Battelle
The Business of Innovation

Final Independent External Peer Review Report

Independent Peer Review of Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS): Crossings with I-10 and I-310, Lake Pontchartrain and Vicinity (LPV) 03.2a and 06e.2

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: 09086
Delivery Order: 0658

December 15, 2010

ACKNOWLEDGEMENTS

This work was supported by the U.S. Army Corps of Engineers (Harvey Johnson, Julie Fritz) under the auspices of the U.S. Army Research Office Scientific Services Program administered by Battelle (Delivery Order 0658, Contract No. W911NF-07-D-0001).

SHORT-TERM ANALYSIS SERVICE (STAS)

Final Independent External Peer Review Report

for the

Independent External Peer Review of the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS), Crossings with I-10 and I-310, Lake Pontchartrain and Vicinity (LPV) 03.2a and 06e.2

by

Battelle Memorial Institute
505 King Avenue
Columbus, OH 43201

for

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

December 15, 2010

Contract No. W911NF-07-D-0001
Task Control Number: 09086
Delivery Order: 0658
Scientific Services Program

This page intentionally left blank.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

A/E	Architectural/Engineering
CIL	Critical Items List
CECW	Corps of Engineer Civil Works
COI	Conflict of Interest
DrChecks^{SM}	Design Review and Checking System
GNOHSDRRS	Greater New Orleans Hurricane and Storm Damage Risk Reduction System
HSDRRS	Hurricane and Storm Damage Risk Reduction System
HSDRRSDG	Hurricane and Storm Damage Risk Reduction System Design Guidelines
IEPR	Independent External Peer Review
IPET	Interagency Performance Evaluation Task
ITR	Independent Technical Review
LECsR	Lower East Coast sub-Regional
LPV	Lake Pontchartrain and Vicinity
MRGO	Mississippi River-Gulf Outlet
NAS	National Academy of Sciences
NTP	Notice to Proceed
PCX	Planning Center of Expertise
PDT	Project Delivery Team
PE	Professional Engineer
P&S	Plans and Specifications
PRQCP	Peer Review Quality Control Plan
STAS	Short Term Analysis Service
USACE	U.S. Army Corps of Engineers
WRDA	Water Resources Development Act

This page intentionally left blank.

Final Independent External Peer Review Report for the

Independent External Peer Review of the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS), Crossings with I-10 and I-310, Lake Pontchartrain and Vicinity (LPV) 03.2a and 06e.2

Executive Summary

The U.S. Army Corps of Engineers (USACE) is currently designing and constructing the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS). Vital components of this system are the GNOHSDRRS crossings of Interstate 10 (I-10) and Interstate 310 (I-310), which are features of Lake Pontchartrain and Vicinity (LPV) 03.2a and LPV 06e.2, respectively. The LPV 03.2a project consists of raising the southern segment of the west return floodwall adjacent to I-10 to design elevation and stability, and construct the floodwall to a 10-year flood level of protection. The LPV 06e.2 project consists of constructing the floodwall under I-310 to a 10-year flood level of protection.

An Independent External Peer Review (IEPR) of the GNOHSDRRS crossings with I-10 and I-310 (hereinafter I-10 and I-310 Crossings) was conducted to ensure the reliability of scientific information and engineering analyses contained within the project review documents which includes:

- Design Architectural/Engineering (A/E) 95% designs and modeling related to overtopping and uplift
- 95% Plans and Specifications (P&S)
- Draft Design Guidelines

In addition, the Water Resources Development Act (WRDA) 2007, Section 2035 (Public Law 110-114) requires a safety assurance review by independent experts on the design and construction activities of the GNOHSDRRS projects. An IEPR of the I-10 and I-310 Crossings project is regarded as a critical element to the safety assurance of this project and is performed as required by WRDA.

Battelle Memorial Institute (hereinafter Battelle), as a non-profit science and technology organization with experience in establishing and administering expert peer reviews, was engaged by the USACE Planning Center of Expertise (PCX) to conduct and coordinate the IEPR of the I-10 and I-310 Crossings projects. The IEPR followed the procedures described in the Department of the Army, USACE, guidance *Peer Review of Decision Documents* (EC 1105-2-410) dated August 22, 2008; CECW-CP Memorandum dated March 30, 2007; *Engineering and Design, Quality Management* (ER 1110-1-12) dated July 21, 2006; and *Engineering and Design,* DrChecks[SM] (ER 1110-1-8159) dated May 10, 2001.

This final IEPR report describes the Battelle IEPR process followed by the IEPR panel members, summarizes the final comments of that IEPR Panel, describes panel members' qualifications, and summarizes the recruitment and selection process for panel members as conducted by Battelle.

The purpose of an IEPR is to strengthen the quality and credibility of the USACE's decision documents in support of its Civil Works program. The IEPR Panel reviewed the 95% design documentation for the I-10 and I-310 Crossings project.

Battelle initially screened 16 potential panel members for their technical and engineering expertise, confirmed availability, lack of potential conflicts of interest, and knowledge of the Greater New Orleans area. Two expert panel members (i.e., panel members) were selected: a hydraulic engineer and a structural engineer. The IEPR panel members were provided with hard and electronic copies of the project review documents as well as supporting documentation. Prior to beginning the review, the panel members were required to develop a Critical Items List (CIL), which identified design elements and/or design interfaces that are critical to the safety and successful completion of the project. The items detailed in the CIL served to focus the panel member review on technical and engineering issues.

Consistent with USACE guidance to maintain IEPR Panel independence, the IEPR panel members were not permitted to have direct or unmonitored e-mail or phone contact with the USACE Project Delivery Team (PDT). All interaction between the IEPR panel members and USACE either occurred in DrChecks^{SM} (Design Review and Checking System), a web-based tool for facilitating design reviews, or via teleconference with Battelle and a USACE PCX representative present.

The I-10 and I-310 Crossings project IEPR began on July 21, 2009, when the panel members participated in an internal project kickoff teleconference conducted by Battelle to highlight the IEPR process, expectations, and describe the anticipated project information. Battelle also arranged for the IEPR Panel to participate in a USACE Orientation Teleconference on July 23, 2009 to review project history, status, and available project documents. The IEPR Panel conducted the IEPR of the I-310 Crossings project first as the 95% project review documents were immediately available (July 2009). The 95% project review documents for the I-10 Crossings project were provided to the IEPR panel members on January 20, 2010.

I-310 Crossings Project

The panel members were provided with hard and electronic copies of the 95% project review documents for the I-310 Crossings project. The IEPR panel members produced 22 individual comments on the I-310 Crossings project, which were input into DrChecks^{SM} on August 14, 2009. Seven of the comments on the I-310 project were marked as critical. USACE completed its initial Evaluator responses by January 29, 2010 and the panel members conducted an initial round of Backcheck responses (i.e., responding to USACE Evaluator responses) and comment resolution (i.e., comment close out). An IEPR review teleconference to discuss some of the comments and possible changes was held on February 9, 2010. The IEPR panel members entered their initial Backcheck responses in DrChecks^{SM} on February 14, 2010. USACE provided additional evaluation responses through March 22, 2010 and the panel members entered final Backcheck responses in DrChecks^{SM} through November 21, 2010.

