COX – OSU
VAN DE LINDT - CSU
DHS Coastal Resilience Center
Year 6 Research Project Workplan
[July 1, 2020 – June 30, 2021]

1. **Title**.

Experimental and Numerical Study to Improve Damage and Loss Estimation due to Overland Wave and Surge Hazards on Near-Coast Structures

Year 6 Subtitle: Integration and Validation of Residential Wave/Surge Fragilities for HAZUS-MH and Hindcast Study for Damage and Loss Uncertainty

2. **Principal Investigator**.

Dr. Daniel Cox, (PI) Professor, Oregon State University
Dr. John van de Lindt (Co-PI), Professor, Colorado State University

3. **Other Participants/Partners**.

Jesse Rozelle, FEMA, Acting Branch Chief, Actuarial and Catastrophic Modeling Branch
Casey Zuzak, FEMA, Actuarial and Catastrophic Modeling Branch
Christina Lindemer, FEMA, Risk Management, Engineering Resources Branch
Lauren Schmeid, FEMA, Coastal Program Specialist
Jordan Burns, NIYAMIT, Inc., Risk Analysis Lead
Doug Bausch, NIYAMIT, Inc., Risk Analysis Program Manager

4. **Short Description**.

We propose to take the hurricane wave/surge damage functions developed in this project and integrate them into FEMA's HAZUS-MH model in direct collaboration with the end-user (FEMA HAZUS team and their consultants). We will use existing FEMA damage data and existing hazard data to validate the new approach using two sections of U.S. shoreline, namely the Texas shoreline impacted by Hurricane Ike and the New Jersey shoreline impacted by Superstorm Sandy. FEMA will use their data to validate the functions and release them from their Github account for use by HAZUS users. We will determine the accuracy of the improvements to HAZUS-MH for future FEMA loss avoidance studies for coastal communities.

5. **Abstract**.

We propose to take the hurricane wave/surge damage functions developed in this project and integrate them into FEMA's HAZUS-MH model in direct collaboration with the end-user (FEMA HAZUS team and their consultants). In Year 1-5, we developed new fragility functions using physics-based computer simulations that were validated using laboratory data collected in this project and other available data. The new fragility functions were compared to existing FEMA damage functions to show the general improvements that can be gained from this new method. This will also allow their coastal analyses to utilize techniques as advanced as earthquake and wind analysis in HAZUS – a feature currently not available to users. During Year 1-4, we held three meetings with HAZUS developers and formulated a general plan for a hindcast study for a section of shoreline that had been impacted by a recent hurricane. Based on

input from the HAZUS team and work plan review comments, we will focus on single family and multi-family residential structures on two areas of the U.S.: (1) a section of the Texas shoreline (Bolivar Peninsula) impacted by Hurricane Ike; and (2) a section of the New Jersey shoreline (Ortley Beach) impacted by Superstorm Sandy. A key for this study will be use existing FEMA damage data and existing hazard data to validate the new approach at a parcel-level scale. We will incorporate an uncertainty analysis, considering the uncertainty in the hazard (surge level, wave conditions), building stock (building inventory, construction standard and code requirements), and corresponding damage prediction. As a demonstration, we show the ability of HAZUS to conduct loss avoidance studies (e.g., buyout, elevation). FEMA will use their data to validate the functions and release them from their Github account for use by HAZUS users. Finally, we will convene a virtual meeting among three groups working on similar aspects of risk-informed decision-making models: OpenHAZUS (FEMA), IN-CORE (NIST) and SimCenter (NSF) to develop future research recommendations, for example, the development of damage models for lifeline infrastructure (transportation, power, water, and communication).