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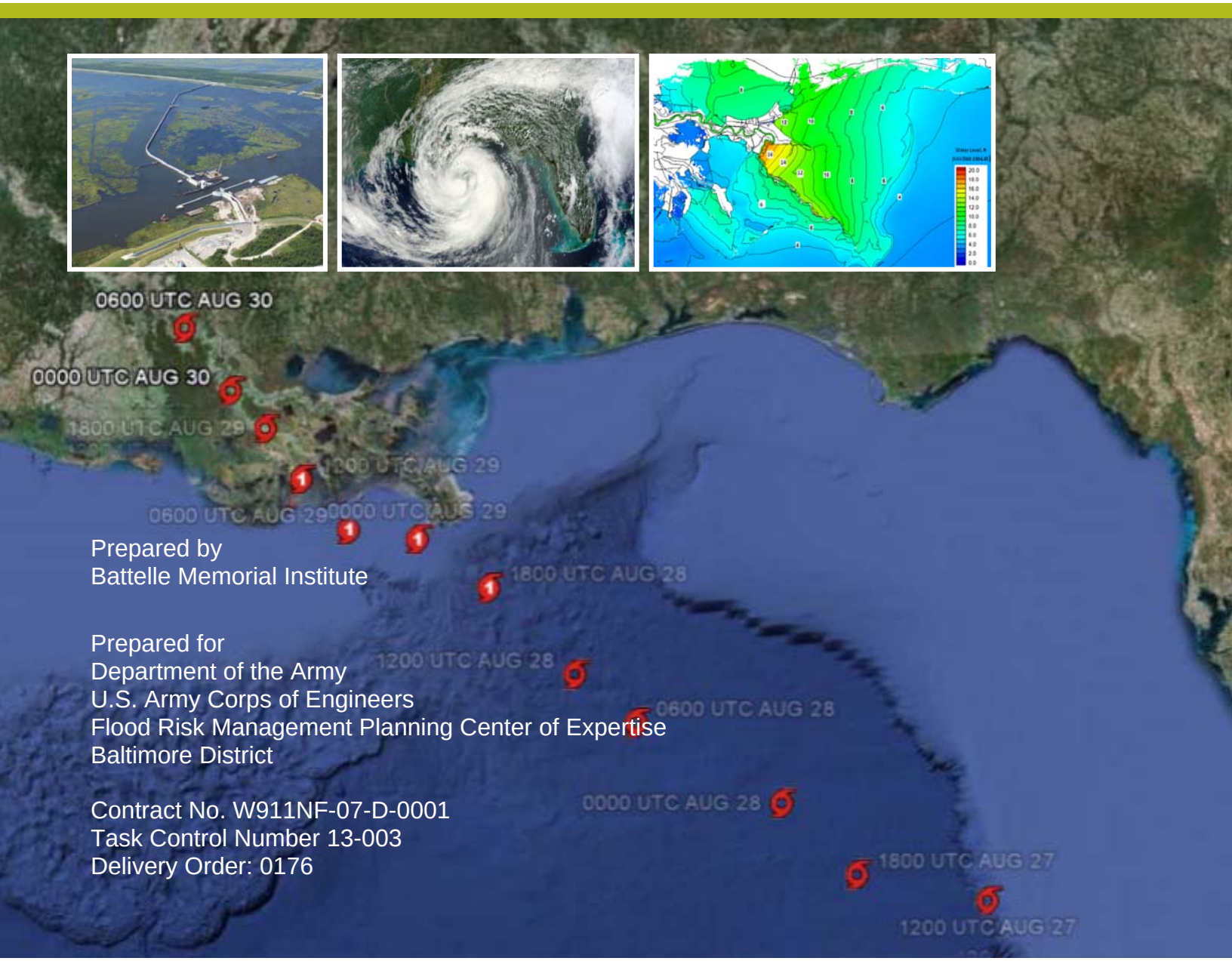
Final Independent External Peer Review Report Hurricane Isaac With and Without 2012 100-Year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report



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Department of the Army
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Flood Risk Management Planning Center of Expertise
Baltimore District

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Final Independent External Peer Review Report
Hurricane Isaac With and Without 2012 100-Year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report

by

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Final Independent External Peer Review Report for the

Hurricane Isaac With and Without 2012 100-Year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report

EXECUTIVE SUMMARY

Project Background and Purpose

Hurricane Isaac's impacts on the coastal Louisiana area, including New Orleans and surrounding communities, were considerable. While the Hurricane and Storm Damage Risk Reduction System (HSDRRS) prevented the storm surge from inundating the areas within its system, major flooding occurred in areas without Federal levee systems. As this was the first major test of the HSDRRS, some have raised concerns that the HSDRRS was also responsible for unintended increased flooding in some of the unprotected areas. Local and state officials have requested an analysis or review to determine if, and to what extent, the HSDRRS affected these unprotected areas. Extensive modeling and analysis was performed during the design phase of the HSDRRS to determine what effect, if any, the HSDRRS could have on other areas. Public meetings were held across the area at which the modeling and analyses were discussed. Environmental documentation included discussions on the effects of the HSDRRS on adjacent areas. The Modeling Hurricane Isaac Pre- and Post- 100-year HSDRRS report will integrate the previous work with an assessment and modeling of Hurricane Isaac.

The report includes, but is not limited to, the following: an overview of Hurricane Isaac (meteorological, hydrological, and hydraulic); HSDRRS system performance during Hurricane Isaac; a review of prior evaluations of expected HSDRRS performance; a summary of hydrodynamic modeling conducted for Hurricane Isaac for both the pre- and post-HSDRRS conditions; and evaluations of storm surge impacts, rainfall, and hydrodynamic modeling for specific communities that sustained flooding during Hurricane Isaac.

Independent External Peer Review Process

The U.S. Army Corps of Engineers (USACE) is conducting an Independent External Peer Review (IEPR) of the Hurricane Isaac With and Without 2012 100-Year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report (hereinafter Hurricane Isaac Assessment). As a 501(c)(3) non-profit science and technology organization, Battelle is independent, is free from conflicts of interest (COIs), and meets the requirements for an Outside Eligible Organization (OEO) per guidance described in USACE (2012). Battelle has experience in establishing and administering peer review panels for USACE and was engaged to coordinate the IEPR of the Hurricane Isaac Assessment. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2012), USACE (2007), and

OMB (2004). This final report describes the IEPR process, describes the panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel (the Panel).

