Exhibit D

Research Project Requirement Template

Risk Assessment of Port Infrastructure Considering Uncertainty in Coastal Forcing

Recipient/Grant (Contract) Number: 69A3552348306 (CY1-TAMU-02)

Center Name: Southern Plains Transportation Center (SPTC)

Research Priority: Improving the Durability and Extending the Life of Transportation Infrastructure

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Partners: Texas A&M University and Texas A&M Transportation Institute

Research Project Funding: Texas A&M University: $60,000 (Federal) and $60,000 (Match); Texas A&M Transportation Institute: $91,186 (Federal)

Proposed Start and End Date: 9/1/2023 to 8/31/2024

Project Description: The goal of this one-year project is to assess the resilience of Texas and Louisiana port infrastructure, including seawalls and waterfronts, amid uncertainties tied to coastal forcing. Uncertainties that arise from the stochastic nature of coastal forces and future extreme events present challenges in optimizing the resilience of these structures. This project has three primary objectives: *Objective 1*: Gain insight into the current practices and policies of Texas and Louisiana coastal ports for dealing with changing coastal forcing; *Objective 2:* Conduct case studies of risk-based lifecycle assessment of port infrastructure considering uncertainties in coastal forcing and structural stability; *Objective 3*: Utilize research findings to devise strategies that reduce uncertainty, enhance risk assessment, and improve lifetime reliability.

Insights into the current practice will be gained through targeted interviews with port employees in both states, followed by informal workshops with selected ports in each state. A comprehensive literature review of policies and practices of ports in Texas and Louisiana will be conducted in regard to changing coastal forcing. This will enable the researchers to determine the best way to approach the interviews and workshops. The research team will send out a brief survey to all deep-water ports in the Texas and Louisiana region. The responses provided by the ports will aid in narrowing down those selected for a more in-depth discussion. A probabilistic risk assessment will be conducted to evaluate the lifecycle performance of seawalls considering future uncertainty in coastal forcing, extreme events, and SLR. This approach comprises the following key components: (i) stochastic wave hazard modeling for predicting coastal forcing; (ii) stochastic deterioration modeling accounting for chronic stressors; (iii) time-dependent structural reliability analysis for estimating failure probability over structures' lifetime; and (iv) a lifecycle management model offering a risk-based tool for optimal design and maintenance strategies. The reinforced concrete curved seawall in Galveston will be used as a case study -- a structure of strategic importance in the Gulf Coast's economic port infrastructure resilience.

US DOT Priorities: The proposed project aligns directly with the research goals of the Southern Plains Transportation Center (SPTC) and goals of the U.S. Department of Transportation (USDOT) on Economic Strength and Competitiveness. To preserve its economic vitality, the port industry must comprehend the long-term integrity of its infrastructure in a timely and efficient manner. Specifically, it is in line with SPTC's topic, "(4) Performance-Based Infrastructure Life Cycle and Asset Management".

Furthermore, the project's objective to assess and mitigate seawall vulnerabilities to coastal forcing complements SPTC's integrated topic, "(1) Novel Technologies and Tools for Assessment of Impact on Infrastructure Durability."

The proposed project embodies breakthrough research by assessing the resilience of Texas and Louisiana's port infrastructure amidst significant uncertainties of coastal force. Its pioneers in integrating a holistic understanding of current practices and policies at the coastal ports with a rigorous, probabilistic risk-based lifecycle assessment of the port structures. The implementation of a probabilistic framework for evaluating waterfront infrastructure, with a spotlight on pivotal structures like Galveston's seawall, represents advanced research that intricately considers future uncertainties in extreme events. The project's structured engagement with port authorities, using surveys and workshops, facilitates a collaborative exchange of ideas, ensuring that the research findings and devised strategies are grounded in the practical realities and needs of the ports.

Outputs: A report documenting the literature search, what is learned from the survey/interviews, and a summary of the workshop discussions will be provided. The models, tools, and policies developed under this project will be made available to all ports in the Texas/Louisiana region and beyond. In addition, peer-reviewed papers and presentations will be prepared. The support of TxDOT and Louisiana Department of Transportation and Development (LADOTD) will elevate the level of participation and the desire to share information. Also, the U.S. Army Engineer Research and Development Center (ERDC) has shown interest in this research topic in the past and their engagement is anticipated throughout this project, particularly in providing essential data/information.

Outcomes/Impacts: The findings from Objective 1 will enable ports to see what their peers are doing and how they are approaching specific issues. It will enable ports to determine whether their approaches are appropriate. It may also make it possible for a group of ports to cooperate in seeking funding or government assistance in dealing with common issues. The findings from Objectives 2 and 3 will lead to an improved understanding of various physical, hazard, and decision elements that are critical in incorporating stochastic methods for reliability-based design and rehabilitation of coastal structures under future uncertain scenarios tied to coastal forcing and structural deterioration. The key performance indicator includes quantification of the probability of failure under different scenarios, measuring the decrease in predicted failure rates, evaluating the increase in expected lifespan, and reducing lifecycle cost by applying the research findings.

Final Research Report: