

## TECHNICAL

### PART 5 - Design Plan

<sup>A17</sup>In general, the Tenderer shall develop and submit a Tender design that meets or exceeds the Employer's Requirements given the information provided via the concept drawings, reference drawings, reports, analyses, and specifications that are provided within the RFP. The Tender design shall include all drawings and designs that the Tenderer considers necessary to develop the price proposal, including those drawings and designs developed by Subcontractors, including fabricators, suppliers, vendors, or the like. Similarly, technical documents, data, calculations, modeling, investigations, and the like that are generated to produce the Tender design or to develop the price proposal shall be included in the proposal submittal. The objective of Part 5 of Volume V is to allow the Tenderer to present in a prescribed manner how his proposed team will produce a final design that complies with or exceeds the Employer's Requirements.<sup>A17</sup> In order to demonstrate this, the Tenderer shall prepare and submit the appropriate documents, drawings, calculations, programmes, results, concepts, and the like, as requested in the following text.

<sup>A17</sup>The Employer's Requirements depict minimum requirements; thus, Tenderers are expected to recommend improvements that could result in higher scoring during the Tender-evaluation process. <sup>A20</sup>As an example, a design that improves the hydraulic performance of the locks (i.e., improving Lockage Times) is part of the Employer's Requirements and a recommendation that addresses such an improvement would not constitute an alternate Tender as stipulated in Paragraph A.6 of the Instructions to Tenderers.<sup>A20A17</sup>

A. <sup>A19</sup>**Tender Design for the Works:** Tenderers shall provide a summary level narrative of the overall Tender design for the Works. The content of this narrative is not to exceed twenty five pages. <sup>A20</sup>Validation calculations, drawings, specifications, tables, figures, charts and sample reports do not apply against the page count.<sup>A20</sup> The narrative shall be validated by addressing, as a minimum, the following:<sup>A19</sup>

1. **General Configuration.** Tenderers shall develop and submit:

- a. <sup>A20</sup>General Works drawings that indicate to the evaluation committee that the Tenderer has a clear understanding of the Employer's Requirements.<sup>A20</sup> This includes, but is not necessarily limited to, Site plans for the Works; including both Atlantic and Pacific lock complexes, Atlantic and Pacific Approach Channels, and Borinquen Dams 2E, 1W and 2W that reflect general arrangement concepts and the location of project elements.
- b. A design plan that describes how the design team will meet or exceed the performance specifications provided in the Employer's Requirements. <sup>A19</sup>This plan shall address each of the Top Project Requirements of Section 01 10 00 (*General Project Requirements*).<sup>A19</sup> The content of this subsection is not to exceed 1,800 words or three pages, whichever is the lesser.

2. **Operational Efficiency.** Tenderers shall develop and submit:

- a. Discussion of the design for the gates, valves, and filling and emptying systems addressing each of the requirements and constraints for systems. Each requirement and constraint shall be listed with an explanation of how the requirement or constraint will be satisfied.
- b. <sup>A19</sup>(Reserved).<sup>A19</sup>
- c. <sup>A19</sup>(Reserved).<sup>A19</sup>

3. **Quality Assurance and Control.** <sup>A19</sup>Tenderers shall provide a narrative explanation of the reasoning behind the proposed QA/QC plan outline as required in Volume V, Part 4, for design, emphasizing how it will result in a design that can be successfully implemented during construction of the Works.
    - a. <sup>A19</sup>(Reserved).<sup>A19</sup>
    - b. <sup>A19</sup>(Reserved).<sup>A19</sup>
    - c. <sup>A19</sup>(Reserved).<sup>A19</sup>
  4. <sup>A19</sup>**Design Programme.** Tenderers shall develop an overall Design Programme that displays the relationships between project design and key milestones for: construction (see also Part 6,C of Volume V), testing, commissioning, and the operations and maintenance period.<sup>A19</sup> This task includes the submission of:
    - a. <sup>A19</sup>A time-scaled precedence diagram that displays the design sequence in detail, addressing all features listed in 1.04 A.1 of Section 01 10 00 (*General Project Requirements*) and also incorporates 8.3 of the Conditions of Contract and provides applicable Milestone Dates (including design milestones), and links to the construction sequence required by Volume V, Part 6, paragraph C.<sup>A19</sup>
    - b. <sup>A19</sup>An example of each type of project programme report proposed by the Tenderer that satisfies the reporting requirements cited by Section 01 31 00 (*Project Management and Coordination*) of the Employer's Requirements using the submitted programme as the basis of the report.<sup>A19</sup>
    - c. A representative programme report and a cost-control report that was prepared under the supervision of the proposed project controls manager (lead programmer) for a comparable project. These reports shall be presented to the Employer as a formal submittal.
  5. **Maintenance.** Tenderers shall demonstrate that the proposed lock complexes (structure, filling and emptying systems, gates, mechanical systems, and power and control systems) are in accordance with the Employer's Requirements. A maintenance program that displays the maintenance requirements and frequencies of the proposed systems, analysis of maintenance durations, and a maintenance staffing plan shall be presented for this demonstration.
- B. **Approach Channels:** <sup>A19</sup>Tenderers shall provide a summary level narrative of the proposed approach channel design for the Works. The content of this narrative is not to exceed twelve pages. Validation calculations, drawings, specifications, tables, figures and charts do not apply against the page count. The narrative shall be validated by addressing, as a minimum, the following:<sup>A19</sup>
1. **For both the Atlantic and Pacific Sites:**
    - a. Develop and submit calculations for the proposed channel configurations at each Site and:
      - 1) Explain how the proposal meets or exceeds the minimum requirements of the RFP including embankment stability analysis.
      - 2) Demonstrate the stability requirements for the plugs

