^{A19} ^{A16}Redundancy shall be provided for valves. The valves shall be properly located, designed to minimize vibration, and provide ease of maintenance as necessary through the use of bulkheads.^{A16} Valves shall be protected against Site-specific ^{A17}corrosion.^{A17}
- f. **Control Systems:** ^{A19}The Works shall include the design, execution and commissioning of complete process control systems (PCSs) based locks machinery control systems (LMCSs). The control systems shall be efficient, safe and reliable. Control shall be accomplished through process-control systems with several programmable-logic controllers (PLCs), remote input-output (RIO) devices, and a redundant fiber-optic network connecting all devices. Operator workstations shall be installed in the central control room in main control buildings and shall allow for

the control of the entire installation. Control systems shall be very open, allowing for future PLC extensions simply by connecting new devices to the network. For reasons of redundancy and proximity during exceptional or maintenance operations, local control devices shall be supplied near the concerned equipment. Controls shall be provided with safety interlocks to ensure that unwanted operations are not allowed under any circumstance. Interlocks shall function to prevent draining the lake, Dry-Docking a ship and flooding lower levels. Interlocks shall allow for safe operation at all times and under all operating conditions.^{A19}

2. **Supplementary Features:** In addition to the principal features, the Works include supplementary features that shall be designed, and constructed in accordance with ^{A17}the Employer's Requirements.^{A17} The following is a summary of their scope, which is further detailed in the Employer's Requirements:

- a. ^{A19}**Locks Buildings and Facilities:** Buildings and facilities required for the operation, maintenance, personnel and security of the new locks shall be appropriately designed, executed and completed to house all needed Plant, controls and machinery, equipment and personnel requirements in accordance with Sections 01 81 36 (*Operations and Maintenance Buildings and Facilities Program*) and 01 81 36.13 (*Operations and Maintenance Buildings and Facilities Space Programming*).^{A19}
- b. **Site and Infrastructure:** This covers all heavy civil work and utility considerations, as well as site construction including, but not limited to, the following:
 - 1) ^{A16}Earthwork (excavation and fill) including grading the areas to drain with no standing water evident within 30 minutes of a rainfall.^{A16}
 - 2) ^{A16}Exterior improvements (walkways, signage, et al.)^{A16}
 - 3) ^{A16}Utilities. This includes utilities within the lock complexes and utilities connecting the lock complexes with the existing infrastructure. Within the lock complexes, the Works include the design, execution and completion of all utilities to feed the required operational buildings and facilities and the proposed maintenance, security and personnel buildings and facilities. The design includes sizing for future demand. The Contractor shall include the design layout in the general plan view drawings required above, in Subparagraph 1.04 A.2.a. The design for the proposed maintenance, security and personnel buildings and facilities shall be prepared to avoid demolitions to make future connections. The execution and completion of the utilities for the proposed maintenance, security and personnel buildings and facilities shall be to 1.5 m of the proposed location.^{A16}
 - 4) ^{A16}Transportation (roads within the lock complexes).^{A16}
 - 5) Dams.

- 6) Waterways and marine construction work.
- c. ^{A16}**Facility Services:** This includes, but is not limited to, all work addressing fire suppression, plumbing, ventilating, air conditioning, integrated automation, electrical systems, communications, compressed air, and electronic safety and security in the required operational buildings. ^{A16}
- d. **Process Equipment (Plant):** ^{A19}This includes, but is not limited to, all work addressing process integration, wastewater treatment plants (WWTP), pollution-control equipment, and electrical-power generation. ^{A19}
- e. ^{A19}**Communications, Control, Security, and Safety (CCSS) Systems:** The Works shall include the design, execution, and completion of fire-fighting control systems (FFCSs), and electrical-distribution control systems (EDCSs). The Works shall include the design, execution and completion of CCSS systems, as specified in Section 01 81 26 (*Communications, Control, Safety, and Security Systems*). ^{A19}
3. ^{A17}**Provisional Sums:** The following additional work is the subject of agreed Provisional Sums as stated in the Schedule of Project Elements and Prices and which may be instructed by the Employer's Representative pursuant to Sub-Clause 13.5 (*Provisional Sums*) of the Conditions of Contract. ^{A17} ^{A16}The execution and completion of the work exercised through Provisional Sums shall include fabrication, installation, testing and maintenance, as applicable. ^{A16}
- a. **Provisional Sum No. 1 - Atlantic Locks Northeast Approach Structure:** ^{A19}The Works includes the design of the Atlantic locks northeast approach structure as specified in Volume II, and particularly in Subparagraph 1.03 A.2.a. of Section 01 81 16 (*Lock Structures*), and the design of the corresponding appurtenances specified in Section 01 81 16.16 (*Locks Appurtenances*), but does not include executing and completing them. ^{A19} Provisional Sum No. 1 shall be for the execution and completion of the Atlantic locks northeast approach structure and its corresponding appurtenances.
- b. **Provisional Sum No. 2 - Pacific Locks Northwest Approach Structure:** ^{A19}The Works includes the design of the Pacific locks Northwest approach structure as specified in Volume II, and particularly in Subparagraphs 1.03 A.1.a. of Section 01 81 16 (*Lock Structures*), and the design of the corresponding appurtenances specified in Section 01 81 16.16 (*Locks Appurtenances*), but does not include executing and completing them. ^{A19} Provisional Sum No. 2 shall be for the execution and completion of the Pacific locks Northwest approach structure and its corresponding appurtenances.
- c. **Provisional Sum No. 3 - Pacific Locks Southwest Approach Structure:** ^{A19}The Works includes the design of the Pacific locks Southwest approach structure as specified in Volume II, and particularly in Subparagraphs 1.03 A.1.a. of Section 01 81 16 (*Lock Structures*), and the design of the corresponding appurtenances specified in

