Final Independent External Peer Review Report Hurricane and Storm Damage Risk Reduction System – Design Elevation Report

Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Coastal Storm Damage Reduction Planning Center of Expertise
Baltimore District

Contract No. W911NF-07-D-0001
Task Control Number: 10-205
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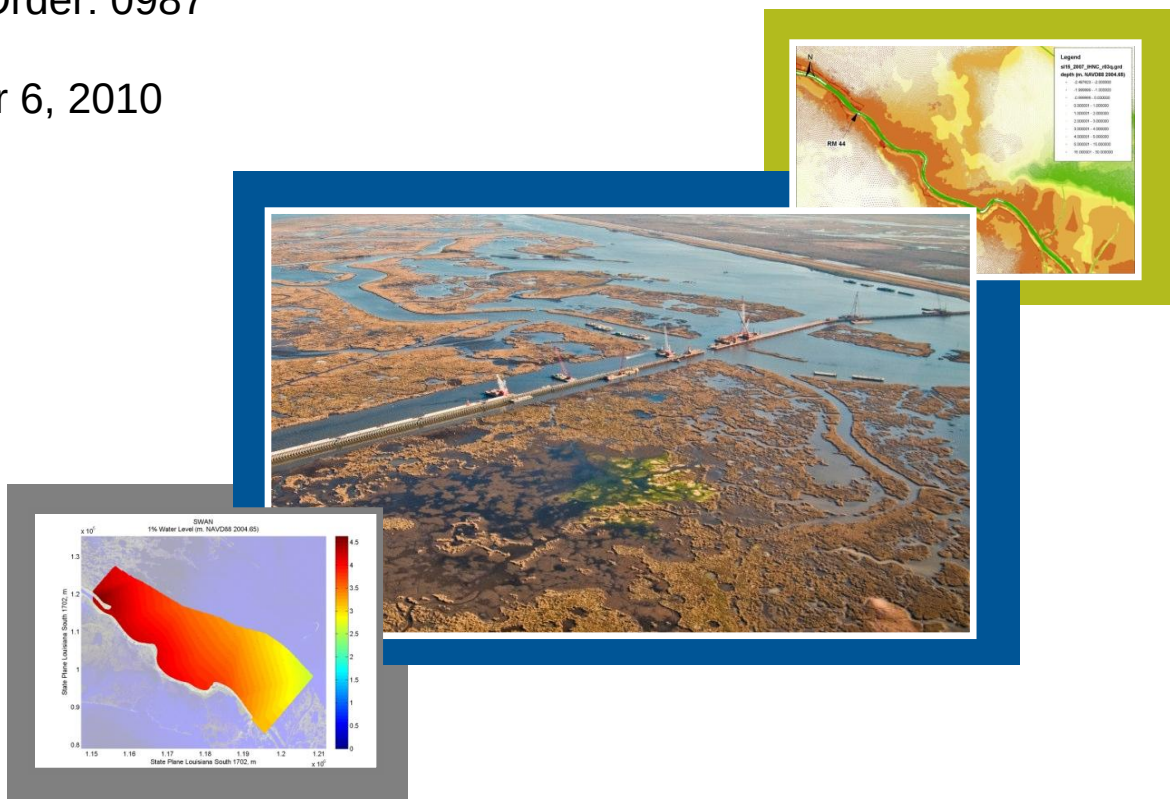
December 6, 2010



SHORT-TERM ANALYSIS SERVICE (STAS)

on

Final Independent External Peer Review Report Hurricane and Storm Damage Risk Reduction System – Design Elevation Report (May 2010)

by

Battelle
505 King Avenue
Columbus, OH 43201

for

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Scientific Services Program

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FINAL
INDEPENDENT EXTERNAL PEER REVIEW REPORT
for the
Hurricane and Storm Damage Risk Reduction System – Design Elevation Report (May 2010)

EXECUTIVE SUMMARY

The Hurricane and Storm Damage Risk Reduction System (HSDRRS) – Design Elevation Report ("Design Elevation Report") is a compendium of initial hydraulic design performed for the HSDRRS Lake Pontchartrain and Vicinity (LPV), West Bank and Vicinity (WBV), Mississippi River Co-Located, and New Orleans to Venice projects. The first version of this report was titled "Elevations for Design of Hurricane Protection Levees and Structures – Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project and West Bank and Vicinity, Hurricane Protection Project" and was completed in October 2007. The report has recently been updated to include Mississippi River Levee co-located work and New Orleans to Venice project features.

The U.S. Army Corps of Engineers (USACE) is conducting an Independent External Peer Review (IEPR) of the HSDRRS Design Elevation Report and Addenda. Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels for USACE, was engaged to coordinate the IEPR of the HSDRRS Design Elevation Report. 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 (2010), USACE (2007a), 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) regarding the Design Elevation Report. Comments on the Addenda will be reported separately.

Two panel members were selected for the IEPR. Battelle followed the criteria for selecting the candidate panel members specified in the USACE Statement of Work to (1) contact candidate panel members to evaluate technical skills, potential conflicts of interest (COIs), availability, and hourly rates, and (2) identify two experts from the pool of candidates on existing Task Force Hope task orders to serve on the IEPR Panel. Based upon these criteria the final panel members were selected for their technical expertise in the following key areas: hydraulic engineering and civil engineering. Although the Panel was disclosed to USACE, Battelle made the final decision on selecting the Panel.

The Panel received electronic versions of the HSDRRS Design Elevation Report documents, totaling more than 550 pages (with 5,200 supplemental pages), along with a charge that solicited comments on specific sections of the documents to be reviewed. The charge was prepared by Battelle to assist USACE in developing the charge questions that were to guide the peer review, according to guidance provided in USACE (2010) and OMB (2004). USACE was given the

opportunity to provide comments and revisions, and subsequently approved the final charge questions.

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 46 individual comments in response to 23 charge questions.

IEPR panel members reviewed the HSDRRS Design Elevation Report 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, six Final Panel Comments were identified and documented. Of these, five had medium significance and one had low significance. There were no Final Panel Comments identified as having high significance.

Table ES-1 summarizes the Final Panel Comments by level of significance. Detailed information on each comment is contained in Appendix A of this report.

Table ES-1. Overview of six Final Panel Comments Identified by the HSDRRS Design Elevation Report IEPR Panel

Significance – Medium	
1	The HSDRRS Design Elevation Report should provide more documentation of the levee resiliency that results from the design elevations and average overtopping rates currently in the HSDRRS Design Elevation Report where the average overtopping rate exceeds 0.1 cfs/ft for the 0.2% annual exceedance probability event.
2	Additional documentation regarding the relative sea level rise (RSLR) assumption of 1 foot in 50 years that was used to establish future surge and wave characteristics is needed in the HSDRRS Design Elevation Report to justify what appears to be a value on the low end of predicted RSLR ranges.
3	Documentation for levee certification needs to be presented in the HSDRRS Design Elevation Report, including numerical parameters for certification requirements.
4	More documentation on input parameters for estimating wave overtopping rates is needed in the HSDRRS Design Elevation Report to clarify how the design elevations were calculated and how the future engineering implications will be implemented.
5	Portions of the HSDRRS Design Elevation Report describing the wave characteristics and calculations need improved clarity and documentation.
Significance – Low	
6	The HSDRRS Design Elevation Report needs to fully document the basis for wave forces on hard structures.

USACE guidance (2010) states the final report will contain the Panel's "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used." However, for the HSDRRS Design Elevation Report IEPR, the Panel focused solely on the coastal and hydraulic engineering analysis of the project; no economic or environmental assessment was conducted. The Panel agreed on its assessment of the adequacy and acceptability of the engineering methods, models, and analyses used in the HSDRRS Design Elevation Report documents. Overall, the assumptions that underlie the engineering analyses and planning methods were sound; however, there were instances throughout the HSDRRS Design Elevation Report where more explanation and documentation of assumptions and results would be appropriate. The HSDRRS Design Elevation Report is generally technically defensible for its purpose to document the analyses performed to develop preliminary design elevations. It is an excellent improvement over the original Design Guidelines of 2007.