- 3) Provide analyses that are clear, well developed and well organized.
- b. <sup>A17</sup>Include temporary structures for the execution of the Works that are required in order comply with the Employer's Requirements.<sup>A17</sup>
- c. <sup>A19</sup>Provide drawings that:<sup>A19</sup>
  - 1) Show the proposed channel configurations, including, as a minimum, longitudinal and cross sections in sufficient detail to convey the design.
  - 2) Identify the channel center line and prism lines, showing the location of the sump or trap to be constructed.
  - 3) <sup>A19</sup>(Reserved).<sup>A19</sup>
  - 4) <sup>A17</sup>Ppresent the drawings in a format compliant with Employer's Requirements.<sup>A17</sup>
  - 5) Include notes, callouts and annotations that are clear and easy to follow.

## **2. For the Pacific Site:**

- a. Develop and submit calculations for Borinquen Dams 2E, 1W and 2W that:
  - 1) <sup>A19</sup>Specifically address the design standards and codes, loading conditions including seismic requirements, design assumptions, methods of analysis, analysis results, design concepts, procedures.<sup>A19</sup>
  - 2) Explain how the proposal meets or exceeds the minimum requirements of the RFP including embankment stability analysis.
  - 3) <sup>A19</sup>(Reserved)<sup>A19</sup>
  - 4) Provide requirements for the areas where the dams abut the lock structures or tie-in to existing rock formations.
  - 5) Provide analyses that are clear, well developed and well organized.
- b. <sup>A17</sup>Include temporary structures for the execution of the Works that are required in order comply with the Employer's Requirements.<sup>A17</sup>
- c. <sup>A19</sup>Provide specifications for Materials and design requirements for construction.<sup>A19</sup>
- d. Develop and submit drawings that:
  - 1) <sup>A19</sup>Show the proposed dam configuration, including, as a minimum, embankment dam and Pacific access channel layout and alignment, longitudinal and cross sections, including Tender stage excavation plans.<sup>A19</sup>
  - 2) Provide the level of detail required to convey the design intent.

- 3) <sup>A17</sup>Present the drawings in a format compliant with Employer's Requirements <sup>A17</sup>
- 4) Include notes, callouts and annotations that are clear and easy to follow.

### C. Locks Civil works

1. **Excavation and Fill.** <sup>A19</sup>**Tender Design:** Tenderers shall provide a summary level narrative of the proposed excavation and fill design plan identifying the requirements for the Works. The content of this narrative is not to exceed five pages. Validation calculations, drawings, specifications, tables, figures and charts do not apply against the page count. The narrative shall be validated by addressing, as a minimum, the following:<sup>A19</sup>
  - a. **Temporary Slope Stability.** Identify the design considerations involved in the determination of geotechnical and structural requirements for slope stability. Describe the materials to be encountered and methods to be used for obtaining the required results.
  - b. **Permanent Slope Stability.** Tenderers shall:
    - 1) Identify the geotechnical considerations involved in the determination of the requirements for the permanent slope stability.
    - 2) Provide analysis to substantiate the proposed design.
    - 3) Describe the materials and methods to be used and the adequacy for obtaining the required results. Include any stabilization requirements.
  - <sup>A19</sup>c. **Drawings.** Provide drawings that are clear and easy to understand, and include enough information to permit the evaluation of the proposal. Drawings shall be in the format indicated by the Employer's Requirements, with units of measure clearly identified and consistent nomenclature throughout. The proposal shall include as a minimum:
    - 1) Show the proposed configurations, including, as a minimum, longitudinal and cross sections in sufficient detail to convey the design, showing the spatial relation with the surrounding structures and geological conditions.
    - 2) Provide the level of detail required to convey the design intent.
    - 3) Present the drawings in a format compliant with Employer's Requirements
    - 4) Include notes, callouts and annotations that are clear and easy to follow
  - d. **Specifications.** Provide specifications for the excavation and fill that address the requirements to perform the work. The proposal shall as a minimum:
    - 1) Provide material requirements and corresponding specifications that cover the most predominant materials identified in the design.
    - 2) Identify codes and standards to be used and demonstrate that they meet or exceed the requirements of the RFP.
    - 3) Provide specifications that are clear, well developed, and well organized.<sup>A19</sup>
2. **Geotechnical.** Tenderers shall provide a description of the methodology to be employed in the determination of the Site-specific foundation requirements.