I-10 Crossings Project

The panel members were provided with hard and electronic copies of the 95% project review documents for the I-10 Crossings project. The IEPR panel members produced 17 individual

comments on the I-10 Crossings project, which were input to DrChecks^{SM} on February 8, 2010. USACE completed its initial Evaluator responses by April 1, 2010 and the panel members conducted an initial round of Backcheck responses and comment resolution. An IEPR review teleconference to discuss some of the comments and possible changes was held on May 12, 2010. The IEPR panel members entered their initial Backcheck responses in DrChecks^{SM} on May 24, 2010. USACE provided additional evaluation responses through July 6, 2010 and the panel members entered their Backcheck responses in DrChecks^{SM} through November 21, 2010.

Comments from the Reviews

Throughout the comments on the reviews of both projects, the IEPR panel members recommended various additional details/clarifications or analysis be provided to improve the design documentation and/or design of the I-10 and I-310 Crossings project. The scope of work requested the panel members assess the uplift and overtopping of the flood protection for the interstate bridges; however, as the panel members considered scour protection to also be an important component of the project, this item was included in their review. Below are those items noted by the IEPR Panel as being most important:

- It is not clear if the wave characteristics (Hs, T, etc.) were adjusted from those used for the Mississippi River-Gulf Outlet (MRGO).
- The results of the latest Barge Impact Study should be used to estimate boat/barge impact load on the floodwall.
- The structural integrity of the bridges should be evaluated beforehand and monitored during construction staging and pile driving activities.
- The floodwall design should consider that high velocity currents during a potential overtopping event may impose an additional lateral load on the floodwall.
- It is not clear if the designers considered the possibility of seiches and standing waves in the lake during a hurricane in the design.
- It is not clear if the designers evaluated the potential soil scour and scour depth for both floodwall and the bridge piers.
- The floodwall design considered the 10% exceedance condition for hydraulic analyses in accordance with Southeast Louisiana Authorization instead of 1% exceedance in accordance with the design guidelines. The design should consider the 100-year storm event and the 500-year storm surge.

In total, the USACE PDT evaluated and responded to all 39 comments in DrChecks^{SM}, 22 comments for the I-310 Crossings project and 17 comments for the I-10 Crossings project. For the 22 I-310 Crossings project IEPR comments, the USACE PDT concurred with 1 comment, non-concurred with 4 comments, and responded "for information only" to 17 comments. For the 17 I-10 Crossings project IEPR comments, the USACE PDT concurred with 5 comments, non-concurred with 4 comments, and responded "for information only" to 8 comments. The USACE PDT also provided an explanation with each response, with the exception of two hydraulics comments on the I-10 project that were marked as "to be answered by Hydraulics."

Upon review of the USACE PDT responses, the IEPR panel members determined that some comments needed further discussion as the comments were inadequately addressed. An IEPR review teleconference was conducted on February 9, 2010 for the I-310 Crossings

project and on May 12, 2010 for the I-10 Crossings project. The purpose of the IEPR review teleconferences was for the IEPR Panel and USACE PDT to discuss those comments that were identified by the IEPR Panel as being inadequately addressed or for which the USACE PDT needed further explanation.

I-310 Crossings (22 comments)

- Seven comments closed in initial comment/response process
- 15 comments required a second round of comment and response
- All 15 comments requiring a second round of consideration were closed; however, 7 of the 15 comments were unresolved. Although the panel members requested further information or clarification on these comments, there was no response from the USACE Evaluator.
- For the seven unresolved comments, the panel member provided a response for the record describing measures that should be incorporated into the 95% design for appropriate safety assurance.

I-10 Crossings (17 comments)

- 11 comments were closed in the initial comment/response process
- Six comments required a second round of comment and response.
- All 6 comments requiring a second round of consideration were closed as follows: 3 were closed with comment, 1 comment was withdrawn, and 2 were closed without comment.

At the close of the comment/response process, the panel members felt that 32 of the comments had been adequately addressed and these comments were closed in DrChecks^{SM}. For the 7 comments that were not adequately addressed and remained unresolved for the I-310 Crossings project, the panel members provided a response for the record describing measures that should be incorporated into the 95% design for appropriate safety assurance.

In general, the IEPR panel members agreed that the numerical modeling results developed for and provided in the 95% project review documents for the project design are acceptable, subject to the following recommendations:

- Adjust wave characteristics (Hs, T, etc.) from those used for the MRGO.
- Estimate boat/barge impact load on the floodwall using the results of the Barge Impact Study.
- Evaluate and monitor the structural integrity of the interstate bridges during construction staging and pile driving loads.
- Consider that high velocity currents during an overtopping event may impose an additional lateral load on the floodwall.
- Consider the possibility of seiches and standing waves in the lake during a hurricane in the design.
- Evaluate the soil scour and scour depth for both floodwall and the bridge piers.
- Consider the 1% exceedance in accordance with the design guidelines, the 100-year storm event, and the 500-year storm surge in the design of the floodwalls.

1.0 INTRODUCTION

1.1 Background of Program

The U.S. Army Corps of Engineers (USACE) is currently designing and constructing the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS). Vital components of this system are the GNOHSDRRS crossings of Interstate 10 (I-10) and Interstate 310 (I-310), which are features of Lake Pontchartrain and Vicinity (LPV) 03.2a and LPV 06e.2, respectively. The LPV 03.2a project consists of raising the southern segment of the west return floodwall adjacent to I-10 to design elevation and stability, and construct the floodwall to a 10-year flood level of protection. The LPV 06e.2 project consists of constructing the floodwall under I-310 to a 10-year flood level of protection.

Battelle Memorial Institute (hereinafter Battelle), as a non-profit science and technology organization with experience in establishing and administering expert peer reviews, was engaged by the USACE Planning Center of Expertise (PCX) to conduct and coordinate the IEPR of the I-10 and I-310 Crossings project. The IEPR followed the procedures described in the Department of the Army, USACE, guidance *Peer Review of Decision Documents* (EC 1105-2-410) dated August 22, 2008; CECW-CP Memorandum dated March 30, 2007; *Engineering and Design, Quality Management* (ER 1110-1-12) dated July 21, 2006; and *Engineering and Design,* DrChecks^{SM} (ER 1110-1-8159) dated May 10, 2001.

This final IEPR report describes the Battelle IEPR process followed by the IEPR panel members, summarizes final comments of that IEPR Panel, describes the panel members' qualifications, and summarizes the recruitment and selection process for panel members as conducted by Battelle.