Because levee resiliency directly affects the actual level of protection achieved by the HSDRRS, the Panel thought that the HSDRRS Design Elevation Report should provide more discussion of levee resiliency, including backslope armoring, where the average overtopping rate exceeds the resiliency criterion of 0.1 cfs/ft for extreme events, including the 0.2% annual exceedance probability event. The Panel also thought that additional discussion regarding the relative sea level rise (RSLR) assumption of 1 foot in 50 years that was used to establish future surge and wave characteristics is needed to justify what appears to be a RSLR value on the low end of predicted RSLR ranges. A need for more documentation in the HSDRRS Design Elevation Report was also identified for levee certification, input parameters for estimating wave overtopping rates, wave characteristics and calculations, and the basis for wave forces on hard structures.

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LIST OF ACRONYMS

ASCE	American Society of Civil Engineers
ATR	Agency Technical Review
CERP	Comprehensive Everglades Restoration Program
COI	Conflict of Interest
cfs/ft	Cubic feet per second per foot
DrChecks	Design Review and Checking System
EC	Engineering Circular
ERDC	Engineer Research and Development Center
FEMA	Federal Emergency Management Agency
HEC-HMS	Hydrologic Engineering Center – Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center – River Analysis System
HSDRRS	Hurricane Storm Damage Risk Reduction System
IEPR	Independent External Peer Review
IPET	Interagency Performance Evaluation Task
JPM	Joint Probability Method
JSS	Joint Surge Study
LPV	Lake Pontchartrain and Vicinity
NRC	National Research Council
NTP	Notice to Proceed
OMB	Office of Management and Budget
RSLR	Relative Sea Level Rise
SOW	Statement of Work
USACE	United States Army Corps of Engineers
WBV	West Bank and Vicinity

1. INTRODUCTION

The Hurricane and Storm Damage Risk Reduction System (HSDRRS) – Design Elevation Report ("Design Elevation Report") is a compendium of initial hydraulic design performed for the HSDRRS Lake Pontchartrain and Vicinity (LPV), West Bank and Vicinity (WBV), Mississippi River Co-Located and New Orleans to Venice projects. The first version of this report was titled "Elevations for Design of Hurricane Protection Levees and Structures – Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project and West Bank and Vicinity, Hurricane Protection Project" and was completed in October 2007. The report has recently been updated to include Mississippi River Levee co-located work and New Orleans to Venice project features.

The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the HSDRRS Design Elevation Report and Addenda in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers Engineer (USACE) Circular *Civil Works Review Policy* (EC No. 1165-2-209) (USACE, 2010), USACE CECW-CP memorandum *Peer Review Process* (USACE, 2007a), and Office of Management and Budget (OMB) bulletin *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels, was engaged to coordinate the IEPR of the HSDRRS Design Elevation Report. 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 engineering analyses contained in the HSDRRS Design Elevation Report. Detailed information on the Final Panel Comments is provided in Appendix A. Review of the HSDRRS Design Elevation Report was conducted as Phase I of the overall IEPR; only Phase I of the review is discussed in this report. Review of the Addenda will be conducted as Phase II of the overall IEPR and reported separately.

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 (2010) and USACE (2007a).

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 HSDRRS Design Elevation Report was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization under Section 501(c)(3) of the U.S. Internal Revenue Code with experience conducting IEPRs for USACE. In this instance, an assessment of the engineering analysis was conducted, economic and environmental analyses were not conducted.

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 (2010) and in accordance with USACE (2007a) 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 defines the schedule followed in executing the IEPR. Due dates for milestones and deliverables are based on the NTP date of August 4, 2010. Note that the work items listed in Task 6 occur after the submission of this report. Battelle will enter the six 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. HSDRRS Design Elevation Report IEPR Schedule

TASK	ACTION	DUE DATE
1	Notice to Proceed (NTP)	August 4, 2010
	Final Review documents available	August 23, 2010
	Battelle submits draft Work Plan and charge [a]	September 14, 2010
	USACE provides comments on draft Work Plan and charge	September 20, 2010
	Battelle submits final Work Plan and charge [a]	September 23, 2010
	USACE approves final Work Plan and charge	September 24, 2010
2	Battelle recruits and screens up to 2 potential panel members; prepares summary information [a]	August 11, 2010
	USACE provides comments on list of panel members	August 23, 2010
	Battelle completes subcontracts for panel members	September 7, 2010

TASK	ACTION	DUE DATE
3	USACE/Battelle Kick-off Meeting	August 20, 2010
	USACE/Battelle/Panel Kick-off Meeting	September 24, 2010
4	Review documents sent to panel members	September 24, 2010
	IEPR panel members complete their review	October 27, 2010
	Convene panel review teleconference	November 5, 2010
	Panel provides draft Final Panel Comments to Battelle	November 16, 2010
5	Battelle submits Final IEPR Report to USACE [a]	December 6, 2010
6[b]	Battelle inputs Final Panel Comments to DrChecks; Battelle provides Final Panel Comment response template to USACE	December 7, 2010
	USACE provides draft responses and clarifying questions to Battelle	December 16, 2010
	Final Panel Comment Teleconference between Battelle, Panel, and USACE to discuss Final Panel Comments, draft responses, and clarifying questions	January 11, 2011
	USACE inputs final Evaluator Responses in DrChecks	January 13, 2011
	Battelle inputs BackCheck Responses in DrChecks	January 27, 2011
	Battelle submits pdf printout of DrChecks to USACE [a]	January 28, 2011
	Project Closeout	August 3, 2011

[a] Deliverable

[b] Task 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 the following key areas: hydraulic engineering and civil engineering. These areas correspond to the technical content of the HSDRRS Design Elevation Report.

To identify candidate panel members, Battelle followed the criteria specified in the USACE Statement of Work (SOW) to (1) contact candidate panel members to evaluate technical skills, potential COIs, availability, and hourly rates, and (2) identify two experts from the pool of candidates on existing Task Force Hope task orders to serve on the IEPR Panel. Battelle chose two of the most qualified candidates and confirmed their interest and availability. Both candidates were proposed as primary reviewers. 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 two proposed primary reviewers constituted the final Panel.

The candidates were screened for the following potential exclusion criteria or COIs.[a] These COI questions were intended to serve as a means of disclosure, and to better characterize a potential 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.

- Financial or litigation association with USACE, "The State" (defined as the State of Louisiana and Local governing entities, including Southeast Louisiana Flood Protection Authority), the Design A/E, their engineering teams, subcontractors, or construction contractors.
- Current employment by USACE.
- Current employment by any federal or state government organization.
- Current personal or firm involvement as a cost-share partner on USACE projects. If yes, provide description.
- Participation in developing the hurricane and storm damage risk reduction system (HSDRRS) project.
- Involvement in producing any USACE guidance documents, including, but not limited to: the Design Guidelines, the Armoring Backslope Design Manual, or the Deep Soil Mixing Design Guidelines.
- A publicly documented statement made by you or your firm advocating for or against any HSDRRS project.
- Paid or unpaid participation in litigation related to USACE work.
- Current or future interests in the subject project or future benefits from the project.
- Current personal or firm involvement with other USACE projects. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, Engineer Research and Development Center [ERDC], etc.) and position/role.
- Previous employment by USACE as a direct employee or contractor (either as an individual or through your firm) within the last 10 years. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.

[a] 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."

- Previous direct employment by USACE, New Orleans District. If yes, provide title/description, dates employed, and position/role.
- A significant portion (i.e., greater than 50%) of personal or firm revenues within the last 3 years from USACE contracts.
- Repeatedly serving as a peer reviewer for Task Force Hope projects (please list).
- Other USACE affiliation [Scientist employed by the USACE (except as described in National Academy of Science criteria, see Engineering Circulars 1105-2-4 section 9b)][1].
- Personal relationships with USACE staff in Mississippi Valley Division Headquarters, Task Force Hope, New Orleans District (Protection Restoration Office), Hurricane Protection Office, or officials from the State of Louisiana and Local governing entities including Southeast Louisiana Flood Protection Authority.
- Participation in the Interagency Performance Evaluation Task (IPET) Force, American Society of Civil Engineers External Review of IPET, the Louisiana Coastal Protection and Restoration Study, and/or National Research Council Committee on New Orleans Regional Hurricane Protection Projects.
- Any other perceived COI not listed.