- a. **Geotechnical Parameters for the Design.** Tenderers shall identify the parameters that will be used in the determination of the capacity of the formations at each site, demonstrating the suitability for the structures to be founded on the formations.
- b. **Geotechnical Research Plan and Analysis Method.** <sup>A17</sup>Tenderers shall define their research plan and describe the analysis methodology to be utilized in evaluation of data and information, including tests and software that will be used, and shall explain how it compares with the standard in the industry for projects of this type and will result in compliance with the Employer's Requirements.<sup>A17</sup>
3. **Structures.** <sup>A19</sup>**Tender Design:** Tenderers shall provide a summary level narrative of the overall Tender design for the main structures of the Third Set of Locks. The content of this narrative is not to exceed twenty pages. Validation calculations, drawings, specifications, tables, figures and charts do not apply against the page count. In this narrative, Tenderers shall identify the type of structure to be used in each major application and how it will satisfy the Employer's Requirements regarding function, structural capacity and stability based on the geotechnical and seismic conditions at each Site. This shall include the effects on navigation due to currents at each location. The major structures to be addressed are the approach structures, chamber walls, gate recesses (lock heads), and Water-Saving Basins (basins, conduits, and valve chambers). To substantiate the narrative, for each major structure, the Tenderer shall submit the following:<sup>A19</sup>
  - a. **Analysis Method.** Provide a description of the methodology that will be used, including seismic requirements, loading conditions and combinations, models, and software. Tenderers shall describe the applicability of the models and the established usage of the software for this type of analysis. The proposal shall include as a minimum:
    - 1) Structural analysis that predicts the behavior of the structural system selected. Uses boundary conditions and elements that are consistent with the proposed design.
    - 2) <sup>A19</sup>Specified loading conditions applied and combined in accordance with the selected design standard.<sup>A19</sup>
    - 3) <sup>A19</sup>Seismic analysis carried out in accordance with 01 81 16.13 (*Seismic Design Criteria*) for Tender design at Tender.
    - 4) <sup>A19</sup>Clear, well developed and well organized analysis.<sup>A19</sup>
  - b. **Design Methods, Codes, and Standards.** Identify the design methodology, codes, and standards that will be used. Tenderers shall describe how the level of design is appropriate for providing a structure that is compliant with the Employer's Requirements. The proposal shall include as a minimum:
    - 1) The codes and standards that will be used in the design.
    - 2) A narrative that identifies the design methodology
    - 3) A narrative that describes the applicability of the chosen methodology and standards for the type of structure and its usage to provide a compliant structure.
  - c. **Results (Calculations).** Submit a report with the results of the analysis and corresponding design in an organized manner to permit proper evaluation. The report shall be separated into the Atlantic and Pacific lock complexes and into the various structures within each. The proposal shall include as a minimum:
    - 1) Separate results for the Atlantic and Pacific locks showing a clear distinction between all different structures and conditions. <sup>A19</sup>Results shall include strength, stability and serviceability analyses for all loading conditions.<sup>A19</sup>