1.2 Project and Documents Reviewed

The work planned for the I-10 Crossings project includes improving the southern segment of the west return floodwall to reduce overtopping by increasing the top of floodwall elevation from EL 11.5 NAVD to EL 16.0 NAVD. The top of the floodwall at the bottom of the bridge girder is presently at EL 13.5 NAVD. The work planned for the I-310 Crossings project includes improving the floodwall under I-310 where the floodwalls cross under I-10 and I-310 by increasing the elevation of the floodwall from EL 11.5 NAVD to EL 15.5 NAVD. The top of the floodwall at the bottom of the bridge girders is presently at EL 13.5 NAVD. The IEPR Panel for the I-10 and I-310 Crossings project specifically reviewed the following documents:

- Design A/E 95% designs and modeling related to Overtopping and Uplift of the I-10 Interstate Bridge
- Design A/E 95% designs and modeling related to Overtopping and Uplift of the I-310 Interstate Bridge
- 95% Plans and Specifications for both I-10 and I-310.

Documents provided for reference and support included:

- Design A/E's Scope of Work

- GNOHSDRRS Quality Management Plan, February 2008
- ER 1110-1-12, Engineering and Design, Quality Management, July 2006
  ER 1110-1-8159, Engineering and Design, DrChecks^{SM}, May 2001.

1.3 Purpose of Independent External Peer Review

The purpose of an IEPR is to strengthen USACE's safety assurance as outlined in Water Resources Development Act (WRDA) 2007, Section 2035 (Type II) for the GNOHSDRRS program in the Greater New Orleans area. Independent, objective external peer review is regarded as a critical element in ensuring the reliability of scientific and engineering analyses.

To help ensure that USACE documents are supported by the best scientific, technical, and engineering information, a peer review process has been implemented by USACE that utilizes an IEPR to complement the agency technical review, as described in the Department of the Army, USACE, guidance *Peer Review of Decision Documents* (EC 1105-2-410) dated August 22, 2008. In this case, the IEPR of the I-10 and I-310 Crossings project was conducted and managed using contract support from an independent 501(c)(3) organization, Battelle, to ensure independent objectivity, along with a high degree of flexibility and responsiveness, which was essential for USACE to meet deadlines.

2.0 INDEPENDENT EXTERNAL PEER REVIEW PROCESS

This section describes the method for selecting panel members, and the process for planning and conducting the IEPR. The IEPR followed the process described in Battelle's Peer Review Quality Control Plan (PRQCP), developed specifically for this project, and was conducted following procedures described in USACE's guidance cited above (Section 1.1), and in accordance with the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review*, released December 16, 2004. In addition, the IEPR followed supplemental guidance on the evaluation of conflicts of interest from the National Academies' *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports*, dated May 12, 2003.

2.1 Planning and Schedule

Table 1 defines the schedule followed during the IEPR.

Table 1. IEPR Project Schedule

Task	Action	End Date
	Notice to Proceed (NTP)*	March 12, 2009
1	**USACE Kick-Off Teleconference and PRQCP** USACE kick-off teleconference with Battelle Battelle submits Draft PRQCP to USACE for review USACE comments on Draft PRQCP Battelle prepares Final PRQCP (*Note, delay between NTP and USACE Kickoff Meeting due to USACE program changes)	 June 19, 2009 June 23, 2009 July 23, 2009 July 23, 2009

Task	Action	End Date
2	**Panel Member Recruitment** Panel members placed under contract Battelle sends CIL and review documents to panel members Panel members participate in Battelle kick-off teleconference Panel members participate in USACE orientation teleconference	 July 12, 2009 July 21, 2009 July 21, 2009 July 23, 2009
3	**I-310 Review** Panel members conduct project review IEPR Panel posts I-310 comments in DrChecks℠ USACE PDT Evaluator reviews and responds to comments Panel members review USACE PDT Evaluator responses IEPR review teleconference with USACE PDT and panel members Panel members post Backcheck responses on DrChecks℠ USACE PDT Evaluator responds to Backcheck responses (2nd round) IEPR Panel close out of all comments in DrChecks℠ **I-10 Review** Panel members conduct project review IEPR Panel posts I-10 comments in DrChecks℠ USACE PDT Evaluator reviews and responds to comments Panel members review USACE PDT Evaluator responses IEPR review teleconference with USACE PDT and panel members Panel members post Backcheck responses on DrChecks℠ USACE PDT Evaluator responds to Backcheck responses (2nd round) IEPR Panel close out of all comments in DrChecks℠	 August 11, 2009 August 14, 2009 January 29, 2010 February 4, 2010 February 9, 2010 February14, 2010 March 22, 2010 November 21, 2010 February 1, 2010 February 8, 2010 April 1, 2010 April 30, 2010 May 12, 2010 May 24, 2010 July 6, 2010 November 21, 2010
4	**IEPR On-Site Review Conference**	N/A
5	**Final Report** Battelle submits Draft Final Report USACE comments on Draft Final Report Battelle submits Final Report Project Closeout	 December 2, 2010 December 7, 2010 December 15, 2010 January 30, 2011

Note: DrChecks℠ = Design Review and Checking System

2.2 Identification and Selection of Independent External Panel Members

Battelle identified 16 panel member candidates who had requisite areas of engineering expertise for the I-10 and I-310 Crossings project. The candidates were identified using referrals, internet searches, and personal contacts. Of the 16 potential candidates, 3 were contacted and screened for their technical and engineering expertise, potential conflicts of interest (COIs), previous performance on similar reviews, and availability to meet the project schedule. Of the three peer review candidates who were contacted, two were selected to perform the IEPR of the I-10 and I-310 Crossings project documents.

The two panel members selected for the IEPR were independent engineering consultants. The areas of technical engineering expertise of the selected IEPR reviewers were hydraulic engineering and structural engineering, which corresponded to the specific needs of the I-10 and I-310 Crossings project. Battelle evaluated the credentials of the panel members, focusing on these key areas of engineering expertise. Previous participation in USACE technical review committees and other technical review panel experience was also considered.

The panel members were screened for the following *potential* exclusion criteria or COIs:

- 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 USACE, federal, or state government employee
- Current employment by any federal or state government organization
- Current personal or firm involvement as a cost-share partner on USACE projects
- Participation in developing the HSDRRS project
- Any publicly documented statement made by the reviewer or reviewer's firm advocating for or against the subject project
- Paid or unpaid participation in litigation related to the work of the USACE
- Current or future interests in the subject project or future benefits from the project
- Current personal or firm involvement with other USACE projects
- Previous employment by the USACE as a direct employee or contractor (either as an individual or through your firm) within the last 10 years
- Previous direct employment by the USACE, New Orleans District
- A significant portion (i.e., greater than 50%) of personal or firm revenues within the last 3 years came from USACE contracts
- Repeatedly serving as a peer reviewer for Task Force Hope projects
- Other USACE affiliation [Scientist employed by the USACE (except as described in National Academy of Sciences (NAS) criteria, see EC 1105-2-410 section 8d)][a]
- 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.

