Adapting Critical Infrastructures in Time via Climate-informed Infrastructure

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As a nation we are making large strides in climate modeling, hazard and risk prediction, and technology development. However, these efforts are not yet seamless and large gaps exist in our efforts to secure our critical infrastructure against the present and mounting threats of climate change. Specifically, we lack the tools to quickly evaluate the physical impacts of climate risks upon the systems vital to U.S. critical infrastructure. As climate change is non-linear and predictions of future climates, by necessity, involve many uncertainties and unknowns, Earth's future climate cannot be a completely predictive science. The goal, rather, is to pair downscaled climate model data with existing data to project possible future climate configurations with as accurate an understanding as possible of the range of possible outcomes. The age of low-frequency high-consequence events is giving way to an era of high-frequency high-consequence events and we must prioritize protection and adaptation actions by consequence. The increased frequency and distribution of severe events make it difficult to anticipate the impact of these events upon our critical infrastructure, and thus adapt how infrastructures and associated technologies monitor and respond to climate extremes. To make innovative leaps in effective adaptation actions, we must better understand the nexus between what past environments a given technology was designed for, and what future conditions it will need to operate within.

Background/Objectives. As one of DOE’s only applied engineering labs, INL is uniquely well positioned to help bridge the gaps in knowledge regarding climate resilient infrastructure that exists in government, industry and academia. Our ultimate objective in developing the CIRE methodology is to provide timely, actionable decision support and related tools to asset owners and operators (AOOs), regulators, and other energy (and other interdependent) sector stakeholders. Two of the primary values steering this effort are an emphasis on simplicity, and the intention to avoid analysis paralysis. In other words, we want something actionable, and we demand it be ready, as least as a functional porotype, as soon as possible.

We seek to be able to answer this question: for a given high consequence critical infrastructure asset, from which climate physical risks (e.g., fire, heat, flood, SLR, etc.) must it be protected and by when? And also determine the best engineered resilience options to present to decision makers for that asset.

Approach/Activities. Our current and projected future approaches involve open-minded explorations leading to gap identification. For best results we’re reaching out to a broad and diverse array of subject matter expert individuals and organizations. To date these include: Argonne National Lab, Sandia National Lab, the National Center for Atmospheric Research (NCAR), Carnegie Melon University, Arizona State University, the US Army, DHS, USACE, the White House NSC, engineering firms Black & Veatch and Burns McDonnell, as well as the consultancy ICF. We’re developing and posing research questions, the answers to which we anticipate will provide pathways to solutions. In particular, we are probing the potential of transforming and leveraging climate model outputs as inputs to risk/hazard models.

Results/Lessons Learned. While still early in the process, we’ve already learned that clear gaps exist that need filling before real progress can be achieved towards prioritizing and protecting and/or adapting critical infrastructure functions and assets that must not be allowed to fail.