- 2) Results that are presented in an organized manner to allow proper evaluation of compliance.
- 3) Identifies controlling conditions.
- d. **Drawings.** Provide drawings that are clear and easy to understand and include enough information to permit the evaluation of the proposal. Drawings shall be in the format indicated by the Employer's Requirements, with units of measure clearly identified and consistent nomenclature throughout. <sup>A19</sup>As a minimum, the proposal shall:<sup>A19</sup>
  - 1) <sup>A19</sup>Provide a clear description of the structures and their spatial relation with the surrounding structures geological conditions and navigation channels<sup>A19</sup>
  - 2) Provide the level of detail required to convey the design intent.
  - 3) <sup>A17</sup>Present the drawings in a format compliant with Employer's Requirements<sup>A17</sup>
  - 4) Include notes, callouts and annotations that are clear and easy to follow.
- e. **Specifications.** Provide specifications for the major structures that address the durability of the structures and that describe the structural requirements of the Materials and the functional requirements of the structures. The proposal shall, as a minimum:
  - 1) Provide Material requirements specifications that cover all or the most predominant materials identified in the design.
  - 2) <sup>A19</sup>Demonstrate that the specifications for Materials provided meet or exceed the requirements of the RFP.<sup>A19</sup>
  - 3) Provide information or specifications to substantiate the durability of the required Materials in compliance with the Employer's Requirements.
  - 4) <sup>A19</sup>Demonstrate that the completed structures meet or exceed the functional requirements<sup>A19</sup>
  - 5) Provide specifications that are clear, well developed and well organized
4. **Concrete.** This is expected to be the most-utilized Material throughout the Works and will, therefore, be crucial to the success of the Works. If the Tenderers utilize codes or standards other than those on which the requirements are based, identify the codes or standards to be used and show that they meet the minimum requirements. Tenderers shall provide the following information.
  - a. **Types.** Identify the different types of concrete to be used in the Works, where the different mixes will be used, and the corresponding mix designs and describe the suitability of the different mix designs for their intended use and meeting the requirements of the RFP. The proposal shall, as a minimum:
    - 1) <sup>A20</sup>Identify the sources for the major components of the mixes (sand, coarse aggregate, cementitious materials) and their suitability for their intended use.<sup>A20</sup>
    - 2) <sup>A20</sup>Identify any admixtures required for achieving the required results and explain how the additives will achieve the results.<sup>A20</sup> The Tenderers should demonstrate that the products have been used successfully for obtaining the expected results.
    - 3) <sup>A19</sup>A narrative that describes the applicability of the chosen mixes for providing structures that meet or exceed the functional requirements, environmental conditions, and service conditions.<sup>A19</sup>

- b. **Specifications.** Provide specifications for the concrete and related items, including but not limited to: water, cement, aggregates, admixtures, concrete, concrete cover for reinforcing, reinforcing, joints, tolerances, requirements for placing, The proposal shall as a minimum:
- 1) Address the Materials and items identified above.
  - 2) <sup>A19</sup>(Reserved).<sup>A19</sup>
  - 3) <sup>A19</sup>Provide information or specifications on the Tenderer's proposed approach to substantiate the durability of the required Materials in compliance with the Employer's Requirements.<sup>A19</sup>
  - 4) <sup>A19</sup>(Reserved).<sup>A19</sup>
  - 5) Provide specifications that are clear, well developed and well organized
5. **Filling and Emptying System.** <sup>A19</sup>**Tender Design:** The lock chamber filling and emptying system is a vital element of the operation of the locks and affects the operating time and safety of vessels in the chamber being filled or emptied. Tenderers shall provide a summary level narrative of the overall Tender design for the filling and emptying system. The content of this narrative is not to exceed twenty pages. To substantiate the narrative, the Tenderer shall submit the following, which does not apply against the page count:<sup>A19</sup>
- a. <sup>A19</sup>**Report on Tender Design and Numerical Model.** This shall include:<sup>A19</sup>
- 1) Discussion of all software applications to be used in the evaluation and design process. The proposal shall, as a minimum:
    - a) Identify the software to be used and where is it has been used successfully in the past.
    - b) Identify any modifications made to the software and validation of the results obtained with the modification.
    - c) Address how the software will be used to obtain results that are compliant with the Employer's Requirements.
    - d) Provide a discussion that is clear, well developed and well organized
  - 2) Explanation of the design and numerical modeling process. The proposal shall, as a minimum:
    - a) Identify the formulas, values, assumptions, data, and reference literature used in developing the Tender design and to be used in the development of the final design of the filling and emptying system.
    - b) Address in detail the numerical model used to evaluate operational times for filling and emptying the lock chambers.
    - c) <sup>A19</sup>(Reserved).<sup>A19</sup>
    - d) Provide an explanation that is clear, well developed and well organized.
  - 3) <sup>A19</sup>Explanation of the Tenderer's plan to refine and/or validate the filling and emptying system design through 3-D modeling, and physical models, including identification of a laboratory.<sup>A19</sup> The proposal shall, as a minimum:
    - a) <sup>A19</sup>(Reserved).<sup>A19</sup>
    - b) Explain how the 3D modeling will be conducted. Identify the formulas, values, assumptions, data, and reference literature that will be used. Include the expected results and how they will be used in providing a filling and emptying system that meets the requirements of the RFP.