The candidates for the Panel were evaluated based on their technical expertise in hydrologic and hydraulic engineering, and coastal engineering. These areas correspond to the technical content of the Hurricane Isaac Assessment and overall scope of the project. Hydrologic and hydraulic engineering is one of the technical areas of expertise previously identified for the Louisiana Water Resources Council (LWRC, as defined in the Water Resources Development Act [WRDA] 2007, Section 7009) Primary Panel. Battelle selected two experts for the panel: Dr. Ralph Ellis, a member of the LWRC Primary Panel, and Mr. Scott Fenical, a participant in a recent LWRC review.

The Panel received an electronic version of the 290-page Hurricane Isaac Assessment IEPR document, along with a charge that solicited comments on specific sections of the documents to be reviewed. USACE prepared the charge questions following guidance provided in USACE (2012) and OMB (2004), which were included in the draft and final Work Plans.

The USACE Project Delivery Team briefed the Panel and Battelle during a kick-off meeting held via teleconference prior to the start of the review. Other than this teleconference, there was no direct communication between the Panel and USACE during the peer review process. The Panel produced more than 38 individual comments in response to the 19 charge questions.

IEPR panel members reviewed the Hurricane Isaac Assessment documents individually. The panel members then met via teleconference with Battelle to review key technical comments, discuss charge questions for which there were conflicting responses, and reach agreement on the Final Panel Comments to be provided to USACE. Each Final Panel Comment was documented using a four-part format consisting of: (1) a comment statement; (2) the basis for the comment; (3) the significance of the comment (high, medium, or low); and (4) recommendations on how to resolve the comment. Overall, three Final Panel Comments were identified and documented. Of these, one was assigned medium significance and two low significance.

Results of the Independent External Peer Review

The panel members agreed between each other on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2012; p. D-4) in the Hurricane Isaac Assessment document. Table ES-1 lists the Final Panel Comments statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A of this report. The following summarizes the Panel's findings.

Based on the Panel's review, the report adequately assesses the effects of the 2012 100-year HSDRRS on areas outside the system, although the analyses are preliminary as acknowledged in the report. The Panel believes that the models used in the Hurricane Isaac Assessment were appropriately chosen and used and realistically represent the actual system. The modeling assumptions were sound, although the Panel found that the limitations of the models (while not unexpected given the preliminary nature of the input data) could have been described in more

detail. Overall, the report presents a strong compilation of field measurement and analysis, and numerical modeling using state-of-the-art techniques. The description of the HSDRRS is clear and appropriate for the report, and the report sufficiently and satisfactorily answers the question of whether the HSDRRS impacted areas outside the system during Hurricane Isaac. The Panel thinks that the wind and pressure data ultimately used for model input should have been better described and documented in the report, and that supplemental, currently available meteorological data might be a beneficial addition to the model input and may help produce more precise storm surge predictions. The Panel also believes that additional graphics, including conceptual illustrations of the storm's winds and surge as it unfolded, and a system-wide figure depicting where hydraulic overtopping would have occurred, would be helpful in demonstrating the causes of severe storm surge during Hurricane Isaac. Overall, the Panel suggests that the question posed by the analysis should have been whether the HSDRRS impacted areas outside the system during Hurricane Isaac *differently than the range of impacts predicted during the design phase*. The effects outside the HSDRRS during Hurricane Isaac were large enough to have been measureable in the field if two identical storms were to occur, but the report effectively demonstrates that those potential impacts were clearly predicted during analyses conducted in the HSDRRS design phase.

Table ES-1. Overview of Three Final Panel Comments Identified by the Hurricane Isaac Assessment IEPR Panel

No.	Final Panel Comment
	Significance – Medium
1	The description and documentation of the wind and pressure data that were ultimately used for storm surge modeling are insufficient to convey the overall input data quality.
	Significance – Low
2	The report does not include graphics that would improve comprehension of the storm surge build-up during Hurricane Isaac, particularly for someone unfamiliar with the geographic area.
3	The report does not include a system-wide figure that graphically shows where hydraulic overtopping would have occurred.

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LIST OF ACRONYMS

ATR	Agency Technical Review
COI	Conflict of Interest
DrChecks	Design Review and Checking System
HSDRRS	Hurricane and Storm Damage Risk Reduction System
IEPR	Independent External Peer Review
LWRC	Louisiana Water Resources Council
NTP	Notice to Proceed
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
USACE	United States Army Corps of Engineers
WRDA	Water Resources Development Act

1. INTRODUCTION

Hurricane Isaac's impacts on the coastal Louisiana area, including New Orleans and surrounding communities, were considerable. While the Hurricane and Storm Damage Risk Reduction System (HSDRRS) prevented the storm surge from inundating the areas within its system, major flooding occurred in areas without Federal levee systems. As this was the first major test of the HSDRRS, some have raised concerns that the HSDRRS was also responsible for unintended increased flooding in some of the unprotected areas. Local and state officials have requested an analysis or review to determine if, and to what extent, the HSDRRS affected these unprotected areas. Extensive modeling and analysis was performed during the design phase of the HSDRRS to determine what effect, if any, the HSDRRS could have on other areas. Public meetings were held across the area at which the modeling and analyses were discussed. Environmental documentation included discussions on the effect of the HSDRRS on adjacent areas. The Modeling Hurricane Isaac Pre- and Post- 100-year HSDRRS report will integrate the previous work with an assessment and modeling of Hurricane Isaac.

The report includes, but is not limited to, the following: an overview of Hurricane Isaac (meteorological, hydrological, and hydraulic); HSDRRS system performance during Hurricane Isaac; a review of prior evaluations of expected HSDRRS performance; a summary of hydrodynamic modeling conducted for Hurricane Isaac for both the Pre- and Post-HDRRS conditions; and evaluations of storm surge impacts, rainfall, and hydrodynamic modeling for specific communities that sustained flooding during Hurricane Isaac.