In selecting the final members of the Panel from the list of candidates, Battelle chose experts who best fit the expertise areas and had no COIs. The two final reviewers were both affiliated with consulting companies. 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. Although the Panel was disclosed to USACE, Battelle made the final decision on selecting the panel members. Section 4 of this report provides names and biographical information on the panel members.

Prior to beginning their review and within 16 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, and other pertinent information for the Panel.

3.3 Preparation of the Charge and Conduct of the IEPR

Battelle drafted a preliminary charge document, including specific charge questions and discussion points. The charge was prepared by Battelle to assist USACE in developing the charge questions that were to guide the peer review, according to guidance provided in USACE (2010) and OMB (2004). The draft charge was submitted to USACE for evaluation as part of the draft Work Plan. USACE provided comments and revisions to the draft charge, which were used to produce the final charge. The final charge was submitted to USACE for approval. In addition to a list of 23 charge questions/discussion points, the final charge 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 final 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 HSDRRS Design Elevation Report documents and the final charge. A full list of

the documents reviewed by the Panel is provided in Appendix B of this report. The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle.

3.4 Review of Individual Comments

At the end of the review period, the Panel produced approximately 46 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. As a result of the review, Battelle was able to summarize the 46 comments into a preliminary list of 13 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 1.5-hour teleconference with the Panel so that the panel experts 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 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 seven 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 HSDRRS Design Elevation Report:

- 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 other IEPR panel members 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 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 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 guidelines that could affect the suggested methods used.
  2. Medium: Affects the completeness or understanding of the guidelines.
  3. Low: Affects the technical quality of the guidelines, but will not affect the recommendation of the methods used.
  5.
- Guidance for Developing the Recommendation: The recommendation was to include specific actions that the 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, six Final Panel Comments were prepared and assembled and one final panel comment was dropped due to it being solely editorial in nature. 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, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy. 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 using criteria specified in the USACE SOW to (1) contact candidate panel members to evaluate technical skills, potential COIs, availability, and hourly rates, and (2) identify two experts from the pool of candidates on existing Task Force Hope task orders to serve on the IEPR Panel. Battelle chose two of the most qualified candidates and confirmed their interest and availability. Both candidates were proposed as primary reviewers for the final IEPR Panel. Battelle prepared a draft list of primary candidate panel members (who were screened for availability, technical background, and COIs), and provided it to USACE for feedback. Battelle made the final selection of panel members.

An overview of the credentials of the final two primary 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 or her area of technical expertise is presented in the text that follows the table.

Table 2. HSDRRS Design Elevation Report IEPR Panel: Technical Criteria and Areas of Expertise

	Dr. Bijay Panigrahi	Dr. Charles Vita
Hydraulic Engineering (one expert needed)	**X**	
Panel member on a previous Task Force Hope IEPR Task Order	**X**	
Extensive experience in design of coastal structures or levees in a coastal environment	**X**	
Extensive experience in hurricane surge and wave modeling	**X**	
Experience in design and construction of projects similar in scope to the HSDRRS	**X**	
Experience with the HSDRRS Design Guidelines	**X**	
Masters degree in engineering or hands on relevant engineering experience	**X**	
Minimum 15 years experience and responsible charge of engineering work in hydraulic engineering	**X**	
Civil Engineering (one expert needed)		**X**
Panel member on a previous Task Force Hope IEPR Task Order		**X**
Extensive experience in design of levees		**X**
Experience in design and construction of projects similar in scope to the HSDRRS		**X**
Experience with the HSDRRS Design Guidelines		**X**
Masters degree in engineering or hands on relevant engineering experience		**X**
Minimum 15 years experience and responsible charge of engineering work in hydraulic engineering		**X**

Bijay Panigrahi

Role: This panel member was chosen primarily for his hydraulic engineering experience and expertise.
Affiliation: BPC Group Inc.

Dr. Bijay Panigrahi is a Principal Engineer and President of BPC Group Inc. in Orlando, Florida. He has more than 28 years of experience in the specialty areas of environmental, geotechnical and water resources engineering, including ground water and surface water modeling. He has directed and managed a number of multidisciplinary projects involving hydraulics and hydrologic modeling, flood protection studies, feasibility studies, stormwater management system design, watershed and water quality assessment and modeling, stochastic modeling, geotechnical and environmental design and studies, seepage and slope stability analyses, foundation analyses, scour and erosion control, water resources facility design, and permitting. He has assessed and designed a number of canal conveyance systems and water resources control structures such as levees/dikes, culverts, reservoirs, and treatment systems. Dr. Panigrahi has completed a number Comprehensive Everglades Restoration Plan (CERP) and non-CERP projects in Florida involving modeling and design of hydraulic structures (reservoirs/impoundments, canals, and pump stations) and hydraulic measurements and rating analyses. He completed wave run analyses and scour evaluation for extreme hurricane conditions on Big Sand Lake to assist in the design of the Westgate Lakes resort in Orlando, Florida and hydrologic and hydraulic modeling of the C-51 basin (including ACME Basin B) in support of Basin Rule modifications, using HEC-HMS/HEC-RAS models for calibration to Hurricane Irene and further basin analyses. On behalf of the Interagency Modeling Center/Water Management District, he has peer reviewed more than 30 hydraulic-hydrodynamic models, which included surface water, groundwater, integrated surface water-ground water, seepage, and numerous watershed water quality models. Some of these projects include Biscayne Bay Coastal Wetlands, Lower East Coast sub-Regional model, C-11 and C-9 Impoundments, C-44 Canal Design, and Stormwater Treatment Area 5&6 Expansion. Additionally, Dr Panigrahi is a member of several professional affiliations, including the American Society of Civil Engineers' Environmental and Water Resources Institute, and has authored more than 50 technical manuals, monographs, and peer-reviewed papers.

Chuck Vita

Role: This panel member was chosen primarily for his civil engineering experience and expertise.
Affiliation: URS

Dr. Charles Vita is a registered civil and geotechnical engineer and is a Senior Principal Engineer for URS in Seattle, Washington. He has over 37 years of geotechnical and geo-environmental experience on hundreds of projects associated with levees, site evaluation, development, redevelopment, and cleanup. His expertise includes engineering planning, siting, exploration, site and route characterization, analysis, design, construction, and monitoring; oversight and quality assurance; and forensic engineering and litigation support. Dr. Vita is specially skilled and a technical leader in the analysis of uncertainty, risk, and reliability, including probability-based site characterization and engineering performance analyses and

reliability-based design. He is noted for rigorous conceptual and statistical data analysis and interpretation, including design and evaluation of exploration, testing, and monitoring programs. Dr Vita has experience with levee design including his support to the Federal Emergency Management Agency for levee breach repairs in Plaquemines Parish, his work with the New Orleans East Levee Improvement Program, his levee work for the National Oceanic and Atmospheric Administration, and with his work for the California Department of Water Resources Urban Levee Geotechnical Evaluation Program. He is familiar with construction industry practices used in wetland restoration, flood control/coastal storm damage reduction in the Gulf of Mexico coast, including the New Orleans HSDRRS. He is familiar with the Levee System Design Guidelines and has served as an independent expert technical reviewer of state of the art levee analysis and design guidelines for a major, world-class levee storm and hurricane risk reduction control system. Major issues included design surge and wave loading, geotechnical structural and seepage stability, and back-slope erosion. Dr. Vita has authored 60 comprehensive reports, professional papers, and presentations on these subjects.