- c) Explain how the physical modeling will be conducted. Identify the scales, the instrumentation, that will be used. Include the expected results and how they will be used in providing a filling and emptying system that meets the requirements of the RFP.
  - d) <sup>A19</sup>Identify the laboratory that will be used for the testing and provide information that indicates that the selected facility meets industry standards and has personnel with the modeling experience to provide validation of the proposed filling and emptying system.<sup>A19</sup>
  - e) Provide an explanation that is clear, well developed and well organized
  - 4) Identification and discussion of the specific quality-control measures employed to validate the results of the models. Provide an explanation that is clear, well developed and well organized.
  - 5) Drawings of the resulting hydraulic network that are:
    - a) Clear and easy to understand and include enough information to permit evaluation of the proposal.
    - b) <sup>A17</sup>Presented in a format compliant with Employer's Requirements with units of measure clearly identified and consistent nomenclature throughout.<sup>A17</sup>
    - c) Include notes, callouts and annotations that are clear and easy to follow.
  - b. <sup>A19</sup>**Tender Design Drawings and Sketches of all Associated Modeling.**<sup>A19</sup>
    - 1) Provide a clear description of the system.
    - 2) Provide the level of detail required to convey the design intent.
    - 3) <sup>A17</sup>Present the drawings in a format compliant with Employer's Requirements.<sup>A17</sup>
    - 4) Include notes, callouts and annotations that are clear and easy to follow.
  - c. **Calculations and Models Used to Determine Water Reutilization Percentages and the Corresponding Results of the Modeling.**
    - 1) <sup>A17</sup>Provide an explanation of the methodology employed and how it will provide a system that meets the Employer's Requirements.<sup>A17</sup>
    - 2) <sup>A19</sup>Provide calculations and results at the level of detail required to convey the design intent.<sup>A19</sup>
    - 3) Present information that is clear and easy to understand and in sufficient detail to permit evaluation of the proposal.
  - d. **Report on the Maintainability of the System and the Safety Aspects Afforded Both Vessels and Operating and Maintenance Personnel.**
    - 1) <sup>A19</sup>Provide a narrative that describes the systems and in particular the features that will minimize maintenance requirements.<sup>A19</sup>
    - 2) <sup>A19</sup>Address the features that provide a safe working environment.<sup>A19</sup>
    - 3) Present the information that is clear and easy to understand and in sufficient detail to permit evaluation of the proposal.
- D. **Lock Gate Design and Fabrication.** The lock gates are a critical operational element of the locks that affect the transit time and ensure the impoundment of Gatun Lake. The upper gates at both lock complexes are the barriers that retain the water from the lake. Loss of these gates would result in the



flooding of downstream areas and closure of the Canal. The design shall address the operating time, reliability, and safety of the system.

1. **Tender Design.** <sup>A19</sup>Tenderers shall present Tender design and specification documentation for the gates, recess closures, gate drives, controls, and appurtenances, specifically describing how the Tenderer will satisfy the Employer's Requirements with regard to performance, configuration, structural capacity, stability, and maintainability. Documentation shall include, but not be limited to, the following. <sup>A19</sup>

- a. <sup>A19</sup>**Draft preliminary specifications for the lock gate, recess closure, and gate seals.**

- 1) Descriptions of workmanship, structures, materials, equipment, corrosion control coatings, fittings and accessories, tests, and trials.
    - 2) The Tenderers shall demonstrate that the specifications provided comply with the Employer's Requirements.
    - 3) (Reserved).
    - 4) Demonstration that the proposed configuration will result in a system that is compliant with the functional requirements.
    - 5) (Reserved). <sup>A19</sup>

- b. **Drawings.** <sup>A19</sup>The Tender drawings shall include, but shall not be limited to, the following.

- 1) A clear description of the system. <sup>A19</sup>
      - a) General arrangement drawings showing lock-gate assembly, plans, profiles, deck arrangement, and equipment arrangement.
      - b) Structural drawings showing gate framework, structural plans and sections, and configuration and location of buoyancy chamber/ballast tanks.
      - c) Layout and arrangement of gate track or pathway.
      - d) Gate drive system.
      - e) Gate support mechanisms.
      - f) Gate seals.
      - g) Sections and details showing all layers or assembled elements at all key gate locations.
      - h) Gate rolling system.
      - i) General arrangement of gate electrical and control equipment.
      - j) Gate control block diagram.
      - k) Operation of the gate control system.
      - l) Electrical system one-line and schematic diagrams with specification-sheet information for electrical equipment and components. This shall include descriptive narrative of the operation of the electrical system.
      - m) <sup>A19</sup>General arrangement and installation details of recess closures and the maintenance closure system. <sup>A19</sup>
    - 2) <sup>A19</sup>Provide the level of detail required to permit the Employer to thoroughly evaluate the technical design solutions provided for the lock gates, proposed lock gate recess closures and maintenance closure. <sup>A19</sup>
    - 3) <sup>A17</sup>Present the drawings in a format compliant with Employer's Requirements <sup>A17</sup>