In selecting final panel members from the list of potential peer review candidates, Battelle selected experts who were not conflicted by the above COI categories and who met or exceeded the criteria and experience factors described in Section 3 of this report (see Section 3 for names and biographical information on the selected IEPR panel members). Battelle established subcontracts with the panel members who had indicated their willingness to participate and confirmed the absence of COIs through focused interviews and a signed COI form.

[a] Note: Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE funding have sufficient independence from USACE to be appropriate panel members. See the OMB memo (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."

2.3 IEPR Kick-Off Teleconferences

Battelle held a project kick-off teleconference with USACE on June 19, 2009 to review the preliminary schedule, discuss the IEPR process, and address any questions regarding the scope. On July 21, 2009, Battelle staff conducted a kick-off teleconference meeting with the IEPR Panel for the review of the I-10 and I-310 Crossings project. During the teleconference, Battelle provided an overview of the IEPR process, reviewed project and reference materials, and discussed overall schedule dates and milestone activities. Another kick-off teleconference (USACE Teleconference Orientation Briefing) was held on July 23, 2009 with USACE and the IEPR Panel to provide USACE an opportunity to brief the IEPR panel members on the I-10 and I-310 Crossings projects and allow the IEPR panel members an opportunity to ask questions.

2.4 Preparation of the Critical Items List

Battelle (with input from the panel members) developed a Critical Items List (CIL) for the peer review, which listed specific items that are critical to the successful completion and function of the construction project. The intended purpose of the CIL was to assist the IEPR Panel and focus their review. The CIL considered:

- Information provided at the USACE Teleconference Orientation Briefing for the I-10 and I-310 Crossings project on July 23, 2009
- GNOHSDRRS Design Guidelines, dated June 2008
- GNOHSDRRS Quality Management Plan, dated February 29, 2008.

The development of a CIL is important to conducting an analysis of critical components, subcomponents, or systems whose malfunction can cause a cascading failure of the entire structure and pose a risk of serious injury, loss of life, or loss of mission objectives. The CIL is a living document that the IEPR panel members could continue to develop throughout the life of the project to focus the review of the design documents and construction activities towards critical issues. With the aid of the CIL, a more effective and efficient peer review could be conducted because the IEPR Panel was able to focus on those items that must not fail, rather than reviewing all details of design or construction. An example of a critical item for the I-310 project is provided in Figure 1.

Figure 1. Example of a Critical Item from the CIL (Structural Engineer)

I-310 Crossing, LPV 06e.2—Critical Item List			
1	**Component Name**	Concrete Floodwall (proposed new T-Wall) and I-310 Bridge	
2	**Component Function**	1) Control flood water from entering the protected side 2) Provide transportation for I-310 traffic over the flood protection system	
3	**Failure Mode** **a) Design Concept** **b) Present Design Phase**	Overtopping, Seepage, Scouring Differential Settlement, Failure due to Impact load, Overturning	Failure at the monolith -joint/connection, Failure of bridge due to Uplift, Impact, Bending & Shear stresses
		Wall – Loss of stability due to overtopping, dynamic wave loading, high currents, seepage or barge/boat impact	**Bridge** – Uplift, dynamic wave loading, Lateral load due to wave and currents during flooding. Bending & Shear stresses during pile driving operation for new flood wall, from the top of the bridge
4	**Cause of Failure**	Breaking waves on the wall and the bridge – (Dynamic wave loading not accounted adequately in the design)	Wave slamming on the flood wall & the bridge. Effect of buoyancy on the bridge structure up-lift. (Dynamic wave loading not accounted adequately in the design)
		Seiches or standing waves in the lake during a hurricane	Under estimation of the Barge/boat Impact loading in the design. Pile driving from top of the bridge, construction staging area may add loads beyond allowable loading for the bridge
		High velocity currents during the overtopping	Soil settlement under the flood wall
		Loss of bearing soil at the side and the base of the structure	Underestimating or neglecting the appropriate loading conditions in the design.
5	**Effects of Failure**	Loss of structural stability or complete structural collapse	Loss of flood protection
		Potential large scale flooding of the nearby communities	High Negative Economical Impact in the area affected by the flooding
		Loss of means for transportation for I-310 traffic	Bridge may collapse and damage the flood wall in case of its failure
6	**Criticality of Effects**	Loss of flood protection and large scale flooding of communities (Severe) Loss of Structural Stability or Complete Collapse (Severe) Loss of means for transportation for I-310 traffic (moderate)	
7	**What are the safeguards against significant failures:** **a). Redundancy** **b). Resilience** **c). Robustness**	Conservative design considering all the possible loading conditions including hydrodynamic loadings, currents, buoyancy, realistic impact loadings, etc. described above. Using proper Soil-Structure Interaction model and methodology to ensure adequate foundations design for the flood wall. Pile Driving for new flood wall from the bridge should be thoroughly evaluated to ensure structural integrity of the bridge. Contractor shall not use the bridge to store material and equipment during the pile driving operation.	
		Proper use of design and construction methodology.	
		Use of proper hydrodynamic loading and realistic barge/boat impact load in the design.	

2.5 Conduct of the Peer Review

The review of the I-10 and I-310 Crossings project was conducted according to the schedule shown in Table 1. Reviews of the 95% project documents resulted in comments that were entered separately into DrChecks[SM] (Design Review and Checking System) under the I-10 or I-310 project. For each review, the IEPR panel members focused on the following:

- Conducting a broad overview of the 95% design documents in the panel member's area of expertise and technical knowledge.
- Identifying, explaining, and commenting on assumptions that underlie engineering or scientific analyses.
- Evaluating whether the interpretations of the analyses and conclusions were reasonable.
- Reviewing scientific information, including factual inputs, data, the use and soundness of models, analyses, assumptions, and other scientific and engineering matters that inform decision makers.

Consistent with USACE guidance to maintain independence and control, the IEPR panel members were not permitted to have direct or unmonitored e-mail or phone contact with the USACE Project Delivery Team (PDT). All interaction between the IEPR panel members and USACE occurred either in DrChecks[SM] or via teleconference with Battelle and a USACE representative present.

Below is a description of each review that was conducted.