The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the Hurricane Isaac With and Without 2012 100-Year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report (hereinafter (Hurricane Isaac Assessment) in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers (USACE) Engineer Circular *Civil Works Review* (EC 1165-2-214) (USACE, 2012), USACE CECW-CP memorandum *Peer Review Process* (USACE, 2007), and Office of Management and Budget (OMB) bulletin *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

This final report details the IEPR process, describes the IEPR panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel on the existing environmental, economic, and engineering analyses contained in the Hurricane Isaac Assessment. The full text of the Final Panel Comments is presented in Appendix A.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the Agency Technical Review (ATR), as described in USACE (2012) and USACE (2007).

In general, the purpose of peer review is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. IEPR provides an independent assessment of the economic, engineering, and environmental analysis of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to make a good decision regarding implementation of alternatives and recommendations.

In this case, the IEPR of the Hurricane Isaac Assessment was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO) (as defined by EC No. 1165-2-214) under Section 501(c)(3) of the U.S. Internal Revenue Code with experience conducting IEPRs for USACE.

3. METHODS

This section describes the method followed in selecting the members for the IEPR Panel (the Panel) and in planning and conducting the IEPR. The IEPR was conducted following procedures described by USACE (2012) and in accordance with USACE (2007) and OMB (2004) guidance. Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

3.1 Planning and Schedule

After receiving the notice to proceed (NTP), Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, discuss the IEPR process, and address any questions regarding the scope (e.g., clarify expertise areas needed for panel members). Any revisions to the schedule were submitted as part of the final Work Plan.

Table 1 presents the schedule followed in executing the IEPR. Table 1 is based on receipt of pre-award funding from the USACE Contracting Officer's Representative and the Army Research Office's (ARO) Contracting Officer to begin initial work on the project (i.e., pre-award funding receipt) on October 30, 2012. Note that the work items listed in Task 6 occur after the submission of this report. Battelle will enter the three Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle.

Table 1. Hurricane Isaac Assessment IEPR Schedule

Task	Action	Due Date
1	Pre-award funding available[a]	10/30/2012
	Notice to Proceed	11/14/2012
	Review documents available	11/15/2012
	Battelle submits draft Work Plan[b]	11/20/2012
	USACE provides comments on draft Work Plan	11/29/2012
	Battelle submits final Work Plan	12/04/2012
2	Battelle requests input from USACE on the conflict of interest (COI) questionnaire	10/30/2012
	USACE provides comments on COI questionnaire	11/01/2012
	Battelle submits list of selected panel members[b]	11/09/2012
	USACE confirms the Panel has no conflicts of interest	11/14/2012
	Battelle completes subcontracts for panel members	11/28/2012
3	Battelle convenes kick-off meeting with USACE	11/15/2012
	Battelle sends review documents to Panel	11/29/2012
	Battelle convenes kickoff meeting with Panel	11/30/2012
	USACE/Battelle convenes kickoff meeting with Panel	11/30/2012
4	Panel members complete their individual reviews	12/11/2012
	Battelle provides Panel merged individual comments and talking points for Panel Review Teleconference	12/13/2012
	Battelle convenes Panel Review Teleconference	12/13/2012
	Panel members provide draft Final Panel Comments to Battelle	12/19/2012
	Battelle finalizes Final Panel Comments	12/28/2012
5	Battelle submits Final IEPR Report to USACE[b]	01/03/2013
6[c]	Battelle convenes teleconference with USACE to review the Post-Final Panel Comment Response Process	01/07/2013
	USACE provides draft PDT Evaluator Responses to Battelle	01/10/2013
	Battelle convenes teleconference with Panel and USACE to discuss Final Panel Comments and draft responses	01/17/2013
	USACE inputs final PDT Evaluator Responses in DrChecks	01/22/2013
	Battelle inputs the Panel's BackCheck Responses in DrChecks	01/30/2013
	Battelle submits pdf printout of DrChecks project file[b]	01/31/2013
	Project Closeout	04/05/2013

a Requested by Battelle to start Task 2 to meet the aggressive schedule.

b Deliverable.

c Task 6 occurs after the submission of this report.

3.2 Identification and Selection of IEPR Panel Members

The candidates for the Panel were evaluated based on their technical expertise in hydrologic and hydraulic engineering, and coastal engineering. These areas correspond to the technical content of the Hurricane Isaac Assessment and overall scope of the project.

Hydrologic and hydraulic engineering is one of the technical areas of expertise previously identified for the Louisiana Water Resources Council (LWRC, as defined in the Water Resources Development Act [WRDA] 2007, Section 7009) Primary Panel. Battelle consulted with the appropriate LWRC Primary Panel Member for that expertise area (Dr. Ralph Ellis) and confirmed that his expertise and schedule commitments made him suitable to serve on the Panel. To locate an additional expert, Battelle consulted with appropriate experts in the LWRC Candidate Pool; however, none of the candidates with suitable expertise in the Pool was available or qualified for this review. Battelle then contacted a coastal engineer who had participated in another recent LWRC review (Mr. Scott Fenical), and he had the requisite expertise and availability to participate.

Battelle made the final selection of panel members according to the selection criteria described in the Work Plan. The final Panel was composed of two expert reviewers, with one expert coming from the LWRC Primary Panel and one expert from outside the LWRC Candidate Pool. Information about the candidate panel members, including brief biographical information, highest level of education attained, and years of experience, was provided to USACE for feedback.

The candidates were screened for the following potential exclusion criteria or COIs.[1] These COI questions were intended to serve as a means of disclosure and to better characterize a candidate's employment history and background. Providing a positive response to a COI screening question did not automatically preclude a candidate from serving on the Panel. For example, participation in previous USACE technical peer review committees and other technical review panel experience was included as a COI screening question. A positive response to this question could be considered a benefit.

- Previous and/or current involvement by you or your firm[2] in the Modeling Hurricane Isaac Pre- and Post- 100-year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Draft Technical Assessment Report and/or technical appendices.
- Previous and/or current involvement (conceptual or actual design, construction, or O&M) by you or your firm[2] in HSDRRS projects in the greater New Orleans or coastal Louisiana areas.