- 4) Include notes, callouts and annotations that are clear and easy to follow.
  - c. **Tender design analysis.** <sup>A19</sup>Tenderers shall prepare and submit an analysis consisting of a written explanation of the design process for the lock gates, recess closures, maintenance closure, and ancillary equipment. The explanation shall contain a summary of the criteria for the design referenced to the Employer's Requirements, codes, references, and safety requirements.<sup>A19</sup>
    - 1) The Tender design analysis shall include, but not be limited to, the following.
      - a) Equipment capacity; electrical rating; principal dimensions; design calculations and estimated weight; and name and brand of major components, machinery, etc.
      - b) Safety features related to vehicular movement around and across the lock chambers and to operations and maintenance personnel.
      - c) Auxiliary machinery/equipment specifications.
      - d) Gate movement hydrodynamic analysis and results demonstrating that gate movement will have minimal effect on the gate and drive equipment.
      - e) <sup>A20</sup>Gate floating stability analysis.<sup>A20</sup>
      - f) Stress calculations supporting preliminary member sizing and Material selection. Structural calculations shall prove adequacy of the system for all possible loading conditions. Comprehensive fatigue calculations shall be included for all cyclically loaded structures.
    - 2) <sup>A19</sup>(Reserved).<sup>A19</sup>
    - 3) <sup>A19</sup>(Reserved).<sup>A19</sup>
    - 4) The justification for each major equipment item selection and design decision shall be clearly stated and shall include supporting calculations, as applicable.
    - 5) The design safety factors shall be clearly identified.
    - 6) <sup>A19</sup>(Reserved).<sup>A19</sup>
  - d. <sup>A20</sup>**Maintainability.**<sup>A20</sup> Maintenance features, with respect to maintainability and maintenance requirements. "Maintainability" for the purpose of the RFP means the ease with which the equipment, machinery, and structure can be accessed, removed, repaired, reinstalled, inspected, etc. Tenderers shall prepare and submit:
    - 1) A discussion of how the design and fabrication of the proposed gates comply with the maintenance requirements in the Employer's Requirements.
    - 2) Identification of specific design features that enhance maintainability and an explanation of how each respective design feature accomplishes the identified enhancement.
    - 3) <sup>A19</sup>Proposed maintenance program reflecting provisions 1) and 2).<sup>A19</sup> Specific components to be addressed include the rolling cart, guide and cable, and drive system.
  - e. **Descriptive literature.** Descriptive literature and catalog information for commercial components and equipment incorporated into the completed gate shall be provided and shall include the experience of the respective supplier.
  - f. <sup>A20</sup>**Quality control plan.**<sup>A20</sup> Quality control plan and tests planned for the fabrication and installation processes.
2. <sup>A19</sup>(Reserved).<sup>A19</sup>

E. **Valves.** The valves are the control elements of the filling and emptying system for the locks. Clearly a critical part of the lock complex, valve design, fabrication, and installation must receive the appropriate level of attention to ensure a high-quality procurement, design, and installation process.

1. **Tender Design.** <sup>A19</sup>Tenderers shall present design and specifications for the valves, drives, controls, frames, fittings, and valve appurtenances, specifically describing how the Tenderer will satisfy the Employer's Requirements with regard to performance, configuration, structural capacity, stability, and maintainability. <sup>A19</sup> Whenever the use of a commercial component is proposed, the Tenderer shall clearly indicate it. Design documentation shall include, but not be limited to, the following.

a. <sup>A20</sup>**Specifications.** <sup>A20</sup> Tenderers shall include specifications for each size and type of valve.

- 1) <sup>A19</sup>The specifications shall include detailed descriptions of workmanship, structures, Materials, equipment, corrosion control coatings, fittings, accessories, as well as tests and trials.
- 2) The Tenderers shall demonstrate that the specifications provided comply with the Employer's Requirements.
- 3) (Reserved).
- 4) Demonstrate that the proposed configuration will result in a system that is compliant with the functional requirements
- 5) (Reserved). <sup>A19</sup>

b. **Drawings.** Tender design drawings shall be of high quality and of sufficient detail to permit the Employer to thoroughly evaluate the technical design solutions provided for the lock valves. The Tender drawings shall include, but not be limited to, the following.