5. SUMMARY OF FINAL PANEL COMMENTS

USACE guidance (2010) states the final report will contain the Panel's "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used." However, for the HSDRRS Design Elevation Report IEPR, the Panel focused on the coastal and hydraulic engineering analysis of the project; no economic or environmental assessment was conducted. The Panel agreed on its assessment of the adequacy and acceptability of the engineering methods, models, and analyses used in the HSDRRS Design Elevation Report documents. Overall, the assumptions that underlie the engineering analyses and planning methods were sound; however, there were instances throughout the HSDRRS Design Elevation Report where more explanation and documentation of assumptions and results would be appropriate. The HSDRRS Design Elevation Report is generally technically defensible for its purpose to document the analyses performed to develop preliminary design elevations. It is an excellent improvement over the original Design Guidelines of 2007.

Because levee resiliency directly affects the actual level of protection achieved by the HSDRRS, the Panel thought that the HSDRRS Design Elevation Report should provide more discussion of levee resiliency, including backslope armoring, where the average overtopping rate exceeds the resiliency criterion of 0.1 cfs/ft for extreme events, including the 0.2% annual exceedance probability event. The Panel also thought that additional discussion regarding the relative sea level rise (RSLR) assumption of 1 foot in 50 years that was used to establish future surge and wave characteristics is needed to justify what appears to be a RSLR value on the low end of predicted RSLR ranges. A need for more documentation in the HSDRRS Design Elevation Report was also identified for levee certification, input parameters for estimating wave overtopping rates, wave characteristics and calculations, and the basis for wave forces on hard structures. The Panel's findings, are described in more detail in the Final Panel Comments (see Appendix A).

Table 3 lists the six Final Panel Comment statements by level of significance.

Table 3. Overview of Six Final Panel Comments Identified by the HSDRRS Design Elevation Report IEPR Panel

Significance – Medium	
1	The HSDRRS Design Elevation Report should provide more documentation of the levee resiliency that results from the design elevations and average overtopping rates currently in the HSDRRS Design Elevation Report where the average overtopping rate exceeds 0.1 cfs/ft for the 0.2% annual exceedance probability event.
2	Additional documentation regarding the relative sea level rise (RSLR) assumption of 1 foot in 50 years that was used to establish future surge and wave characteristics is needed in the HSDRRS Design Elevation Report to justify what appears to be a value on the low end of predicted RSLR ranges.
3	Documentation for levee certification needs to be presented in the HSDRRS Design Elevation Report, including numerical parameters for certification requirements.
4	More documentation on input parameters for estimating wave overtopping rates is needed in the HSDRRS Design Elevation Report to clarify how the design elevations were calculated and how the future engineering implications will be implemented.
5	Portions of the HSDRRS Design Elevation Report describing the wave characteristics and calculations need improved clarity and documentation.
Significance – Low	
6	The HSDRRS Design Elevation Report needs to fully discuss the basis for wave forces on hard structures.

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.

Resio, D.T. (2007). White Paper on Estimating Hurricane Inundation Probabilities. Probability Methodology – Optimal Sampling. January 29, 2006. Vicksburg, MS: U.S. Army Corps of Engineers.

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

USACE (2007b). USACE/FEMA Southeast Louisiana Joint Surge Study: Responses to ASCE External Peer Review. June 19, 2007.

USACE (2010). Water Resources Policies and Authorities: Civil Works Review Policy. Department of the Army, US Army Corps of Engineers, Washington, D.C. Engineer Circular (EC) No. 1165-2-209. January 31.

APPENDIX A

Final Panel Comments

on the

HSDRRS Design Elevation Report

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Final Panel Comment 1:

The HSDRRS Design Elevation Report should provide more documentation of the levee resiliency that results from the design elevations and average overtopping rates currently in the HSDRRS Design Elevation Report where the average overtopping rate exceeds 0.1 cfs/ft for the 0.2% annual exceedance probability event.

Basis for Comment:

Levee resilience affects the actual level of protection that will be achieved by the Hurricane Storm Damage Risk Reduction System (HSDRRS). While the HSDRRS Design Elevation Report does state (p.10) that additional research and modeling is needed to establish resiliency guidance, in its present state, the HSDRRS Design Elevation Report is not completely consistent on resiliency issues. Specifically, for many levee segments (e.g., NO10 and NO01), the 50%-assurance overtopping rate (or "q50") computed in the resiliency analysis for the 0.2% event exceeds, and sometimes greatly exceeds, the 0.1 cubic feet per second per foot (cfs/ft) maximum allowable average overtopping rate that was interpreted from the literature as discussed in Appendix E. The 0.1 cfs/ft criterion appears to contain much inherent uncertainty.

It therefore appears that those levee segments having q50 much greater than 0.1 cfs/ft may not be resilient under the 0.2% event. This seems problematic because the 0.2% annual exceedance probability event used in the residency analysis is reported to represent the approximate recurrence of a Hurricane Katrina-level event (HSDRRS Design Elevation Report, page10), where levees breached and frequently failed to provide protection because of severe backslope erosion due to overtopping and inadequate backslope protection.

Furthermore, the HSDRRS Design Elevation Report does not address the use of backslope armoring to provide levee resiliency where it could be appropriate. The Panel considers armoring to be an important issue relevant to the HSDRRS Design Elevation Report that should be addressed at some level, if only to reference where armoring is addressed and how it is addressed. Additionally, the HSDRRS Design Elevation Report does not explain how resiliency relates to robustness, redundancy or system effectiveness, which the Panel understands are part of the design intent.

Ideally, levee resilience would provide an appropriate margin of safety against: (a) the uncertainty of future surge and wave overtopping rates (i.e., future levee "demand"), and (b) the uncertainty of levee resistance to overtopping by surge or waves (i.e., future levee "capacity"). While the HSDRRS Design Elevation Report deals with uncertainty in future surge and wave overtopping, an unquantified residual risk remains — that residual risk which requires levee resiliency.

One element of residual risk is suggested by the American Society of Civil Engineers (ASCE) comments (USACE, 2007b; page 15) that the White Paper on Estimating Hurricane Inundation Probabilities (Resio, 2007) "leaves an overly optimistic impression of the state-of-the-art in computing storm surges and their statistics with Joint Probability Method (JPM) methodology." This suggests that future surge estimates included in the HSDRRS Design Elevation Report are more uncertain than quantified. The Joint Surge Study (JSS) response strongly agreed and indicated "the need for further research to clarify many of the questions and nagging concerns

embedded within the overall effort" (USACE, 2007b). Again, it appears that levee resiliency is a major aspect in dealing with these, and other, uncertainty gaps.

Significance – Medium:

The HSDRRS Design Elevation Report would benefit from additional discussion on levee resiliency issues because levee resilience is a critical element of the HSDRRS that affects the actual level of protection that will be achieved by the HSDRRS, and is directly affected by the design elevations and average overtopping rates determined in the HSDRRS Design Elevation Report.

Recommendation(s) for Resolution:

1. Provide clarifying discussion of the apparent inconsistency of the condition where the 50%-assurance overtopping rate, q50, computed in the resiliency analysis exceeds the adopted 0.1 cfs/ft maximum allowable average overtopping rate. As appropriate, update the maximum allowable average overtopping rate to include an update of the Appendix E evaluation, based on subsequent information that is now available.
2. Add discussion regarding the use of backslope armoring to provide levee resiliency where it could be appropriate.
3. Consider including for all reaches the example resiliency-analysis table for St. Charles Parish included in the comment response section 5.2 at page 45 in the June 19, 2007 JSS Response to the ASCE External Peer Review (USACE, 2007b). This kind of table (showing q50 and q90 for both the 1% and 0.2% events) is not included in the HSDRRS Design Elevation Report, but would be a useful addition for reader understanding and to serve as a kind of sensitivity/resiliency analysis. These tables would also provide for a more complete resiliency analysis.
4. Consider and discuss the related concepts and functions of redundancy, resilience, robustness, and system effectiveness in a holistic fashion in a subsection of the HSDRRS Design Elevation Report.
5. Discuss or reference "The Risk and Reliability Analysis" that will be integrated into a full systems analysis, as stated at pp. 40-41 in USACE (2007b), in the HSDRRS Design Elevation Report.
6. Discuss residual risk. For example, the ASCE comment on the Estimating Hurricane Inundation Probabilities White Paper (Resio, 2007) should be explicitly addressed in the HSDRRS Design Elevation Report.