Section 01 81 16.16 (*Locks Appurtenances*), but does not include executing and completing them.^{A19} Provisional Sum No. 3 shall be for the execution and completion of the Pacific locks Southwest approach structure and its corresponding appurtenances.

- d. **Provisional Sum No. 4 Maintenance Closure System:** ^{A19}The Works includes the design of the maintenance closure system and the execution and completion of the civil works required to facilitate the future installation of the maintenance closure system, such as embedded parts, as specified in Volume II, and particularly in Subparagraph 1.03 Y. of Section 01 81 19 (*Lock Gates*), but does not include executing and completing it.^{A19} Provisional Sum No. 4 shall be for the execution and completion of one maintenance closure system.
 - e. **Provisional Sum No. 5 Atlantic Locks Maintenance Services:** ^{A19}Provisional Sum No. 5 shall be for providing Maintenance Services for the Atlantic lock complex after the issuance of the Taking-Over Certificate as specified in Section 01 93 00 (*Maintenance Services*).^{A19}
 - f. **Provisional Sum No. 6 Pacific Locks Maintenance Services:** ^{A19}Provisional Sum No. 6 shall be for providing Maintenance Services for the Pacific lock complex after the issuance of the Taking-Over Certificate as specified in Section 01 93 00 (*Maintenance Services*).^{A19}
- B. **Other Work by the Contractor:** ^{A16}The Contractor shall design and construct all interfaces and perform other work as required for the Works, including:^{A16}
- 1. ^{A19}**Pacific Approach Channel (PAC) Dams:** The design and construction of the structures corresponding to the East Barrier Dam 2E, the West Barrier Dam 1W, and the West Barrier Dam 2W shall be performed by the Contractor.^{A19}
 - 2. ^{A12}**Pacific Approach Channel Access:** The design, dry excavation and dredging necessary to construct the access to the Pacific Approach Channel from the Pacific locks (north of the Pacific locks), shall be performed by the Contractor.^{A19}This includes the design and the dry excavation necessary to construct the southern end of the PAC, which is north of the Pacific locks, south of the intermediate plug, and below elevation 17.0 m PLD. This part of the Works includes the intermediate plug removal.^{A19} However, the intermediate plug shall be removed after the Gaillard Cut plug, and the date requires the approval of the Employer's Representative.^{A12}
 - 3. **Pacific Entrance Access Channel:** The design and the dry excavation or dredging necessary to construct the northern end of the Pacific entrance access channel, which is south of the Pacific locks, shall be performed by the Contractor. ^{A5}If the area is dry-excavated, this shall include the removal of the means used by the Contractor to restrain the Pacific Ocean, drying the area up, and the subsequent removal of this restraint. This shall also^{A5} include all dredging required to finalize the deepening and widening the Pacific entrance access channel.
 - 4. **Atlantic Entrance Access Channel:** The design and the dry excavation necessary to construct the southern end of the Atlantic entrance access channel,

which is north of the Atlantic locks and south of the Atlantic Ocean plug, shall be performed by the Contractor. This includes the Atlantic Ocean plug removal. This also includes all dredging required to finalize the deepening and widening of the Atlantic entrance access channel.

5. **Gatun Lake Access:** The design, dry excavation and dredging necessary to construct the access to Gatun Lake from the Atlantic locks (south of the Atlantic locks), shall be performed by the Contractor. This includes the Gatun Lake plug removal.
6. ^{A16} (Reserved) ^{A16}
7. ^{A16} The Contractor shall identify and clear all affected utilities prior to excavation and shall coordinate their removal or work that interferes with their continuous service with the Employer's Representative. The utilities belonging to the Employer are shown on Drawings 5802-3 to 5802-15 for the Atlantic Site and Drawings 5803-3 to 5803-39 for the Pacific Site; ^{A16} ^{A17} refer to Volume VI, Part 1 (*Reference Drawings*). ^{A17} The Contractor shall locate, through the corresponding utility owners/operators other than the Employer, the location of their utility lines on the Site and the particular requirements for their removal and work that interferes with their continuous service. Particular requirements for the removal and other work that interferes with the Employer's utility lines can be found in the particular Sections of the Employer's Requirements.