- 1) General arrangement of valve assembly, including profile, plan, arrangement, and equipment arrangement.
- 2) General arrangement of valve framework, structural plans, and sections.
- 3) Valve drive system.
- 4) Valve support mechanisms.
- 5) Sections showing all layers or assembled elements comprising the valve.
- 6) General arrangement of electrical and control equipment.
- 7) Control block diagram with specification sheet information for control equipment and components, including a description of the operation of the control system.
- 8) Electrical system one-line and schematic diagrams with specification sheet information for electrical equipment and components. This submittal shall include a description of the operation of the electrical system.

c. **Analysis.** Tenderers shall prepare and submit a Tender design analysis consisting of a written explanation of the valve design and equipment selection. The analysis shall contain a summary of the criteria for the background of the Tender design. <sup>A19</sup>These design criteria shall include the basic criteria established in the Employer's Requirements, codes, references, and safety requirements. <sup>A19</sup> The justification for each major equipment item selection and design decision shall be clearly stated and shall include supporting calculations, when

applicable. The design safety factors shall be clearly identified. The Tender design analysis shall include, but not be limited to, the following:

- 1) Equipment capacity; electrical rating; principal dimensions; Tender design calculations and estimated weight; and the name and brand of major components, machinery.
  - 2) Safety features related to the Tender design and personnel safety.
  - 3) Auxiliary machinery/equipment specification and list by name and brand (including but not limited to equipment, circuit breakers, and electrical equipment).
- d. **Maintainability and maintenance requirements.** Tenderers shall prepare and submit:
- 1) A discussion of how the design and fabrication of the proposed valves comply with the maintenance requirements defined in the Employer's Requirements.
  - 2) Identification of specific design features that enhance maintainability and an explanation of how each respective design feature accomplishes the identified enhancement.
  - 3) <sup>A19</sup>Proposed maintenance program reflecting provisions 1) and 2).<sup>A19</sup>
- e. **Descriptive literature.** Tenderers shall include, with the technical proposal, two copies of descriptive literature and catalog information for commercial major components and equipment.
2. <sup>A19</sup>(Reserved).<sup>A19</sup>
- F. **Electrical.** <sup>A19</sup>Tenderers shall provide a Tender design for the electrical systems for the lock complexes. The Tender design shall include, but not necessarily be limited to:<sup>A19</sup>
1. **Description of the Tender Design for the Power System.** <sup>A19</sup>The electrical system concepts that are based on the referenced one-line diagram shall be described. Tenderer shall reference the proposed solution to the corresponding specifications and explain how the proposed solution meets or exceeds the Employer's Requirements.<sup>A19</sup> The description shall:
    - a. Address system integrity and characteristics.
    - b. Identify how the Tenderer's approach will allow incorporation of current technology at the time of system installation.
    - c. <sup>A19</sup>(Reserved).<sup>A19</sup>
    - d. Address system reliability and identify how designed redundancies will ensure that lock operations can continue in a failure mode. <sup>A19</sup>This shall include a failure modes and analysis study.<sup>A19</sup>
  2. **One-Line Diagram for Each Lock Complex.** <sup>A19</sup>Tenderers shall provide a one-line diagram, including information that addresses or contains:<sup>A19</sup>
    - a. The distribution plan for low and medium voltage;
    - b. Loads, redundancy, and remote and local controls;
    - c. Emergency power generation and distribution;
    - d. An equipment list for each lock complex with accompanying equipment technical data sheets and defining technical features;
    - e. Systems and parameters to be monitored and provided with alarm notification and the communication medium for the monitoring/alarm system;
    - f. Forecasted power consumption and system efficiency.
    - g. <sup>A19</sup>The maintenance program for the proposed electrical system.<sup>A19</sup>

## G. Control Systems

1. **Locks Machinery Control System (LMCS).** Tenderers shall develop and submit a Tender design for the control and operation of the locks machinery control systems (LMCS) at the locks complexes. The Tender design shall include a general description of the proposed system. This general description shall demonstrate compliance with the Employer's Requirements and shall:
  - a) Reference each proposed solution to the corresponding specifications in the Employer's Requirements and explain how the proposed solution meets or exceeds the Employer's Requirements, in terms of, but not limited to, the following:
    1. <sup>A19</sup>System reliability
    2. System integrity
    3. Fabrication and installation quality management
    4. Human-machine interface (HMI) aspects, including ease of operation
    5. Maintainability
    6. Performance enhancements
    7. Future upgrade capability<sup>A19</sup>
  - b) Identify the codes, standards, and guidelines that the systems will adhere to, and as applicable to the design and construction as stated in the Employer's Requirements.
  - c) Provide block diagrams for the system, and shall also:
    1. Explain how his approach will allow incorporation of current technology at the time of system installation.
    2. <sup>A19</sup>(Reserved).<sup>A19</sup>
    3. <sup>A19</sup>(Reserved).<sup>A19</sup>
    4. Diagram functional relationships and communication links for each of the systems.
2. **Electrical Distribution Control System (EDCS).** Tenderers shall develop and submit a Tender design for the control and operation of the electrical distribution control systems at the locks complexes. The Tender design shall include a general description of the proposed system. This general description shall demonstrate compliance with the Employer's Requirements and shall:
  - a) <sup>A19</sup>Reference each proposed solution to the corresponding specifications in the Employer's Requirements and explain how the proposed solution meets or exceeds the Employer's Requirements, in terms of, but not limited to, the following:
    1. System reliability
    2. System integrity
    3. Fabrication and installation quality management
    4. Human-machine interface (HMI) aspects, including ease of operation
    5. Maintainability
    6. Performance enhancements