I-310 Crossings Project

The panel members were provided with hard and electronic copies of the 95% project review documents for the I-310 Crossings project. The IEPR panel members produced 22 individual comments on the I-310 Crossings project, which were input into DrChecks[SM] on August 14, 2009. Seven of the comments on the I-310 project were marked as critical. USACE completed its initial Evaluator responses by January 29, 2010 and the panel members conducted an initial round of Backcheck responses (i.e., responding to USACE Evaluator responses) and comment resolution (i.e., comment close out). An IEPR review teleconference was held between the USACE PDT and the panel members on February 9, 2010 to discuss some of the comments and possible changes. The IEPR panel members entered their initial Backcheck responses in DrChecks[SM] on February 14, 2010. USACE provided additional evaluation responses through March 22, 2010 and the panel members entered the final Backcheck responses in DrChecks[SM] through November 21, 2010.

I-10 Crossings Project

The panel members were provided with hard and electronic copies of the 95% project review documents for the I-10 Crossings project. The IEPR panel members produced 17 individual comments on the I-10 Crossings project, which were input to DrChecks[SM] on February 8, 2010. USACE completed its initial Evaluator responses by April 1, 2010 and the panel members conducted an initial round of Backcheck responses and comment resolution. An IEPR review teleconference to discuss some of the comments and possible changes was held on May 12, 2010. The IEPR panel members entered their initial Backcheck responses in DrChecks[SM] on May 24, 2010. USACE provided additional evaluation responses through July 6, 2010 and the

panel members entered the final Backcheck responses in DrChecks[SM] through November 21, 2010.

Critical Comments

In total, the panel members produced 39 individual comments across the two reviews. Of these, the panel members developed seven comments that they considered critical. In addition, three comments were identified during the IEPR review teleconference. Critical comments are defined by the Water Resources Development Act (WRDA) 2007 (Public Law 110-114), Section 2035 (i.e., Type II IEPR), as being associated with issues that address public safety, health, and welfare.

2.6 IEPR Review Teleconferences

Battelle led two IEPR review teleconferences, one for each crossing project, between members of the USACE PDT who responded to the DrChecks[SM] comments and the IEPR panel members. Each IEPR review teleconference provided an interactive forum for a discussion of those comments that the IEPR panel members considered inadequately addressed, or for which the USACE requested further discussion. The teleconferences also provided an opportunity for the IEPR panel members to further discuss some of the responses from the USACE PDT. Overall, the IEPR review teleconferences were successful in clarifying and resolving many of the issues. Both the panel members and USACE PDT had some comments that needed further response, but in general, at the conclusion of the teleconferences, the IEPR panel members considered most of their comments adequately addressed or would be addressed pending additional information provided by the USACE PDT.

Table 2 is an example of an IEPR panel member comment that was entered into DrChecks[SM], evaluated by the USACE PDT, further discussed by panel members, and then agreed upon and closed out.

Table 2. Example of IEPR Panel Member Review [1] and USACE PDT Evaluator Entries in DrChecks[SM]

Id	Discipline	DocType	Spec	Sheet	Detail
2707269	Hydraulics	Design Analysis	Page 29, Scour Protection	n/a	n/a
(Document Reference: I-10 & I-310 Floodwall Overtopping Analysis) A more complete documentation of the overtopping analysis is required. During a teleconference on August 10, it was indicated that the analysis was completed in 2007, and the report would be made available for review of the assumptions and processes. At the time of this review comment, the modeling report was not available for my review. A review of this document is essential to make a constructive comment. Submitted On: 17-Aug-09					
1-0	**1-0** Evaluation **For Information Only** Documentation on overtopping can be found in the Interim Report, "Hurricane and Storm Damage Reduction System Design Guidelines", dated October 2007, and the report, "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", October 2007. A link to both documents is located on the HSDRRS Design Guidelines website at http://www.mvn.usace.army.mil/eng/hurrdesign.asp Submitted On: 16-Jan-10				
1-1	BackCheck Recommendation : **Open Comment** I am one of the Hydraulic Reviewers of the HSDRRS Design Guidelines. I am familiar with that document which				

Id	Discipline	DocType	Spec	Sheet	Detail
2707269	Hydraulics	Design Analysis	Page 29, Scour Protection	n/a	n/a
	is currently going through the comments-responses-BackCheck responses. I reviewed the HEC-RAS and HMS models that were completed in 2007. This document was provided to us after I entered the comments into the Dr.Checks. I have the following comments on the hydraulic analysis models (primarily based on the HEC-RAS & HMS models). 1. The models have been implemented for a 10-year, 24-hour storm event (rainfall event) for the Lower LaBranche wetland. This should have been 100-year event. Please explain and provide the reasoning. 2. The hydrograph was added to the model (I interpreted HEC-RAS) through a single inflow at cross section station 27923. This is located downstream of the I-310 intersection. Why was the runoff hydrograph added downstream of the intersection, while a significant portion of the wetland is located upstream of the I-310 crossing? This assumption eliminates the impact of wetland on the flood wall at the I-310 crossing. Please explain and provide the reasoning. 3. The hydraulic computation related to scour is not included in the report. The scour analysis and hydraulic design go hand-in-hand, which needs to be addressed as part of the hydraulic analysis. Submitted On: 14-Feb-10				
2-0	Evaluation **For Information Only** EM 1110-2-1413 (Hydrologic Analysis of Interior Areas) reads "If a local storm drainage system is in existence, then the minimum facility should pass the local system design event with essentially no increase in interior flooding." The minimum facility was equated to the design event for which the interior pump station(s) or drainage structures have been sized. The interior drainage system and pump stations for Jefferson and Orleans Parishes that pump into the Harvey and Algiers Canals have been designed for the 10% exceedance 24-hour extratropical rainfall event under the Southeast Louisiana (SELA) authorization. Thus, a rainfall event of the same magnitude and duration was selected for the modeling effort. Regarding the modeling inflow question, the placement of the inflow hydrograph was not very significant since the overtopping was not found to route into the wetland storage area. The overtopping volume was found to have minimal impact on the channel. If we consider the wetland south of Hwy 61, there are no major boundaries to interfere with wetland interconnectivity on the east and west sides of the I-310 overpass. Therefore, if we apply a much larger overtopping volume of water to the channel, both sides of the wetland could potentially be storage. Submitted On: 22-Mar-10				
2-1	BackCheck Recommendation **Close Comment** The 10% exceedance condition (instead of 1% exceedance in accordance with the design guidelines)should be clearly documented in the design report along with the compelling reason as stated above. Submitted On: 21-Nov-10				
	Current Comment Status: **Comment Closed**				

Note: Output modified to remove attribution of comment to any individual peer reviewer.

2.7 IEPR Final Report

After concluding the IEPR and closing out the final IEPR panel members' comments in DrChecks[SM], Battelle prepared a final report on the overall IEPR process and the IEPR panel members' project findings. Both IEPR panel members reviewed and commented on the report, and the report was subject to an editorial and technical review by Battelle, before submission to USACE.