C. ^{A17} (Reserved) ^{A17}

1.05 WORK PERFORMED BY OTHERS:

- A. ^{A5} **Dry Excavation North of Pacific Locks:** The design for the dry excavation and corresponding execution of the work necessary to construct the southern end of the PAC, which is north of the Pacific locks, south of the intermediate plug, and above elevation 17.0 m PLD will be performed by the Employer as part of the work under the second contract for the excavation of the PAC (PAC No. 2). ^{A16} PAC No. 2 contract comprises two phases: the first excavation phase that includes the work described above, Borinquen bridge demolition, constructing Borinquen Road phase 2, Cocoli River diversion channel, new Bruja Road bridge, installation of the new electrical lines, and other miscellaneous work is scheduled to finish on May 15, 2009. ^{A16} The second phase with the remaining work is scheduled to finish on October 18, 2009; this includes the excavation above elevation 30.0 m PLD north of the intermediate plug. ^{A5}
- B. **Pacific Approach Channel (PAC):** ^{A12} The excavation for the PAC north of the intermediate plug, including the removal of the Gaillard Cut plug will be performed by the Employer. ^{A12}
- C. ^{A16} **Pacific Entrance Access Channel:** The deepening and widening of the Pacific entrance access channel will be the responsibility of the Employer; however, the construction and later removal of the Pacific Ocean plug shall be performed by the Contractor. ^{A16}
- D. **Atlantic Entrance Access Channel:** The deepening and widening of the Atlantic entrance access channel will be the responsibility of the Employer; however, the removal of the Atlantic Ocean plug shall be performed by the Contractor.

- E. ^{A16} (Reserved) ^{A16}
- F. ^{A16}**Plugs:** The removal of all plugs will be reviewed and revised as necessary in cooperation with the Contractor to facilitate compliance with the Accepted Baseline Programme. The Employer has programmed the removal of the Gaillard Cut plug for 16 January 2014. ^{A16}
- G. ^{A16}**Electrical Interconnections:** The work to connect the Atlantic locks with the Agua Clara Substation, including modifications at the substation, will be performed by the Employer. The work to connect the Pacific locks with the Miraflores Substation will be performed by the Employer. Refer to Section 01 81 29 (*Electrical and Lighting System*) and Section 26 05 43 (*Underground Ducts and Raceways for Electrical Systems*) for details of work by the Employer and partial work by the Contractor. ^{A16}
- H. ^{A19}(Reserved) ^{A19}
- 1.06** ^{A16}**REFERENCES:** The use of reference standards is stipulated under the ^{A16} ^{A17}Conditions of Contract, Sub-Clause 5.4 (*Technical Standards and Regulations*) and Section 01 42 19 (*Reference Standards*). ^{A17}
- 1.07** ^{A16}**SUBMITTALS:** The Contractor shall make submittals as required by particular Sections of the Employer's Requirements and the Contractor's Accepted Baseline Programme. ^{A16}
- 1.08** **SYSTEM RELIABILITY:** ^{A19}The Contractor shall provide system reliability analysis, as specified in Section 01 93 00 (*Maintenance Services*), for the Plant and structures of the Works to ensure the required lane availability under Subparagraph 1.02 K. ^{A19}
- 1.09** **SERVICE-LIFE ANALYSIS:**
- A. ^{A16}Expected service-life span substantiation shall be provided for individual facets of the Works as specified. The overall functional service life of the Works shall be 100 years. ¹⁶ Service-life span of individual elements that differ from the overall life span for the ^{A17}Works ^{A17} shall be as specified in the particular Sections of the Employer's Requirements.
- B. ^{A16}The Contractor shall provide service-life expectancy analysis for the principal and supplementary features that will contribute to the overall life expectancy of the Works and to the expectancy for those parts with different life spans. This analysis shall include: ^{A16}
1. Length of effective service life and aesthetic service life, if specified, with the action required at the end of the lifespan, e.g. complete replacement, partial replacement, or refurbishment. Each time estimate shall be based on proven in-use experience in other places.
 2. Conditions under which estimates will be valid, such as expected usage, inspection frequency, and maintenance frequency.
- C. ^{A16}In calculating the life-cycle cost of the Works over the specified service life (excluding operating staff costs), the Contractor shall, during design submittals, identify: ^{A16}
1. The replacement frequency for each element not expected to last the entire lifespan of the third set of locks.

2. The frequency of the routine maintenance required for operating equipment, including the replacement of worn parts before their failure.
3. The type and frequency of the routine cleaning that will be required to clear obstructions from exposed elements including, but not limited to, culvert-intake screens, drainage screens, rolling-gate tracks, and sumps.

END OF SECTION

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