Literature Cited

Resio, D.T. (2007). White Paper on Estimating Hurricane Inundation Probabilities. Probability Methodology – Optimal Sampling. January 29, 2006. Vicksburg, MS: U.S. Army Corps of Engineers.

USACE (2007b). USACE/FEMA Southeast Louisiana Joint Surge Study: Responses to ASCE External Peer Review. June 19, 2007.

Final Panel Comment 2:

Additional documentation regarding the relative sea level rise (RSLR) assumption of 1 foot in 50 years that was used to establish future surge and wave characteristics is needed in the HSDRRS Design Elevation Report to justify what appears to be a value on the low end of predicted RSLR ranges.

Basis for Comment:

The HSDRRS Design Elevation Report makes it apparent that relative sea level rise (RSLR) is an important, but uncertain, variable for estimating future surge and wave overtopping rates used in the HSDRRS design. The HSDRRS Design Elevation Report uses a RSLR of 1 foot in 50 years based on USACE (2004; as cited on HSDRRS Design Elevation Report page 57). The Panel understands that the RSLR range estimated for the Louisiana Coastal Area Ecosystem Restoration Projects Study Area ranged from a low of 1.5 feet/50 years to a high of 3.2 feet/50 years with an intermediate rate of 1.9 feet/50years based on local historic subsidence rates plus estimated eustatic sea level rise. The National Research Council (NRC) has reportedly estimated an intermediate RSLR of 1.6 ft in 50 years.

The HSDRRS Design Elevation Report says that the RSLR will be revisited and updated as part of the expected 10-year reviews. However, it may not be cost-effective or even practicable to delay dealing with RSLR that proves to be significantly greater than the 1-ft per 50 yrs presently assumed in the HSDRRS Design Elevation Report. Therefore, because there is so much uncertainty in future RSLR, and 1 foot in 50 years appears to be toward the lower end of the potential range, the HSDRRS Design Elevation Report needs a more thorough discussion of the justification for adopting a RSLR of 1 foot in 50 years and explaining how the HSDRRS would be retrofitted if RSLR proves to be significantly greater than presently assumed.

The Panel also notes that the subsidence discussion at HSDRRS Design Elevation Report page 11 is not clear regarding long-term levee soil-consolidation settlement due directly to levee construction. This levee-caused settlement is distinct from regional or local long-term subsidence in the absence of levee construction.

Significance – Medium:

RSLR directly affects the future (year 2057) surge elevations and wave characteristics used in the HSDRRS Design Elevation Report, and, therefore, the actual level of protection that will be achieved by the HSDRRS.

Recommendation(s) for Resolution:

1. Provide a more thorough discussion of the justification for adopting a RSLR of 1 foot in 50 years.
2. Explain the implications for HSDRRS performance if RSLR proves to be significantly greater than presently assumed.
3. Explain how the HSDRRS would be retrofitted if RSLR proves to be significantly greater than presently assumed.

Final Panel Comment 3:

Documentation for levee certification needs to be presented in the HSDRRS Design Elevation Report, including numerical parameters for certification requirements.

Basis for Comment:

Section 1.3, page 10, of the HSDRRS Design Elevation Report identifies that levee certification is a critical requirement of the hydraulic system design. The HSDRRS Design Elevation Report indicates, "Use of a risk based approach in the design of the HSDRRS ensures that the design elevations meet certification requirements" (page 10). Although the hydraulic design approach in Section 2 includes a brief description of hydraulic and geometric parameters, it is not evident from the current description which parameters are relevant to levee certification. Because levee certification criteria have been in a state of developmental flux for some time, the Panel believes that an explicit identification and explanation of the current hydraulic requirements for levee certification is necessary.

Furthermore, an example explaining how the HSDRRS Design Elevation Report addresses the levee certification requirements would be useful in the HSDRRS Design Elevation Report. Sections 3 through 6 present applications of the risk based approach to Lake Pontchartrain and Vicinity, West Bank and Vicinity, Mississippi Coincident, and New Orleans to Venice, respectively. However, these design applications do not describe the levee certification requirements and how were they satisfied. The tabular presentation of results for the design applications in Sections 3 through 6 is fragmented making it difficult to relate and compare the results to the specific application. The parameters and results presented in the HSDRRS Design Elevation Report (Sections 3 through 6) would be more useful if they were provided in a manner that made verification of the results with the certification requirements obvious.

The Panel did a few spot checks of levee heights for two levee segments. They compared the final levee crest heights with the Federal Emergency Management Agency (FEMA) requirements of 44 CFR 65.10, specifically regarding freeboard for coastal levees. The 44 CFR 65.10 part (b)(1)(iii) indicates "freeboard must be established at one foot above the height of the one percent wave or the maximum wave runup (whichever is greater) associated with the 100-year stillwater surge elevation." The two levee segments included in the spot checks were the New Orleans Lakefront Levee (NO01) and Topaz St (NO10), both of which were part of the Orleans Parish Lakefront Metro. These levee segments had crest heights (elevations) exceeding "the height of the 1% wave associated with the 100-year stillwater surge elevation" which was assumed to be equivalent to the "mean surge level plus the mean significant wave height" for the 1% hydraulic boundary conditions as presented in Table 21 on page 78, Section 3 of the HSDRRS Design Elevation Report. The spot check evaluation could not be completed using the "maximum wave runup" because that value depends on parameters that could not be located in this section of the HSDRRS Design Elevation Report, although the maximum wave runup typically exceeds the significant wave height. To ensure the guidelines are followed, the HSDRRS Design Elevation Report should present such information in a clear and concise manner.

Significance – Medium:

The levee certification is a direct outcome of the information contained in the HSDRRS Design

Elevation Report, which also serves as the basis of satisfying the certification requirements, however, the HSDRRS Design Elevation Report does not clearly indicates what is needed to meet the certification requirements.
Recommendation(s) for Resolution:
1. Consider adding a new sub-section in Section 2 with a self-describing title such as "Levee Certification." This sub-section should provide some explanation on how design elevations are addressed in the context of meeting levee certification requirements, both now and in the future. This sub-section may include information such as levee certification requirements, list of parameters needed, free board criteria for certification along with statistically based performance target, cross-reference to other sections from which the necessary parameters could be derived. 2. Include an example of how the levee certification requirements are satisfied for one of the levee segments and how it would be helpful in demonstrating how the guidelines are applied. 3. Include a dedicated sub-section on levee certification as it applies to Sections 3 through 6 to clearly identify specific parameters, their values, and sources.

Final Panel Comment 4:

More documentation on input parameters for estimating wave overtopping rates is needed in the HSDRRS Design Elevation Report to clarify how the design elevations were calculated and how the future engineering implications will be implemented.

Basis for Comment:

While the design approach in Section 2 adequately presents the design concepts and background, the HSDRRS Design Elevation Report needs better documentation of several elements regarding the assumptions, input parameters, and results for overtopping calculations. In addition, the Panel recommends that more transparency is needed regarding implementation of future engineering investigations. The following elements do not constitute a complete list of desired documentation, but serve only as examples.