3.0 IEPR PANEL MEMBER SELECTION

Potential IEPR panel member candidates were identified through Battelle's IEPR expert database, trade organizations, engineering societies, targeted internet searches using key words (e.g., terms focusing on technical area and geographic region), search of websites of universities

or other compiled expert sites, and through referrals. Both IEPR panel members selected for the final IEPR Panel met all three of the following minimum requirements:

- Registered professional engineer (P.E.) (or equivalent in home country)
- Masters degree
- 20 years of experience and responsible charge of engineering work.

Panel members in each discipline also were required to have specific technical experience in the areas summarized in Table 3 below.

Table 3. Required Technical Experience for IEPR Panel Members

Discipline (# of Reviewers)	Required Experience
Hydraulic Engineer (1)	• Hurricane surge and wave generation • Navigational hydraulics
Structural Engineer (1)	• T-wall and L-wall floodwall design • Wave impact/armoring

Battelle submitted to USACE a draft list of panel members that were screened for availability, technical background, and COI. The final list of IEPR panel members was determined by Battelle (Table 4) based on their specific experience in the areas of expertise specified in the scope of work (Table 5).

Table 4. Final List of IEPR Panel Members

Discipline/Name	Affiliation	Location	Education	P.E.	Years of Experience
Hydraulic Engineer					
Bijay Panigrahi	BPC Group, Inc	Orlando, FL	BS AgEng, ME-Hydraulics, MSCE, PhDCE	Yes	28
Structural Engineer					
Jay Jani	Engineering Consulting Services, Inc.	Metairie, LA	BECE, MSCE, PhD (Ocean Engineering)	Yes	25+

Table 5. Specific Experience of IEPR Panel Members Requested in the Scope of Work

Expertise	Total	Jay Jani	Bijay Panigrahi
General Experience			
Planning	**1**		X
Design	**2**	X	X
Construction	**2**	X	X
Structural Engineer (1)		**1**	
Sector gates subject to high wind and wave loading	**1**	X	
T-wall and L-wall floodwall design	**1**	X	
Hydraulic Engineer (1)			**1**
Hurricane surge and wave generation	**1**		X
Navigational hydraulics	**1**		X
Construction Experience			
Constructability of proposed designs	**2**	X	X
QC/QA requirements and testing	**1**		X[a]
Field experience verifying that projects are being constructed as designed	**1**		X
Plans and specifications	**2**	X	X
Worked on at least five multi-million dollar projects (number of projects)	**1**	X (>5)[b]	[c]

[a] QC/QA (quality control/quality assurance) experience was associated with earthen berm, sheet pile, roadways, and parks.
[b] Field experience primarily related to the installation of off-shore structures.
[c] Dr. Panigrahi's construction experience has included four environmental and stormwater projects (less than $1M, construction costs), one $1.3M project, and one $7M project (although he was only responsible for a small civil portion of this project). However, he will be providing the construction inspection and field QC/QA testing for two multi-million dollar projects for the South Florida Water Management District that are expected to begin in early 2011.

A summary of the credentials and IEPR-related qualifications of the two panel members selected for the IEPR project is presented below. Resumes of the panel members with more detailed biographical information and technical areas of expertise are included in Appendix A.

Dr. Jay Jani, P.E., is a licensed Professional Engineer. He has worked as a structural engineer and has over 25 years of design experience in civil and marine/offshore engineering industries. Dr. Jani founded his firm, Engineering Consulting Services, Inc., in 1990. Since then, Dr. Jani has served as the President and Senior Structural Engineer of Engineering Consulting Services, Inc., and has worked on a variety of structural design and assessment projects, as well as performed independent technical reviews (ITRs) for several structural design projects in the New Orleans area. For example, Dr. Jani performed the ITRs of the structural design of T-walls for several pumping stations in New Orleans, as well as reviews of the Inner Harbor Navigational Canal Replacement Lock, Riverside Gatebay Module and the Harvey Canal Flood Wall Design in New Orleans. Dr. Jani has also performed the structural design of weather station equipment support structures and lateral support systems at various canals in New Orleans, Louisiana. Dr. Jani served as Chairman and Vice Chairman of American Society of Civil Engineer (ASCE)-Structural Engineering Institute, New Orleans Chapter, during the 2008-2009 and 2007-2008 terms, respectively. He also served as an adjunct faculty in the Civil Engineering Department at University of New Orleans.

Dr. Bijay K. 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, water quality assessment and 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 of CERP (Comprehensive Everglades Restoration Plan) 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. Some of these projects include Site 1 Impoundment, Four-Corner site flow-way design, Southwest Florida Feasibility studies, C-51 Basin Rule, C-139 Regulatory Criteria development, and Everglades Agricultural Area watershed data evaluation, among others. On behalf of the Interagency Modeling Center (IMC), he has peer reviewed more than 20 models for the CERP projects that included a diversified array of issues involving hydrology, hydraulics, hydrodynamics, water quality, operations, optimizations, flood control, water supply, and design of water resources facilities. Some of these projects include Biscayne Bay Coastal Wetlands, Lower East Coast sub-Regional (LECsR) model, C-11 and C-9 Impoundments, C-44 Canal Design, and STA 5&6 Expansion.

4.0 RESULTS – SUMMARY OF REVIEW

The IEPR panel members followed the Battelle processes described in Sections 2.3 through 2.6 to conduct their review, participate in the IEPR teleconferences, and to finalize remaining comments in DrChecks^{SM}. These processes were in accordance with USACE guidance documents. Listed below are summaries of how the IEPR panel experts (respective of their different disciplines) approached their reviews, comments made by the panel members, and the status of any open issues, including critical items.

4.1 Overall Review Approach

This section describes how the IEPR panel members approached their reviews and documented their comments in DrChecks^{SM}. The IEPR panel members were encouraged to work individually according to their assigned expertise and to contribute to the reviews being conducted by the reviewer in the other discipline, as appropriate based upon their experience. In general, the reviewers worked individually in reviewing the 95% IEPR review documents; however, project discussions were held between IEPR panel members throughout the IEPR review process. For instance, IEPR panel members discussed their comments with each other prior to input of their comments in DrChecks^{SM} or prior to IEPR conference calls. Note, the scope of work requested the panel members assess the uplift and overtopping of the flood protection for the interstate bridges; however, as the panel members considered scour protection to also be an important component of the project, this item was included in their review.

Hydraulic Engineering Review Approach
During the review of the project documents, the hydraulic engineer focused on the following concerns:

- Does the hydraulic design result in an adequate estimation of flows, stages, and wave heights?
- Does the design consider loads resulting from the wave surge?
- Does the flow velocity and scour loss affect the slope and bottom of the floodwall?
- Does the design consider loss of flood protection or damage to flood protection system that may cause loss of life and/or property damage?
- Does the project address redundancy, resilience, and robustness of the hydraulic system (i.e., adequate safety factor in design parameters; diligence in construction quality control and QA procedures; incorporation of adequate post-construction long-term monitoring/engineering inspection; comprehensive design analyses)?

