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**SUBJECT:** Implementation of Resilience Principles in the Engineering & Construction (E&C) Community of Practice (CoP)

**CATEGORY:** Policy and Guidance

## 1. References:

- a. Engineer Pamphlet (EP) 1100-1-2, U.S. Army Corps of Engineers (USACE) Resilience Initiative Roadmap, 16 Oct 17
- b. EP 1100-1-3, USACE Sustainability: Definition and Concepts Guide, 19 Jul 18
- c. EP 1100-2-2, Civil Works Sustainable Infrastructure Practices Guidebook, 01 Dec 19
- d. Engineer Regulation (ER) 1105-2-101, Risk Assessment for Flood Risk Management Studies, 15 Jul 19
- e. ER 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, 15 Jun 19
- f. EP 1100-2-1, Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation, 30 Jun 19
- g. Engineering and Construction Bulletin (ECB) 2019-8, Managed Overtopping of Levee Systems, 24 Apr 19
- h. EP 1100-1-5, USACE Guide to Resilience Practices, 01 Dec 20
- i. EP 1100-2-3, Civil Works Guide to Sustainable Infrastructure Requirements, 01 Jun 2020
- j. ECB 2018-14 Rev2, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs and Projects, 19 Aug 22
- k. CECW-HS Memorandum, Resilience Integration in the USACE Flood Risk Management Mission, 22 Sep 23
- l. Engineer Circular 1100-1-113 USACE Guidance for Incorporating Study-Specific Projections of Climate-Changed Meteorology and Hydrology, 26 Jun 23

2. **Purpose.** This ECB provides policy and guidance for applying the USACE principles of resilience — Prepare, Absorb, Recover, and Adapt (PARA) — to the E&C CoP efforts.

3. **Applicability.** This ECB applies to the Military Programs, Civil Works, and International and Interagency programs.

4. **Background.**

a. USACE introduced the Resilience Initiative in 2015 to address an increasing focus on resilience internally and with partners and stakeholders. USACE established the initiative to clearly articulate (1) how USACE's actions, projects, and systems support community resilience, and (2) how USACE provides increased project and system resilience within its authorities and capabilities. These considerations complement USACE's approach to resilience via risk-informed decision-making and coincide with partners' and stakeholders' increased focus on resilience.

b. As part of the Resilience Initiative, USACE introduced “resilience thinking” to more effectively apply established and emerging practices and procedures that lead to improved resilience. This includes applying the PARA principles of resilience to USACE activities. The 2017 USACE Resilience Initiative Roadmap encouraged all personnel to use the PARA principles to consistently provide more resilient solutions at the project, system, and community levels. A description of each PARA principle is provided below:

(1) Prepare. The *Prepare* principle considers measures to meet the needs of a project component or system, including reducing risks or costs under loading conditions beyond those required by technical standards or norms (e.g., USACE, International Code Council, American Society of Civil Engineers, American Society of Mechanical Engineers).

(2) Absorb. The *Absorb* principle considers measures to limit damage to, or loss of function of, a project component or system due to both acute and chronic loading conditions, including conditions beyond those used for the design. This principle is also relevant when considering adding system component robustness, redundancy, and increased reliability.

(3) Recover. The *Recover* principle stresses wise and rapid repair or functional restoration of a project component or system.

(4) Adapt. The *Adapt* principle considers modifications to a project component or system that maintains or improves future performance based on lessons learned from a specific loading condition or loadings associated with changed conditions.

c. Resilience is the ability to anticipate, prepare for, and adapt to changing conditions; and withstand, respond to, and recover rapidly from disruptions. This ECB reflects this definition and also supports the application of a more project-specific definition of resilience as the capacity of a component, unit, or system to withstand occasional large overloads (for a definite duration of time) that cause minimal permanent deformation, damage, or cumulative degradation and then essentially recover (within a specified time) its original state and function after the overloading event.

5. **Policy.** As established in the 2017 Resilience Initiative Roadmap, USACE will implement resilience thinking agency-wide through the application of the PARA principles and in support of risk-informed decision-making. The E&C CoP and sub-CoPs will reflect resilience thinking in their practices and in new and updated standards and criteria.

6. **Guidance.** To apply resilience thinking at the project or system level, an evaluation should be performed using the PARA principles during planning and design.

a. Resilience evaluations should be completed as needed based on engineering judgment and reflective of project complexity and assessed risk. Analyses and outcomes should be formally documented. Where appropriate, interconnections between project components and systems, and their individual and cumulative effect on project performance and resilience should be considered.

b. Consideration of resilience may result in recommendations by the project team for measures to improve resilience. These recommendations can be incorporated into the design when they are permitted by project authorities and do not significantly increase total project life cycle cost, including recovery costs. Recommendations that result in significant cost increases may also be considered in some cases, but these recommendations must be appropriately justified.

7. **Update.** New requirements will be included in the next appropriate policy document update.
8. **Point of Contact.** The Headquarters USACE E&C CoP point of contact for this ECB is Dr. William Veatch, CECW-EC, (202) 761-7755.

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