[1] Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See OMB (2004, p. 18), "….when a scientist is awarded a government research grant through an investigator-initiated, peer-reviewed competition, there generally should be no question as to that scientist's ability to offer independent scientific advice to the agency on other projects. This contrasts, for example, to a situation in which a scientist has a consulting or contractual arrangement with the agency or office sponsoring a peer review. Likewise, when the agency and a researcher work together (e.g., through a cooperative agreement) to design or implement a study, there is less independence from the agency. Furthermore, if a scientist has repeatedly served as a reviewer for the same agency, some may question whether that scientist is sufficiently independent from the agency to be employed as a peer reviewer on agency-sponsored projects."

[2] Includes any joint ventures in which your firm is involved and if your firm serves as a prime or as a subcontractor to a prime. Please clarify which relationship exists in the rows above.

- Current employment by the U.S. Army Corps of Engineers (USACE).
- Previous and/or current involvement with paid or unpaid expert testimony related to the HSDRRS.
- Previous and/or current employment or affiliation with members of the cooperating agencies or local sponsors: the National Weather Service, the Water Institute of the Gulf, and/or the Southeast Louisiana Flood Protection Authority-East (for pay or pro bono).
- Past, current, or future interests or involvements (financial or otherwise) by you, your spouse, or your children related to the greater New Orleans or coastal Louisiana areas.
- Current personal involvement in other USACE projects, including authorship of any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the New Orleans District.
- Previous or current involvement in the development or testing of models that will be used for or in support of the Modeling Hurricane Isaac Pre- and Post- 100-year HSDRRS Draft Technical Assessment Report, including but not limited to ADCIRC.
- Current firm[2] involvement in other USACE projects, specifically those projects/contracts that are with the New Orleans District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please also clearly delineate the percentage of work you personally are currently conducting for the New Orleans District. Please explain.
- Any previous employment by USACE as a direct employee or contractor (either as an individual or through your firm[2]) within the last 10 years, notably if those projects/contracts are with the New Orleans District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning flood risk management and include the client/agency and duration of review (approximate dates).
- Pending, current, or future financial interests in HSDRRS project-related contracts/awards from USACE.
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years from USACE contracts.
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years from contracts with non-Federal sponsors (the National Weather Service, the Water Institute of the Gulf, and/or the Southeast Louisiana Flood Protection Authority-East).
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to the HSDRRS.
- Previous and/or current participation in prior Federal studies relevant to the HSDRRS.
- Previous and/or current participation in prior non-Federal studies relevant to the HSDRRS.
- Is there any past, present, or future activity, relationship, or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project? If so, please describe:

In selecting the final members of the Panel, Battelle chose experts who best fit the expertise areas and had no COIs. One of the two final reviewers is affiliated with an academic institution and the other is affiliated with a consulting company. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. USACE was given the list of candidate panel members, but Battelle made the final selection of the Panel. Section 4 of this report provides names and biographical information on the panel members.

Prior to beginning their review and within 2 days of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication procedures, and other pertinent information for the Panel.

3.3 Preparation of the Charge and Conduct of the IEPR

USACE provided the Panel with 19 charge questions/discussion points (included in the draft and final Work Plans), as well as the final charge, which included general guidance for the Panel on the conduct of the peer review (provided in Appendix B of this final report).

Battelle planned and facilitated a kick-off meeting via teleconference during which USACE presented project details to the Panel. Before the meeting, the IEPR Panel received an electronic version of the final charge as well as the Hurricane Isaac Assessment documents and reference materials listed below. The documents and files in bold font were provided for review; the other documents were provided for reference or supplemental information only.

- **Hurricane Isaac With and Without 2012 100-year HSDRRS Evaluation – Preliminary Report** (291 pages)
- USACE guidance Civil Works Review, (EC 1165-2-214) dated 15 December 2012
- CECW-CP Memorandum dated March 30, 2007

Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

3.4 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle. At the end of the review period, the Panel produced 38 individual comments in response to the charge questions/discussion points. Battelle reviewed the comments to identify overall recurring themes, areas of potential conflict, and other overall impressions. Following the review, Battelle summarized the 38 comments into a preliminary list of four overall comments and discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

3.5 IEPR Panel Teleconference

Battelle facilitated a 2-hour teleconference with the Panel so that the panel members could exchange technical information. The main goal of the teleconference was to identify which issues should be carried forward as Final Panel Comments in the Final IEPR Report and decide

which panel member would serve as the lead author for the development of each Final Panel Comment. This information exchange ensured that the Final IEPR Report would accurately represent the Panel's assessment of the project, including any conflicting opinions. The Panel engaged in a thorough discussion of the overall positive and negative comments, added any missing issues of high-level importance to the findings, and merged any related individual comments. In addition, Battelle confirmed each Final Panel Comment's level of significance to the Panel.

At the end of these discussions, the Panel identified three comments and discussion points that should be brought forward as Final Panel Comments.

3.6 Preparation of Final Panel Comments

Following the teleconference, Battelle prepared a summary memorandum for the Panel documenting each Final Panel Comment (organized by level of significance). The memorandum provided the following detailed guidance on the approach and format to be used to develop the Final Panel Comments for the Hurricane Isaac Assessment:

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged individual comments table, a summary detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.
- Directive to the Lead: Each lead was encouraged to communicate directly with the other panel member as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.
- Format for Final Panel Comments: Each Final Panel Comment was presented as part of a four-part structure:
    1. Comment Statement (succinct summary statement of concern)
    2. Basis for Comment (details regarding the concern)
    3. Significance (high, medium, low; see description below)
    4. Recommendation(s) for Resolution (see description below).
- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
    1. High: Describes a fundamental problem with the analysis that could affect the conclusions. Comments rated as high indicate that the Panel analyzed or assessed the methods, models, and/or analyses and determined that there is a "showstopper" issue.
    2. Medium: Affects the completeness or understanding of the reports/analysis. Comments rated as medium indicate that the Panel does not have sufficient information to analyze or assess the methods, models, or analyses.
    3. Low: Affects the technical quality of the reports, but will not affect the conclusions. Comments rated as low indicate that the Panel identified information (tables, figures,

equations, discussions) that was mislabeled or incorrect or data or report sections that were not clearly described or presented.