Structural Engineering Review Approach
The primary objective of the structural engineer was to assess the structural integrity of the proposed floodwalls at I-10 and I-310 crossings subjected to storm surge and other associated loading conditions. The structural engineering review mainly focused on the following major issues:

- Does the design provide adequate structural integrity to the floodwalls and components?
- Is the structural design based on sound engineering and hydrodynamic principles and data?
- Does the design account for the safety of life and property in the protected areas?

4.2 Summary of IEPR Panel Comments

The IEPR Panel comments made during the I-10 and I-310 Crossing project review have been placed into four categories (some into more than one category) based on the response provided by the USACE PDT. These categories include:

- For Information Only – comments for which the IEPR panel member either (1) requested a clarification narrative from the USACE, or (2) received further explanation or additional documents that allowed the IEPR panel member to agree with the USACE approach.
- Suggestion for Clarification – minor, but important suggestions to improve the document's completeness and/or clarity.
- Value Added – comments that resulted in a significant impact or change that would not have happened without the IEPR review.
- Open Comments – unresolved issues that the IEPR panel members and the USACE PDT could not determine a resolution.

Table 6 provides a summary of the number of comments in each of the above four categories, as well as the number of critical comments identified initially and after the IEPR teleconference.

Table 6. Categorized DrChecks^{SM} Comments

Review	Total Comments	Initial Critical Comments	Critical Comments Identified after the IEPR Teleconference	For Information Only	Suggestion for Clarification	Value Added	USACE PDT Open Comments
I-10	17	0	3	8	3	0	4
I-310	22	7	0	17	3	0	8

Following are summaries of the types of comments provided in DrChecks^{SM} for each of the reviews and the resulting USACE evaluations (i.e., concurred and non-concurred). Table 7 provides a summary of the comments and USACE PDT responses by discipline.

Table 7. Total IEPR Panel Comments and Initial USACE PDT Evaluation Responses

IEPR Panel Member Comments by Discipline	Initial USACE PDT Evaluation			
	Total Comments	Concurred	Non-Concurred	For Information Only
Structural				
• I-10	13	5	4	4
• I-310	18	1	4	13
Hydraulic				
• I-10	4	0	0	4
• I-310	4	0	0	4
Subtotal				
• I-10	17	5	4	8
• I-310	22	1	4	17
Total	39	6	8	25

4.3 Discussion of Comments

During review of the 95% project documents, the IEPR Panel developed 39 comments on the I-10 and I-310 Crossing projects. In general, the IEPR panel members recommended additional details/clarifications or analysis be conducted to improve the design of the I-10 and I-310 Crossings.

Below are those items noted by the IEPR Panel as the most important concerns:

- It is not clear if the wave characteristics (Hs, T, etc.) were adjusted from those used for the Mississippi River-Gulf Outlet (MRGO).
- The results of the latest Barge Impact Study should be used to estimate boat/barge impact load on the floodwall.
- The structural integrity of the bridges should be evaluated beforehand and monitored during construction staging and pile driving activities.
- The floodwall design should consider that high velocity currents during an overtopping event may impose an additional lateral load on the floodwall.

- It is not clear if the designers considered the possibility of seiches and standing waves in the lake during a hurricane in the design.
- It is not clear if the designers evaluated the potential soil scour and scour depth for both floodwall and the bridge piers.
- The floodwall design should consider the 10% exceedance condition (instead of 1% exceedance in accordance with the design guidelines), the 100-year storm event, and the 500-year storm surge.

I-310 Crossings

Using the CIL as a guide, the IEPR panel members produced 22 individual comments on the I-310 Crossings project; these were input to DrChecks[SM] on August 14, 2009. Seven of the comments on the I-310 Crossings project were flagged as critical. All comments were subjected to a quality assurance (QA) review by Battelle prior to submission to USACE to ensure clarity and lack of redundancy.

The USACE PDT reviewed, evaluated and responded (i.e., concurred or non-concurred) to the IEPR comments in DrChecks[SM] with 17 comments designated as For Information Only (5 critical issues), 1 Concurred, and 4 marked as Non-concurred (2 critical issues). After USACE completed its initial Evaluator responses, the IEPR panel members were instructed to prepare draft Backcheck responses with Concur (i.e., comment resolution or comment close out) or Non-concur, including a written response to the USACE Evaluator response. Battelle held a teleconference with the IEPR panel members to discuss the initial Evaluator responses and the IEPR Panel's draft Backcheck responses. Battelle then conducted an IEPR review teleconference for the USACE PDT and IEPR panel members to discuss unresolved comments with each other.

Because of the IEPR review conference, there was immediate resolution and close out for 7 of the 22 comments and 15 comments required a second round of comment/response. In a second round of DrChecks[SM] responses, the USACE PDT responded to 8 of the remaining comments as follows: 5 responses with a recommendation to close (1 critical issue), 2 Concurred (1 critical issue), and 1 Non-concurred (1 critical issue). In addition, there were 7 comments where a response was not received from the USACE PDT Evaluator, including 1 critical issue. The IEPR Panel closed out the 7 unresolved comments as follows: 2 were closed with comment, including 2 marked as critical issues; 5 were closed without comment, including 3 marked as critical issues.

I-10 Crossings

The IEPR panel member produced 17 individual comments on the I-10 project that were input to DrChecks[SM] on February 8, 2010. None of the comments on the I-10 project was deemed critical; however, two comments were identified as critical items in the comment statement. All comments were subjected to a quality assurance (QA) review by Battelle prior to submission to USACE to ensure clarity and lack of redundancy.

The USACE PDT reviewed, evaluated and responded to the IEPR comments in DrChecks[SM] with 8 comments designated as For Information Only (including 1 request for information and 2 non-responses), 5 Concurred, and 4 Non-concurred. After USACE completed its initial

Evaluator responses, the IEPR panel members were instructed to prepare draft Backcheck responses with Concur or Non-concur response to each comment. Battelle held a teleconference with the IEPR panel members to discuss the initial Evaluator responses and the IEPR Panel's draft Backcheck responses. Battelle then conducted an IEPR review teleconference for the USACE PDT and IEPR panel members to discuss unresolved comments. Because of the IEPR review conference, there was immediate resolution and close out for 7 of the 17 comments, while 10 comments required a second round of comment/response. In addition, three comments were designated as critical; two contained "critical" in the original comment statement, plus one comment identified during the IEPR review teleconference.

Summary of IEPR Panel Comments

In this section of the report, the issues that the panel identified as important or critical to the success of the I-10 and I-310 Crossings project are discussed.