- Section 1.3 of the HSDRRS Design Elevation Report briefly indicates that future engineering analyses would be performed at 10-year intervals. Further elaboration is needed of the proposed schedule, future engineering investigations, monitoring, maintenance, time frame, and quantification of subsidence .
- The example overtopping calculation presented in Appendix F is unclear in how it has been presented and needs more complete documentation regarding input parameters and results output.
- The documentation of various assumptions used in the HSDRRS Design Elevation Report needs to be further clarified. For example, the numerical values of all parameters used in Eq 1 and 2 (page 30) to calculate average overtopping rate, q, are not specified in the report. Therefore, it is difficult to independently calculate q for given design segments as reported in the "Hydraulic Design Heights" sections and tables. In other words, calculations of q are not completely transparent and the report does not provide complete documentation of how the design elevations were calculated. For complete transparency, all the Eq 1 and 2 parameters used in the q calculations should be included in the report. Ideally, the report should include an adequate but brief (appropriate) justification or rationale for each of the parameters used in the calculations for each segment in Sections 3 through 6.
- The methods for determining wave overtopping and wave forces are appropriate at the current level of technological knowhow. The HSDRRS Design Elevation Report, however, needs to document further clarification on the assumptions and their application to levee designs in Section 2, followed by presentations in Sections 3 through 6. For example, Section 2 of the HSDRRS Design Elevation Report on page 21 states that errors generated by the probabilistic model for the best estimate of the 1% surge level are generally in the range of 1 to 2 feet (based on frequency analysis from ADCIRC and STWAVE). However, Sections 3 through 6 present the standard deviation of 10% of the best estimates (as stated on page 21), which is quite often less than 1 foot (Table 1 Input for Monte Carlo Analysis on page 33). This needs clarification on the basis of accepting a standard deviation (SD) value less than the expected best estimate error.
- The Monte Carlo Analyses (MCA) and imbedded Van der Meer equations (Eq 1 and 2, page 30) used to estimate average overtopping rate q at 50% and 90% confidence levels recognize and consider both model uncertainty and parameter uncertainty, which is

appropriate. However, it appears that there are judgments required in assessing overtopping input parameters, which introduces uncertainty that does not appear to be explicitly included in the MCAs. These apparently unaccounted for parameter uncertainties and their potential effects on estimation errors should probably be introduced and discussed in Section 2.3.5. Some discussion of total uncertainty could also be added, and perhaps even tied into the 10-year reviews.

- Issues relevant to armoring, on either the flood side or the protected side (backslope), are not addressed in this HSDRRS Design Elevation Report. Hopefully, they are addressed somewhere else or they may be addressed in the final version. If armoring is outside the scope of the HSDRRS Design Elevation Report, the report should provide a reference to where armoring would be addressed.
- Appendix E of the HSDRRS Design Elevation Report presents a concise summary of overtopping effects, but it is not clear how recent it is (appears to be circa 2007) and does not discuss additional studies that may be currently in progress or planned as indicated in Section 8 pages 56 through 58 of USACE (2007b).

Significance – Medium:

A clear understanding of the overtopping rate calculation and proper implementation of the assumptions and procedure are critical elements of the HSDRRS. It is necessary to be transparent on the limitations, the schedule of potential improvement, and monitoring and maintenance of the relevant elements.

Recommendation(s) for Resolution:

1. Improve documentation and transparency on the assumptions and estimation of overtopping rates in Section 2 and in Sections 3 through 6 for each levee and floodwall segment.
2. Provide complete details on the example in Appendix F describing the input parameters and results output.
3. Provide clarification on the status of the procedure updates documented in Appendix E.

Literature Cited:

USACE (2007b). USACE/FEMA Southeast Louisiana Joint Surge Study: Responses to ASCE External Peer Review. June 19, 2007.

Final Panel Comment 5:

Portions of the HSDRRS Design Elevation Report describing the wave characteristics and calculations need improved clarity and documentation.

Basis for Comment:

The section describing wave characteristics in Section 2.3.6 (Step 2 of the Step-Wise Approach) on page 35 along with the Hydraulic Boundary Condition Tables found throughout the text need better clarification. The implementation of Step 2, as presented in Tables in Sections 3 through 6, causes some confusion in the "Hydraulic Boundary Conditions" sections of the report. This is because it is not always clear if the reported "Significant wave heights" (H_s) in the tables are (a) 1% wave heights at 600-ft from the levee toe or structure toe, based on the JPM-OS method, or (b) reduced wave heights due to shallow foreshores, where $H_{max} = 0.4h$ for $H_s/h > 1/3$ and h = water depth of the 1% surge at the levee toe. Where the reported H_s are reduced, it is not always readily apparent that they are reduced and what the "unreduced" wave heights were, making it difficult to check or evaluate results.

For transparency of the report, both the "unreduced H_s" (i.e., the 1% wave heights at 600-ft from the levee toe or structure toe, based on the JPM-OS method) and "reduced H_s" at the levee toe should be included in the report. The rationale and calculation for reduction should also be clear and transparent for each levee segment in Sections 3 through 6, particularly where H_s is between the unreduced H_s and $H_{max}=0.4h$.

It is also cautioned that the 2.3.3 Breaker Parameter used for wave height reduction not be confused with the "surf similarity parameter," ξo, in Eq 1 and 2 on page 30, from TAW (2002) because ξo is called the "breaker parameter" in TAW (2002) Eqs 22 and 23. Further, it is not always clear how the breaker parameter is calculated for a given segment.

The interpretations of analyses and conclusions are reasonable; however, all of the interpretations are not obvious from the current document. Sections 2.4 and 2.5 represent two examples of sections that lack the necessary details, causing a perception of incompleteness. This is also carried over to Sections 3 through 6. Sections 3 through 6 do not adequately document the implementation of the design approach. The actual assumptions of special conditions and options for each segment of the levee/wall as presented are not clear. The results presented in Tables in these sections need more clarification as to their basis of the computations and need improved documentation. The Panel found it difficult to compare segment-specific information across the tables showing "1% Hydraulic Boundary Conditions," "1% Design Heights," and "Resiliency Analysis" located on separate pages in the HSDRRS Design Elevation Report. Ideally, all this information would be summarized in one table so that all the values could be easily compared for a given segment, and between segments in a given section.

Presentation of maps of 1% still water levels, wave heights, and wave periods in Appendix A may be supplemented with further details on the procedures and assumptions. Figures A.1 shows the 1% still water levels at the west end (St. Charles Parish) as higher than the values at the east end (Orleans Parish) despite the landward existence of St. Charles Parish. An explanation for this seemingly counterintuitive result could not be found in the HSDRRS

Design Elevation Report. Ideally, there would be a way to independently verify the accuracy of these calculations, including provision of adequate documentation for future evaluation and changes as the HSDRRS evolves.

Significance – Medium:

Clear and sufficient documentation of the basis for calculations is essential for the hydraulic design. The information documented for design elevations should allow for independent verification and future evaluation as the HSDRRS evolves.

The difficulty of comparing results found in separate tables affects the readability and understanding of the DER and thus decreases the functional quality of the guidelines.

Recommendation(s) for Resolution:

1. Provide additional clarification on assumptions and computations of wave characteristics in Sections 2.3, 2.4, and 2.5.
2. Provide additional details on assumptions and calculations for each design segment in Sections 3 through 6.
3. Provide additional clarification and enhancement to the results presented in the tables in Sections 3 through 6. Add reader-friendly "summary tables" with all the tabular information from the "1% Hydraulic Boundary Conditions," "1% Design Heights," and "Resiliency Analysis" consolidated into the same table, one table for each HSDRRS section (as presented in the report).
4. Clarify Figures A.1 through A.9 with minor additions. At a minimum, these figures need north indicators. The 1% still water levels at the west end (St. Charles Paris) of Figure A.1 are higher than the values at the east end (Orleans Paris) despite the landward existence of St. Charles Parish. The reason for this counterintuitive result should be explained.

Final Panel Comment 6:
The HSDRRS Design Elevation Report needs to fully document the basis for wave forces on hard structures.
Basis for Comment:
The analysis methodology for calculating wave forces on hard structures is limited to a short discussion in Section 2.2.5 which references the Goda formulations and EM 1110-2-1100 (Part VI), Chapter 5, 1 June 2006. Details, such as a brief presentation of the equations of analysis, are not documented in the report. The Panel was unable to verify the accuracy of this methodology using documentation in the current version of the HSDRRS Design Elevation Report. The HSDRRS Design Elevation Report refers to a CD-ROM which may have the necessary information, but the CD-ROM was not available for review.
Significance – Low:
Wave forces and load calculations are important components of the system design, which is a function of the hydraulic and geometric features, including the hydrostatic pressures and pressure differentials.
Recommendation(s) for Resolution:
1. Enhance documentation on the basis for calculating wave forces on hard structures to support independent verification of the calculations and provide a basis of understanding for future evaluation and updating of the HSDRRS. 2. Provide a copy of the CD-ROM containing the information on details of the wave force calculation and the load results with the HSDRRS Design Elevation Report.