- Guidance for Developing Recommendations: The recommendation section was to include specific actions that USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

At the end of this process, three Final Panel Comments were prepared and assembled. Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in Appendix A of this report.

4. PANEL DESCRIPTION

Candidates for the Panel were identified from the LWRC Primary Panel and by using Battelle's Peer Reviewer Database. An overview of the credentials of the two members of the Panel and their qualifications in relation to the technical evaluation criteria is presented in Table 2. More detailed biographical information regarding each panel member and his area of technical expertise is presented in the text that follows the table. The two panel members have complementary expertise, with Mr. Fenical having a strong background in modeling and Dr. Ellis having decades of experience in design and construction expertise for flood control projects.

Table 2. Hurricane Isaac Assessment IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criterion	Ellis	Fenical
Registered professional engineer with a minimum 15 years demonstrated experience assessing Hurricane Protection and Storm Damage Risk Reduction System projects	X	X
Direct design or construction management experience with regard to:		
Levees	X	X
Floodwalls	X	X
Retaining walls	X	X
Pump stations	X	
Gate well structures	X	
Utility penetrations	X	
Stop log and sandbag gaps and other closure structures	X	X
Interior drainage	X	X
Drainage structures	X	
At least 5 years of experience working with numerical modeling applications for storm surge and wave analysis modeling and interior hydraulic modeling		X
Experience with the ADCIRC storm surge model		X
Familiarity with USACE application of risk and uncertainty analyses in hurricane storm damage risk reduction studies	X	X

Ralph Ellis, Ph.D., P.E.

Role: Hydrologic and hydraulic engineering, and coastal engineering expertise.
Affiliation: Independent consultant (University of Florida)

Dr. Ellis is an associate professor in the Department of Civil and Coastal Engineering at the University of Florida, from which he earned a Ph.D. in civil engineering in 1989. Dr. Ellis is a licensed professional engineer in Florida with 37 years of experience working with large-scale civil engineering projects both regionally and internationally, including HSDRRS projects.

In his current role as associate professor, Dr. Ellis teaches the fundamentals of assessing HSDRRS in senior design classes involving the design of sheet pile walls, cofferdams, and other marine-related structures. He has maintained current knowledge of professional practice and HSDRRS design criteria requirements including the USACE application of HSDRRS risk and uncertainty analyses.

Prior to joining the University of Florida, he was president of the Hammer Corporation construction firm and Director of Projects for the FMI Hammer Joint Venture, where he was

responsible for engineering and delivering all construction projects, including numerous projects for USACE and numerous water management projects. Many of these projects were located in south Florida and Central America and involved the construction of large-scale earthworks, floodwalls, temporary and permanent retaining walls, gate well structures, utility penetrations for a variety of structure types, and interior drainage systems, all of which were directly associated with flood control projects and large-scale control structures. He is familiar with all aspects required for the construction of pump station structures, which typically require setting up complex dewatering operations, and he has experience implementing stop logs, sand bag gaps, and other closure structures.

Dr. Ellis is a primary member of the Louisiana Water Resources Council (LWRC) and has conducted a number of IEPRs for projects in this geographic area, including the Donaldsonville to the Gulf flood control project, the Barataria Basin Barrier Shoreline restoration project, and the Morganza to the Gulf hurricane protection project, all of which required an understanding of the USACE application of risk and uncertainty analyses.

Scott Fenical, P.E.

Role: Hydrologic and hydraulic engineering, and coastal engineering expertise.
Affiliation: Coast & Harbor Engineering, Inc.

Mr. Fenical is a principal coastal engineer at Coast & Harbor Engineering with 16 years professional experience in coastal processes analysis, numerical modeling, and coastal engineering structure design in the U.S. and overseas. He earned his M.S. in ocean engineering from Texas A&M University in 1996 and is a registered professional civil engineer in Louisiana and California. His areas of expertise are in the preparation and review of engineering plans and specifications for coastal/shoreline structures; his experience with levees includes his coastal flood protection work for properties along San Francisco Bay and the Oregon coast. Mr. Fenical gained experience with floodwalls and retaining walls through his work on coastal bank retention and bank stabilization for properties along San Francisco Bay. He designed stop log modifications and potential removal/tunnel closure schemes for a utility company in coastal California, and also conducted a drainage evaluation for the city of Olympia, Washington following storm activity and incorporating future projected seas level rise.

His coastal engineering analysis experience includes the development, validation, verification, calibration, and application of standard USACE numerical modeling tools such as ADCIRC, SBEACH, GENESIS, STWAVE, CMS, and SWAN. Mr. Fenical is an expert in using models to simulate hurricane-induced storm surge and waves, tidal and river current circulation, beach evolution, local wind-wave generation and transformation, wave and wind-generated nearshore circulation, and sediment transport under waves and currents. Direct model applications related to hurricanes and typhoons have included storm surge modeling for hurricanes Rita and Katrina on the Gulf Coast; Caminada Pass Bridge Design, Grand Isle, Louisiana, and Oil Spill Hydrodynamic Analysis, Barataria Bay, Louisiana; Hurricane Wilma wave modeling in the Caribbean; Hurricane Floyd storm surge modeling in New York; and wave modeling and storm surge modeling for Super Typhoon Paka in Guam. Mr. Fenical has also used Pacific Ocean scale ADCIRC modeling to develop coastal currents and storm surges in coastal Oregon. He has conducted numerous ADCIRC applications including validation with measured storm surges

from tide gauges, tidal current circulation and power evaluation, and navigation studies. He is familiar with USACE application of risk and uncertainty analyses in hurricane and coastal storm damage risk reduction projects and is familiar with USACE development of extreme storm analysis and return period determination based on wind field and storm surge ADCIRC model applications. In 2012, Mr. Fenical was on the panel for the Donaldsonville to the Gulf Flood Control project.

5. SUMMARY OF FINAL PANEL COMMENTS

The panel members agreed between each other on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2012; p. D-4) in the Hurricane Isaac Assessment document. Table 3 lists the Final Panel Comments statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A of this report. The following summarizes the Panel's findings.