7. Future upgrade capability<sup>A19</sup>
  - b) Identify the codes, standards, and guidelines that the systems will adhere to, and as applicable to the design and construction as stated in the Employer's Requirements.
  - c) Provide block diagrams for the system, and shall also:
    1. Explain how his approach will allow incorporation of current technology at the time of system installation.
    2. <sup>A19</sup>(Reserved).<sup>A19</sup>
    3. <sup>A19</sup>(Reserved).<sup>A19</sup>
    4. Diagram functional relationships and communication links for each of the systems.
3. **Description of Integrator's Past Performances in Similar Projects and Competencies of the Proposed System's Integrator.** No less than three projects of comparable complexity and size to the required locks machinery controls system, fire fighting control system and electrical distribution control system shall be cited and explained in details related to the systems concerned. Up to date contact information for contact persons for each references shall be included.

H. **Fender System.** Tenderers shall develop and submit a Tender design for the fender system for the following lock areas.

1. **Approach Structures.** Minimizing the approach times for vessels while complying with safety requirements is an integral part of optimizing the transit of vessels through the locks. The proposed approach wall fender system shall be appropriate for the selected approach structure and shall comply with the Employer's Requirements. The proposal shall as a minimum:
  - a. Provide drawings showing the general layout of the fender system and sufficient details to permit proper evaluation of the proposal.
  - b. Provide specifications for the fender system including Materials.
  - c. Provide analysis showing the capacity of the fender for meeting the requirements and the loads transferred to the structures.
  - d. Provide a narrative that explains the applicability of the fender system for meeting the Employer's Requirements. <sup>A19</sup>The content of this narrative is not to exceed two pages. Validation calculations, drawings, specifications, tables, figures and charts do not apply against the page count.<sup>A19</sup>
  - e. Provide the testing protocol for ensuring compliance with the specifications.
  - f. The information provided shall be clear, well developed and well organized. <sup>A17</sup>Drawings shall be presented in a format compliant with Employer's Requirements and include notes, callouts and annotations that are clear and easy to follow.<sup>A17</sup>
2. **Chamber Walls.** Minimizing the times for vessels moving into the chamber or from chamber to chamber, as well as avoiding damage to vessels or the walls during filling and emptying, is an integral part of optimizing the transit of vessels through the locks. The proposed chamber fender system shall be appropriate for the intended use and shall comply with the Employer's Requirements. The proposal shall, as a minimum:

- a. Provide drawings showing the general layout of the fender system and sufficient details to permit proper evaluation of the proposal.
  - b. Provide specifications for the fender system including Materials.
  - c. Provide analysis showing the capacity of the fender for meeting the requirements and the loads transferred to the structures.
  - d. Provide a narrative that explains the applicability of the fender system for meeting the Employer's Requirements. <sup>A19</sup>The content of this narrative is not to exceed two pages. Validation calculations, drawings, specifications, tables, figures and charts do not apply against the page count. <sup>A19</sup>
  - e. Provide the testing protocol for ensuring compliance with the specifications.
  - f. The information provided shall be clear, well developed and well organized. <sup>A17</sup>Drawings shall be presented in a format compliant with Employer's Requirements and include notes, callouts and annotations that are clear and easy to follow. <sup>A17</sup>
3. <sup>A19</sup>**Corner Protection.** <sup>A19</sup> Minimizing the approach times for vessels while complying with safety requirements is an integral part of optimizing the transit of vessels through the locks. The proposed wing wall fender system shall be appropriate for the specific location and shall comply with the Employer's Requirements.
- a. Provide drawings showing the general layout of the fender system and sufficient details to permit proper evaluation of the proposal.
  - b. Provide specifications for the fender system including Materials.
  - c. Provide analysis showing the capacity of the fender for meeting the requirements and the loads transferred to the structures.
  - d. Provide a narrative that explains the applicability of the fender system for meeting the Employer's Requirements. <sup>A19</sup>The content of this narrative is not to exceed two pages. Validation calculations, drawings, specifications, tables, figures and charts do not apply against the page count. <sup>A19</sup>
  - e. Provide the testing protocol for ensuring compliance with the specifications.
  - f. The information provided shall be clear, well developed and well organized. <sup>A17</sup>Drawings shall be presented in a format compliant with Employer's Requirements and include notes, callouts and annotations that are clear and easy to follow. <sup>A17</sup>

## END OF SECTION

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