APPENDIX B

Final Charge to the Independent External Peer Review Panel
as
Submitted to USACE on September 23, 2010

on the

HSDRRS Design Elevation Report

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Final Charge Guidance and Questions to the Peer Reviewers
for the
Independent External Peer Review (IEPR) for the Document "Hurricane and Storm Damage Risk Reduction System – Design Elevation Report", Dated May 2010 and Addenda to this Report

BACKGROUND

The document "Hurricane and Storm Damage Risk Reduction System (HSDRRS) – Design Elevation Report" hereinafter referred to as the "Design Elevation Report," is a compendium of initial hydraulic design performed for the HSDRRS Lake Pontchartrain and Vicinity (LPV), West Bank and Vicinity (WBV), Mississippi River Co-Located and New Orleans to Venice projects. The first version of this report was titled "Elevations for Design of Hurricane Protection Levees and Structures – Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project and West Bank and Vicinity, Hurricane Protection Project" and was completed in October 2007. The report has recently been updated to include Mississippi River Levee co-located work and New Orleans to Venice project features. The Addenda to this report will include a compendium of additional hydraulic design that will be performed after the completion of the initial designs (i.e., Post-Design Addenda). It is estimated that up to three (3) Addenda will be provided for review.

The term "State" refers to both the State of Louisiana and Local governing entities, including the Southeast Louisiana Flood Protection Authorities and any levee district under their supervision.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the Design Elevation Report (Review 1) and Addenda to this Report (Review 2) in accordance with the Department of the Army, U.S. Army Corps of Engineers (USACE), Water Resources Policies and Authorities' *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010, 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.

This purpose of the IEPR is "ensure the hydraulic design performed to develop initial and final HSDRRS design elevations and geometries meet current professional standards for similar studies" (per USACE Scope of Work). The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR panel members) with extensive experience in engineering issues relevant to the project. They should also have experience applying their subject matter expertise to coastal storm damage reduction.

The panel members will be "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall report/addenda. The panel members will identify, examine, and comment upon the assumptions underlying the analyses as well as evaluate the soundness of models and analytic methods. The panel members will evaluate whether the interpretations of analyses and conclusions are technically sound and reasonable, provide effective review in terms of both usefulness of results and of credibility, and have the flexibility to bring important issues to the attention of decision makers.

DOCUMENTS PROVIDED

The following is a list of documents and reference materials that will be provided for the review. **The documents and files presented in bold font are those which are to be reviewed**. All other documents are provided for reference.

USACE will provide the following documents for review:

- Review 1 (Tasks 4-6) **"HSDRRS - Design Elevation Report" - *includes LPV and WBV completed in October 2007 and NOV and MRL Co-located completed in May 2010***
- Review 2 (Tasks 7-9) **Post Design Addendum - "Elevations for Design of Hurricane Protection Levees and Structures" - LPV and WBV**
- Review 2 (Tasks 7-9) **Post Design Addendum - NOV**
- Review 2 (Tasks 7-9) **Post Design Addendum - MRL Co-located**

USACE will provide the following supplemental information to inform the reviewers (not part of the review, will be supplied as part of the documentation for Review 1, Tasks 4-6):

- *EPR files*
    - Att 101 oprt report 5-31-07
    - Att 301 Nearshore_Waves_June07
    - Att 401 JPM_FEMA_OFFSHORE_WAVES_REJ_2007_05-18
    - Att 501 DraftTR_May25 Erosion Test
    - Att 612 Overtopping Criteria Comparison
    - Att 711 2007-03-23-2007 HPS QMP
    - Att 712 02318
    - Att 713 02332-06-12Emb
    - Att 714 02922
    - Att 715 QMP Flowchart
    - Att 716 STB08_W912P8-06-R-0094[1]
    - Att 731 33cfr208.10
    - Att 732 Lake Borgne Levee District 2006 Compliance Inspection Report
    - Att 733 Levee Owner's Manual
    - Att 734 Encl 3- FCW Inspection Guide
    - Att 735 FEMA 44CFR65_10
    - Att 736 checklist_accred_criteria[1]
    - JSS Response to ASCE EPR 19June07
    - JSS Response to ASCE EPR No2 14Sept07

- *ITR files*
  - USACE FEMA JSS ITR Report Final Oct15 2007
- *Sela ids2 final pdf files*
  - App A erdc-tracks-001-162
  - App B PBL-A Storm Track File
  - App C PBL-B TROP File
  - App D PBL-C WIN_PRE File Format
  - Appendix A-D
  - Figure 1-27
  - Figure 28-130
  - Figure 131-154
  - Figure 155-175
  - Figure 176-185
  - Figure 186-199
  - Figure 200-221
  - Figure 222-246
  - Figure 247-266
  - Figure 267-278
  - Figure 279-314
  - Figure 315-340
  - Figure 341-369
  - Figure 370-373
  - Figure 374-476
  - Tables 1-40 - IDS2
  - Text SELA 2007 IDS 2 FINAL 072808
- *Other FEMA documents*
  - Att 101 oprt report 5-31-07
  - hull letter10-03-07
  - hull letter 7-30-07 v5 final
  - JSS Response to ASCE EPR 19June07
  - JSS Response to ASCE EPR No2 14Sept07
  - SELA_QAQC_App_Vol1of8_storms001to0018
  - SELA_QAQC_App_Vol2of8_storms019to037
  - SELA_QAQC_App_Vol3of8_storms038to056
  - SELA_QAQC_App_Vol4of8_storms057to080
  - SELA_QAQC_App_Vol5of8_storms081to105
  - SELA_QAQC_App_Vol6of8_storms106to131
  - SELA_QAQC_App_Vol7of8_storms132to153
  - SELA_QAQC_App_Vol8of8_storms154to162
  - USACE FEMA JSS ITR Report Final Oct15 2007
- *IPET review documents*
  - 11292006erpletter
  - Ch9_What Must We Do Next
  - erp_letter_4-15-08_FINAL
  - erp_progressreport
  - erpletterformat

    - ERPNRCBriefingv.6_5.15.06
    - ERPreport[1]
    - IPETASCEpanelmembers
    - New Orleans Hurricane Protection SystemIPETERPscope
    - NRCmeeting3-20
- *NRC documents*
    - Letter Report of the Committee on New Orleans Regional Hurricane Protection Projects
    - Second Report of the National Academy of Engineering/National Research Council Committee on New Orleans Regional Hurricane Protection Projects
    - Third Report of the National Academy of Engineering/National Research Council Committee on New Orleans Regional Hurricane Protection Project
    - Fourth Report of the National Academy of Engineering/National Research Council Committee on New Orleans Regional Hurricane Protection Projects: Review of the IPET Volume VIII
    - The New Orleans Hurricane Protection System: Assessing Pre-Katrina Vulnerability and Improving Mitigation and Preparedness
- USACE guidance *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010
- CECW-CP Memorandum dated March 31, 2007
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.
- ER 1110-1-12 Engineering and Design Quality Management (21 July 2006)