Based on the Panel's review, the report adequately assesses the effects of the 2012 100-year HSDRRS on areas outside the system, although the analyses are preliminary as acknowledged in the report. The Panel believes that the models used in the Hurricane Isaac Assessment were appropriately chosen and used and realistically represent the actual system. The modeling assumptions were sound, although the Panel found that the limitations of the models (while not unexpected given the preliminary nature of the input data) could have been described in more detail. Overall, the report presents a strong compilation of field measurement and analysis, and numerical modeling using state-of-the-art techniques. The description of the HSDRRS is clear and appropriate for the report, and the report sufficiently and satisfactorily answers the question of whether the HSDRRS impacted areas outside the system during Hurricane Isaac. The Panel thinks that the wind and pressure data ultimately used for model input should have been better described and documented in the report, and that supplemental, currently available meteorological data might be a beneficial addition to the model input and may help produce more precise storm surge predictions. The Panel also believes that additional graphics, including conceptual illustrations of the storm's winds and surge as it unfolded, and a system-wide figure depicting where hydraulic overtopping would have occurred, would be helpful in demonstrating the causes of severe storm surge during Hurricane Isaac. Overall, the Panel suggests that the question posed by the analysis should have been whether the HSDRRS impacted areas outside the system during Hurricane Isaac *differently than the range of impacts predicted during the design phase*. The effects outside the HSDRRS during Hurricane Isaac were large enough to have been measureable in the field if two identical storms were to occur, but the report effectively demonstrates that those potential impacts were clearly predicted during analyses conducted in the HSDRRS design phase.

Table 3. Overview of 3 Final Panel Comments Identified by the Hurricane Isaac Assessment IEPR Panel

No.	Final Panel Comment
	Significance – Medium
1	The description and documentation of the wind and pressure data that were ultimately used for storm surge modeling are insufficient to convey the overall input data quality.
	Significance – Low
2	The report does not include graphics that would improve comprehension of the storm surge build-up during Hurricane Isaac, particularly for someone unfamiliar with the geographic area.
3	The report does not include a system-wide figure that graphically shows where hydraulic overtopping would have occurred.

6. REFERENCES

OMB (2004). Final Information Quality Bulletin for Peer Review. Executive Office of the President, Office of Management and Budget, Washington, D.C. Memorandum M-05-03. December 16.

The National Academies (2003). Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports. The National Academies (National Academy of Science, National Academy of Engineering, Institute of Medicine, National Research Council). May 12.

USACE (2007). Peer Review Process. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. CECW-CP Memorandum. March 30.

USACE (2012). Water Resources Policies and Authorities: Civil Works Review. Department of the Army, US Army Corps of Engineers, Washington, D.C. Engineer Circular (EC) No. 1165-2-214. December 15.

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APPENDIX A

Final Panel Comments

on the

Hurricane Isaac Assessment

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Final Panel Comment 1

The description and documentation of the wind and pressure data that were ultimately used for storm surge modeling are insufficient to convey the overall input data quality.

Basis for Comment

Accurate wind and pressure fields are critical for performing storm surge hindcasting, as real historical storms are poorly represented by models in the absence of significant data assimilation. This is particularly true given the unique nature of Hurricane Isaac and significant changes to the local flood protection system. While the report includes a review of wind and pressure data sources available at the time, the basis for the dataset ultimately used in the analysis is inadequately presented. In response to an inquiry from the Panel, USACE stated that the wind and pressure data were generated by Oceanweather, Inc. under contract to USACE for the purposes of this report. Specifically, the details of the underlying Planetary Boundary Layer model, the source of the measurements used in data assimilation, the amount and type of data assimilated, the methods used in data assimilation, and many other details are not provided.

Many times the report states that the best data available at the time were used for the report (e.g., pp. 6-1, 6-2, 6-3). The Panel is aware that additional wind and pressure data (specifically 47 H*Wind fields) are available from the Hurricane Research Division of the Atlantic Oceanographic & Meteorological Laboratories, National Oceanic and Atmospheric Administration. Absence of details in the report regarding the chosen wind and pressure data makes it difficult for the Panel to determine if the wind and pressure input data product generated is better or worse than the presently available H*Wind data, and if reproducing the analysis with newer data would represent an improvement in storm surge predictions and hence predictions about impacts of the 2012 100-year Hurricane Storm Damage Risk Reduction System (HSDRRS). The benefit of including more detail about the chosen wind and pressure data product is that the Panel would have the information necessary to conclude (if accurate) that an analysis with other datasets may not lead to any significant gains in storm surge prediction accuracy.

Significance – Medium

The omission of details about the wind/pressure data used as storm surge model input affects the completeness of the report and also prevents a solid understanding about what was done and whether supplemental, highly detailed analysis would provide any significant benefit.

Recommendations for Resolution

1. Include a summary of the wind and pressure data fields as either supplemental text to Section 6, page 6-5, or as an appendix to the report. To assist USACE, Oceanweather should provide some basic documentation, or a brief independent technical memo/letter summarizing the wind and pressure field generation.

2. Include a brief comparison of wind and pressure fields generated by Oceanweather and the H*Wind data available at the time of the review from Hurricane Research Division, including commentary as to which dataset would produce more accurate storm surge predictions and expected differences.

Final Panel Comment 2

The report does not include graphics that would improve comprehension of the storm surge build-up during Hurricane Isaac, particularly for someone unfamiliar with the geographic area.

Basis for Comment

The report and analysis under review was performed in large part because storm surge during Hurricane Isaac was much larger than typically expected based on its general meteorological characteristics. The report provides ample data and narrative description regarding the meteorological differences between Hurricane Isaac and other storms. However, an easily understandable description of the timing and sequence of the storm events would be beneficial to convey the reason storm surge was as high as it was, and also provide more confidence in the modeling results.

The step-by-step chronological description of how the surge built up over time on page 3-31 is very difficult to visualize. It would be helpful here to show a chronological series of conceptual sketches of the area, with cities/towns/HSDRSS features included, that display at each point in time where the winds were coming from, and arrows showing the directions of surge movement and buildup during the storm.

Significance – Low

While the conclusions of the report are not affected, the narrative description of the storm surge buildup is less clear than it could be, and technical quality could be improved through the addition of graphical representations.

Recommendations for Resolution

1. Provide a series of snapshots (either basic concept graphics or storm surge modeling snapshots) showing how winds evolved and surge built up over time during the storm. Develop the snapshots based on, and with reference to, the narrative description sections already provided on page 3-31.

Final Panel Comment 3

The report does not include a system-wide figure that graphically shows where hydraulic overtopping would have occurred.

Basis for Comment

The report includes a discussion of the analysis indicating areas where wave overtopping and/or surge overflow of the pre-HSDRRS flood protection system would have been possible at the time of Hurricane Isaac. The report's descriptions of these areas do not clearly communicate the positioning of the locations within the context of the HSDRRS system to a reader not familiar with the geographic area.

Significance – Low

Inclusion of a system-wide graphic indicating the areas where hydraulic overtopping would have occurred improves understanding of the information presented.

Recommendations for Resolution

1. Include a system-wide figure that graphically shows where hydraulic overtopping would have occurred. Include on the figure arrows indicating the flooding direction and a quantification of the overtopping (e.g., difference in elevation between the water level and the levee crest).

APPENDIX B

Final Charge to the Independent External Peer Review Panel as Submitted to USACE on December 3, 2012

on the

Hurricane Isaac Assessment

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Charge Questions and Guidance to the Peer Reviewers for the Independent External Peer Review of the Hurricane Isaac With and Without 2012 100-year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report

BACKGROUND

The Hurricane Isaac With and Without 2012 100-year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report includes areas in southeast Louisiana outside of the HSDRRS, including but not limited to the communities of Slidell, Mandeville, Madisonville, Laplace, Braithwaite, Lafitte, and the Mississippi gulf coast.

Hurricane Isaac's impacts on the coastal Louisiana area, including New Orleans and surrounding communities, were considerable. While the HSDRRS prevented the storm surge from inundating the areas within its system, major flooding occurred in areas without Federal levee systems. As this was the first major test of the HSDRRS, some have raised concerns that the HSDRRS was also responsible for unintended increased flooding to some of the unprotected areas. Local and state officials have requested an analysis or review to determine if, and to what extent, the HSDRRS affected these unprotected areas.

Extensive modeling and analysis was performed during the design phase of the HSDRRS to determine what effect, if any, the HSDRRS could have on other areas. Public meetings were held across the area at which the modeling and analyses were discussed. Environmental documentation included discussions on effects of the HSDRRS on adjacent areas. The Hurricane Isaac With and Without 2012 100-year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report integrates the previous work with an assessment and modeling of Hurricane Isaac.

The report includes, but is not limited to, the following items: an overview of Hurricane Isaac (meteorological, hydrological, and hydraulic); HSDRRS system performance during Hurricane Isaac; a review of prior evaluations of expected HSDRRS performance; a summary of hydrodynamic modeling conducted for Hurricane Isaac for both the with and without 2012 100-year HDRRS conditions; and evaluations of storm surge impacts, rainfall, and hydrodynamic modeling for specific communities that sustained flooding during Hurricane Isaac.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the Hurricane Isaac With and Without 2012 100-year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report (hereinafter: Hurricane Isaac Assessment IEPR) in accordance with the U.S. Army Corps of Engineers (USACE) Engineer Circular *Civil Works Review* (EC 1165-2-214) and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Peer review typically

evaluates the clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

The purpose of the IEPR is to assess the "adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (EC 1165-2-214; p. D-4) for the Modeling Hurricane Isaac documents. The IEPR will be limited to technical review and will not involve policy review.

The Panel will be "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-214, Appendix D, review panels should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. Review panels should be able to evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable. Reviews should focus on assumptions, data, methods, and models. The panel members may offer their opinions as to whether there are sufficient analyses upon which to base a recommendation.

DOCUMENTS PROVIDED

There is one review document for this IEPR:

- Hurricane Isaac With and Without 2012 100-year HSDRRS Evaluation – Preliminary Report (291 pages)

Documents for Reference

- USACE guidance Civil Works Review, (EC 1165-2-214) dated 15 December 2012
- CECW-CP Memorandum dated March 31, 2007
- Office of Management and Budget's Final Information Quality Bulletin for Peer Review released December 16, 2004.

SCHEDULE

This final schedule is based on the November 15, 2012 receipt of the final review documents. The schedule will be revised upon receipt of final review documents.

Task	Action	Days to Complete Action	Due Date
Conduct Peer Review	Battelle sends review documents to Panel	Within 1 day of Panel being under subcontract or submission of final Work Plan, whichever is later	11/29/2012
	Battelle convenes kickoff meeting with Panel	Within 2 days of Panel being under subcontract or submission of final Work Plan, whichever is later	11/30/2012
	USACE/Battelle convenes kickoff meeting with Panel	Within 2 days of Panel being under subcontract or submission of final Work Plan, whichever is later	11/30/2012
	Battelle convenes mid-review teleconference for Panel to ask clarifying questions of USACE	At the halfway point of Panel review	12/6/2012
	Panel participates in In-Progress Review Meeting (this activity is an Option that has not been awarded)	TBD	TBD
	Panel members complete their individual reviews	Within 7 days of Battelle/Panel kick-off meeting	12/11/2012
Prepare Final Panel Comments and Final IEPR Report	Battelle provides Panel merged individual comments and talking points for Panel Review Teleconference	Within 4 days of panel members completing their review	12/13/2012
	Battelle convenes Panel Review Teleconference	Within 5 days of panel members completing their review	12/13/2012
	Final Panel Comments finalized	Within 5 days of receipt of draft Final Panel Comments	12/28/2012
	Battelle provides Final IEPR Report to Panel for review	Within 2 days Final Panel Comments being finalized	12/31/2012
	Panel provides comments on Final IEPR Report	Within 2 days of receipt of Final IEPR Report	1/2/2013
	*Battelle submits Final IEPR Report to USACE	Within 14 days of panel members providing draft Final Panel Comments to Battelle	1/3/2013