SCHEDULE

TASK	ACTION	REVIEW 1 ESTIMATED DUE DATES	REVIEW 2 ESTIMATED DUE DATES
Conduct Peer Review	Review documents sent to panel members	9/24/2010	12/7/2010
	Battelle/IEPR Panel Kick-off Meeting	9/23/2010	12/7/2010
	USACE/Battelle/Panel Kick-off Meeting with panel members	9/24/2010	12/7/2010
	IEPR panel members complete their review	10/27/2010	1/6/2011
Prepare Final Panel Comments and Final IEPR Report	Battelle provides panel members merged individual comments and talking points for panel review teleconference	11/3/2010	1/13/2011
	Convene panel review teleconference	11/5/2010	1/17/2011
	Battelle provides Final Panel Comments directive to panel	11/8/2010	1/18/2011
	Panel members provide draft Final Panel Comments to Battelle	11/16/2010	1/25/2011
	Battelle provides feedback to panel members on draft Final Panel Comments; panel provides revised draft Final Panel Comments per Battelle feedback (iterative process)	Not Applicable	Not Applicable
	Final Panel Comments finalized	11/23/2010	2/1/2011
	Battelle provides Final IEPR report to panel for review	11/29/2010	2/3/2011
	Panel provides comments on Final IEPR report	12/1/2010	2/7/2011
	*Battelle submit Final IEPR Report to USACE	12/6/2010	2/10/2011
Comment/ Response Process	Battelle inputs Final Panel Comments to DrChecks; Battelle provides Final Panel Comment response template to USACE	12/7/2010	2/11/2011
	USACE PDT provides draft responses and clarifying questions to Battelle (Highly recommended)	12/16/2010	2/22/2011
	Battelle provides panel members the draft Evaluator responses and clarifying questions	12/21/2010	2/25/2011
	Panel members provide Battelle with draft BackCheck responses	12/27/2010	3/2/2011
	Teleconference with Battelle and panel members to discuss panel's draft BackCheck responses	12/27/2010	3/2/2011
	FPC Teleconference between Battelle, IEPR team, and PDT to discuss Final Panel Comments, draft responses and clarifying questions	1/4/2011	3/9/2011
	USACE inputs final Evaluator responses in DrChecks	1/13/2011	3/18/2011
	Battelle provides Evaluator responses to panel members	1/18/2011	3/23/2011
	Panel members provide Battelle with BackCheck responses	1/21/2011	3/28/2011
	Battelle inputs BackCheck responses in DrChecks	1/27/2011	4/1/2011
	*Battelle submits pdf printout of DrChecks to USACE	1/28/2011	4/4/2011

CHARGE FOR PEER REVIEW

Members of this peer review panel are asked to determine whether the technical approach and scientific rationale presented in the Design Elevation Report and Addenda (Review 1 and 2, respectively) are credible and whether the conclusions are valid. The reviewers are asked to determine whether the technical work is adequate and properly documented; satisfies established quality requirements; and yields scientifically credible conclusions. The Panel is being asked to provide feedback on the engineering. The reviewers are not being asked whether they would have conducted the work in a similar manner.

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

The following will be taken into consideration by the Panel:

- JPM-OS and the original surge and wave modeling that were used as input into the hydraulic design for the HSDRRS were initiated for the Louisiana Coastal Protection and Restoration study (LACPR) and incorporated into FEMA DFIRM mapping. A prior review was conducted on the FEMA products. IPET also utilized information developed from ADCIRC and STWAVE models and the JPM-OS process. Chapter 2 of the Design Elevation Report formed the basis for the hydraulic chapter in the Design Guidelines (i.e., Chapter 1 - HSDRRS Design Guidelines, June 2008). An IEPR was performed on the Design Guidelines, and comments and responses were documented in DrChecks. In 2007, a draft version of the Design Elevation Report was reviewed by an independent ASCE team. The draft report has been updated since this review to include the HSDRRS MRL Co-Located projects and NOV projects. As part of the IPET work, the National Research Council (NRC) and ASCE performed reviews of the IPET documents; NRC also reviewed the reviews/reports produced by ASCE for IPET.

- All supporting information, including the descriptions of the JPM-OS and modeling results, the IPET, ASCE, and Design Guidelines IEPR review documents and the NRC reports, are part of the supporting information provided for reference during the review.

- The IEPR Panel shall perform an independent review and make efforts to not replicate comments made in the FEMA review, the 2007 ASCE review, or the Design Guidelines review; the IEPR team should assess these review documents and report on the completeness of the reviews, in view of the use of the JPM-OS and model results used in the hydraulic design documented in the Design Elevation Report. The IEPR team should make comments on items that were not addressed and/or resolved in the original reviews.

- One specific topic that the IEPR Panel shall address pertains to the wave overtopping rates (i.e., Are these rates reasonable and appropriate for the hydraulic design?). Wave overtopping rates established for the New Orleans District hurricane protection system are as follows:

- For the 1% exceedence still water, wave height and wave period, the maximum allowable average wave overtopping of 0.1 cfs/ft at 90% level of assurance and 0.01 cfs/ft at 50% level of assurance for grass-covered levees;
- For the 1% exceedence still water, wave height and wave period, the maximum allowable average wave overtopping of 0.1 cfs/ft at 90% level of assurance and 0.03 cfs/ft at 50% level of assurance for floodwalls with appropriate protection on the back side.

General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the Design Elevation Report and Addenda. Please focus on your areas of expertise and technical knowledge. Some sections have no questions associated with them; however, 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 are asked to review. In addition, please note the following guidance. Note that the Panel will be asked to provide an overall statement related to the adequacy of the report(s).

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. Identify, explain, and comment upon assumptions that underlie all the analyses, and evaluate the soundness of models, surveys, investigations, and methods.
3. Evaluate whether the interpretations of the analysis and the conclusions based on the analysis are reasonable
4. 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 (Lynn McLeod, mcleod@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 project manager 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 Lynn McLeod, mcleod@battelle.org, no later than October 27, 2010, 10 pm EDT for Review 1 and no later than January 6, 2011, 10 pm EST for Review 2.

Independent External Peer Review (IEPR) for the Document "Hurricane and Storm Damage Risk Reduction System – Design Elevation Report", Dated May 2010 and Addenda to this Report

Final Charge Questions for the Design Elevation Report

GENERAL QUESTIONS

1. Comment on whether the assumptions that underlie the engineering analyses are sound.
2. Comment on whether the engineering methods, models, and analyses used are adequate and acceptable.
3. In general terms, are the planning methods sound? If not, please explain.
4. Are the interpretations of analysis and conclusions based on the analysis reasonable? If not, please explain.

Developed from USACE SOW

5. Comment on whether the hydraulic design performed to develop initial and final HSDRRS design elevations and geometries meets current professional standards for similar studies.
6. Comment on items that were not addressed and/or resolved in the original reviews.
7. Comment on whether the wave overtopping rates are reasonable and appropriate for the hydraulic design?

Developed from Appendix E of EC 1165-2-209

8. Comment on whether the Design Elevation Report adequately addresses redundancy with an emphasis on interfaces between structures, materials, members, and project phases.
9. Comment on whether the Design Elevation Report adequately addresses resiliency with an emphasis on interfaces between structures, materials, members, and project phases.
10. Comment on whether the Design Elevation Report adequately addresses robustness with an emphasis on interfaces between structures, materials, members, and project phases.
11. Comment on whether the project features and/or components work effectively as a system.
12. Comment on whether the models used to assess hazards appropriate.

Developed from Design Elevation Report

13. Comment on whether the Design Elevation Report adequately addresses the parameters needed to meet the hydraulic requirements for levee certification.
14. Comment on whether the Design Elevation Report adequately addresses the major components of the HSDRRS design intent.
15. Comment on whether the Design Elevation Report adequately addresses the proposed schedule for the future engineering investigations associated with determining final levee elevation.
16. Comment on whether the Design Elevation Report presents the most appropriate methods for determining wave overtopping and wave forces.

17. Comment on whether the Design Elevation Report adequately addresses the step-wise design approach associated with determining the design elevations and minimum cross sections of levees and design elevation for floodwalls.
18. Comment on whether the Design Elevation Report adequately addresses future conditions.
19. Comment on whether the Design Elevation Report adequately addresses the design elevations and loads for levees, floodwalls, and other structures.
20. Comment on whether Design Elevation Report adequately details the process to document changes in the design elevations.
21. Comment on whether the Design Elevation Report adequately addresses areas identified for further investigation.
22. Comment on whether the Design Elevation Report adequately addresses armoring and resiliency.

FINAL OVERVIEW QUESTION

23. What is the most important concern you have with the document or its appendices that was not covered in your answers to the questions above?

Charge Questions for the Design Elevation Report Addenda

Charge questions that relate to the Design Elevation Report Addenda will be prepared and supplied upon receipt of the documents from USACE prior to their review.