Task	Action	Days to Complete Action	Due Date
Comment/ Response Process	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process (if necessary)	Within 2 days of submittal of Final IEPR Report	1/7/2013
	USACE provides draft PDT Evaluator Responses to Battelle	Within 10 days of receipt of Final IEPR Report	1/10/2013
	Battelle provides the Panel the draft PDT Evaluator Responses	Within 2 days of receipt of draft PDT Evaluator Responses	1/11/2013
	Panel members provide Battelle with draft comments on draft PDT Evaluator Responses (i.e., draft BackCheck Responses)	Within 3 days of receipt of draft PDT Evaluator Responses from Battelle	1/16/2013
	Battelle convenes teleconference with Panel to discuss draft BackCheck Responses	Within 1 day of receipt of draft BackCheck Responses	1/17/2013
	Battelle convenes teleconference with Panel and USACE to discuss Final Panel Comments and draft responses	Within 5 days of USACE providing draft PDT Evaluator Responses	1/17/2013
	USACE inputs final PDT Evaluator Responses in DrChecks	Within 2 days of Final Panel Teleconference	1/22/2013
	Battelle provides PDT Evaluator Responses to Panel	Within 3 days of final PDT Evaluator Responses being available	1/24/2013
	Panel members provide Battelle with final BackCheck Responses	Within 3 days of receipt of final PDT Evaluator Responses	1/29/2013
	Battelle inputs the Panel's BackCheck Responses in DrChecks	Within 10 days of notification that USACE final PDT Evaluator Responses have been posted in DrChecks	1/30/2013
	*Battelle submits pdf printout of DrChecks project file	Within 1 day of DrChecks closeout	1/31/2013

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the Hurricane Isaac Assessment IEPR documents are credible and whether the conclusions are valid. The Panel is asked to determine whether the technical work is adequate, competently performed, properly documented, satisfies established quality requirements, and yields scientifically credible conclusions. The Panel is being asked to provide feedback on the economic, engineering, environmental resources, and plan formulation. The panel members are not being asked whether they would have conducted the work in a similar manner.

Specific questions for the Panel (by report section or Appendix) are included in the general charge guidance, which is provided below.

General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the Hurricane Isaac Assessment IEPR documents. Please focus your review on the review materials assigned to your discipline/area of expertise and technical knowledge. Even though there are some sections with no questions associated with them, that does not mean that you cannot comment on them. Please feel free to make any relevant and appropriate comment on any of the sections and appendices you were asked to review. In addition, please note the following guidance. Note that the Panel will be asked to provide an overall statement related to 2 and 3 below per USACE guidance (EC 1165-2-214; Appendix D).

1. Your response to the charge questions should not be limited to a “yes” or “no.” Please provide complete answers to fully explain your response.
2. Assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, and any biological opinions of the project study.
3. Assess the adequacy and acceptability of the economic analyses, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, and models used in evaluating economic or environmental impacts of the proposed project.
4. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation.
5. Identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods.
6. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable
7. Please focus the review on assumptions, data, methods, and models.

Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please

do not comment on or make recommendations on policy issues and decision making. Comments should be provided based on your professional judgment, **not** the legality of the document.

1. If desired, panel members can contact one another. However, panel members **should not** contact anyone who is or was involved in the project, prepared the subject documents, or was part of the USACE Independent Technical Review.
2. Please contact the Battelle Project Manager (Corey Wisneski, wisneskic@battelle.org) or Program Manager (Karen Johnson-Young (johnson-youngk@battelle.org) for requests or additional information.
3. In case of media contact, notify the Battelle Program Manager, Karen Johnson-Young (johnson-youngk@battelle.org) immediately.
4. Your name will appear as one of the panel members in the peer review. Your comments will be included in the Final IEPR Report, but will remain anonymous.

Please submit your comments in electronic form to Corey Wisneski, wisneskic@battelle.org, no later than December 11, 2012, 10 pm ET.

Independent External Peer Review of the

Hurricane Isaac With and Without 2012 100-Year Hurricane and Storm Damage Risk Reduction System (HSDRRS) Preliminary Technical Assessment Report

Charge Questions and Relevant Sections as Supplied by USACE

General Questions

1. Does the report adequately assess the effect of the 2012 100-Year HSDRRS on areas outside of the system?
2. Are the assumptions that underlie the analyses sound and sufficiently documented?
3. Are the models and analyses appropriate for the scope of this effort?
4. Were all models used in the analyses used in an appropriate manner with assumptions appropriately documented and explained?
5. Was data used for the meteorological review sufficient and adequately presented?
6. Is the description of the HSDRRS clear and appropriately detailed for the scope of the report?

Technical Quality

7. Comment on the availability and use of the data required by the models given the preliminary nature of the wind and storm data.
8. Are geographic boundaries and domain clearly defined?
9. Are the limitations of the numerical models clearly defined and documented?
    a. How do the limitations impact the ability of the models to evaluate whether construction of the 100-year HSDRRS project had a measurable effect on areas outside the system inundated by Hurricane Isaac?
    b. How can those limitations be overcome?
10. Do the models realistically represent the actual system ?

11. Are the analytical requirements of the models properly identified? Do the data collected for the Hurricane Isaac With and Without Evaluation meet those requirements? If not, why?

12. Were changes to the grid for the Without HSDRSS and with 2010 100-year HSDRRS conditions adequately described? Are these conditions sufficiently sensitive to measure change at the level of resolution needed?

13. Is the conclusion that the Hurricane Isaac model outputs are consistent with and support the previous modeling used in the design and environmental assessment of the HSDRRS supported by the data provided in the report?

Detailed Evaluations

14. Are the conclusions regarding overtopping and flooding outside the HSDRRS adequately supported by the analysis?

15. Were observed and simulated conditions during Hurricane Isaac compared to previous storm events such as Katrina and Gustav adequately described and documented?

16. Does the report adequately address what areas of the system would or would not have been hydraulically overtopped during Isaac in their Pre-HSDRRS condition?

17. Does the report adequately address what HSDRRS impacts to areas outside of the system have been documented through previous evaluations, were these explanations clear and adequately explained?

Summary of Findings

18. Do the modeling outputs sufficiently and satisfactorily answer the question if, and to what extent, the HSDRRS impacted areas outside of the 100-year HSDRRS during Hurricane Isaac?

Final Overview Question

19. What is the most important concern you have with the document or its appendices in addition to the above?