I-310 Crossings

- Seven comments closed in initial comment/response process, including 3 marked as critical issues
- 15 comments required a second round of comment and response
- All 15 comments requiring a section round of consideration were closed; however, 7 of the 15 comments were unresolved. Although the panel members requested further information or clarification on these comments, there was no response from the USACE Evaluator.
- For the seven unresolved comments, the panel member provided a response for the record describing measures that should be incorporated into the 95% design for appropriate safety assurance.

I-10 Crossings

- 11 comments closed in initial comment/response process
- Six comments required a second round of comment and response
- All 6 comments requiring a second round of consideration were closed and were resolved as follows: 3 were closed with comment, 1 comment was withdrawn, and 2 were closed without comment.

4.4 Critical Comments and any other Open Issues that Remain to be Resolved

At the close of the comment/response process, the panel members felt that 32 of the comments had been adequately addressed and these comments were closed in DrChecks^{SM}. However, the IEPR panel members did not consider some of the comments to be fully addressed by the USACE PDT responses, as the actual questions were not directly answered (e.g., responses to the comments on scour only indicated that this issue was not part of the IEPR review). For the 7 comments that were not adequately addressed in the I-310 Crossings project, the panel members provided a response describing measures that should be incorporated into the 95% design.

In general, the IEPR panel members agreed that the numerical modeling results developed for and provided in the 95% review documents for the project design are acceptable subject to the following recommendations:

- Adjust wave characteristics (Hs, T, etc.) from those used for the MRGO.
- Estimate boat/barge impact load on the floodwall using the results of the latest Barge Impact Study.
- Evaluate and monitor the structural integrity of the interstate bridges during construction staging and pile driving loads.
- Consider that high velocity currents during an overtopping event may impose an additional lateral $_{v}$load on the floodwall.
- Consider the possibility of seiches and standing waves in the lake during a hurricane in the design.
- Evaluate the soil scour and scour depth for both floodwall and the bridge piers.
- Consider the 1% exceedance in accordance with the design guidelines, the 100-year storm event, and the 500-year storm surge in the design of the floodwalls.

5.0 CONCLUSIONS

Battelle established criteria for the selection of the panel members using defined technical and engineering expertise, conflict of interest criteria, and the Battelle established IEPR process developed in strict compliance with USACE peer review guidance documents, and in the Battelle Peer Review Quality Control Plan.

The IEPR panel members were provided with hard and/or electronic copies of the 95% design documents and supporting documentation. On July 23, 2009, the panel members participated in an Orientation Teleconference with the USACE PDT where they were briefed on the I-10 and I-310 Crossings project. The IEPR panel members produced 39 individual written comments. These comments were initially discussed between the panel members and the USACE PDT during an IEPR review teleconference held on February 9, 2010 for the I-310 Crossings project and on May 12, 2010 for the I-10 Crossings project. It should be noted that the scope of work requested the panel members assess the uplift and overtopping of flood protection for the interstate bridges; however, as the panel members considered scour protection to be an important component of the project, this item was included in their review. Examples of IEPR panel member recommendations include requests for the addition of detail to improve the design include the following:

- Adjust wave characteristics (Hs, T, etc.) from those used for the MRGO.
- Estimate boat/barge impact load on the floodwall using the results of the latest Barge Impact Study.
- Evaluate and monitor the structural integrity of the interstate bridges during construction staging and pile driving loads.
- Consider that high velocity currents during an overtopping event may impose an additional lateral $_{v}$load on the floodwall.
- Consider the possibility of seiches and standing waves in the lake during a hurricane in the design.
- Evaluate the soil scour and scour depth for both floodwall and the bridge piers.
- Consider the 1% exceedance in accordance with the design guidelines, the 100-year storm event, and the 500-year storm surge in the design of the floodwalls.

The remaining IEPR panel members' comments focused on recommendations to clarify the design documents and ensure consistency among future designs.

The USACE PDT evaluated and responded to all 39 IEPR Panel comments: they concurred with 6 comments, agreed to provide additional information in support of 24 comments, and non-concurred with 8 comments, providing an explanation with each. Upon review of the USACE PDT responses, the IEPR panel members determined that some comments were inadequately addressed and needed further discussion. Therefore, IEPR teleconferences were conducted for the IEPR Panel and USACE PDT to discuss those comments that were identified by the Panel as being inadequately addressed.

The IEPR review teleconferences conducted provided an effective interactive voice medium to communicate and discuss IEPR panel member review comments with the USACE PDT interactively and in real time. The IEPR review teleconferences were critical components of the independent peer review process, in consideration of the requirement for no direct e-mail or telephone contact between the USACE PDT and the IEPR panel members without specific facilitation by the USACE PCX and Battelle. The IEPR review teleconferences provided resolution of multiple technical and engineering issues included in DrChecks^{SM}.

Upon completion of the IEPR teleconferences and subsequent evaluations by the USACE PDT, the IEPR panel members considered many comments adequately addressed and these comments were closed. However, the Panel did not consider some of the comments to be fully addressed by USACE responses, as the actual questions were not directly answered (e.g., responses to the comments on scour only indicated that this issue was not part of the IEPR review). For the seven unresolved comments on the I-310 Crossings project, the panel member provided a response for the record describing measures that should be incorporated into the 95% design for appropriate safety assurance.

In general, the IEPR panel members agreed that the I-10 and I-310 Crossings project contains very important design revisions to prevent overtopping of the existing bridges. The panel members appreciated that the design methods and criteria in the I-10 and I-310 Crossings project are not considered final by USACE, but rather are subject to learning and evolutionary improvement. However, the IEPR panel recommends revisions and/or further evaluation to the issues noted in DrChecks^{SM} during the IEPR process.

Appendix A. IEPR Panel Member Resumes

This page intentionally left blank

Jay Jani, Ph.D., P.E
Structural Engineer

Experience
25+ years

Expertise
Structural design
Structural integrity assessment

Education
Ph. D., Ocean Engineering (Major: Structural Engineering) Florida Atlantic University, Boca Raton, 1990
M.S., Civil Engineering (Major: Structural Engineering) Carnegie-Mellon University, Pittsburgh, 1984
B.E., Civil Engineering (Major: Structural Engineering) University of Bombay, Bombay, India,1982

Registration
Professional Engineer, Louisiana, 1997
Engineer-In-Training, Pennsylvania, 1983

Special Skills
Extensive software experience:
(i) *ALGOR, COSMOS, MARC, ADINA* -Finite Element Analysis (FEA) Packages
(ii) *RISA-3D* - Interactive 3-D Structural Analysis Software Package
(iii) *MicroSAS, and PIPELAY* - McDermott's in-house Software programs for Structural Design & Analysis of Offshore Structures, and analysis related to Marine Pipe-Laying respectively
(iv) *MOSES* – Naval Architectural/ Ocean Engineering Analysis Package
(v) *AutoPipe* – Pipeline Stress Analysis Package
(vi) *AGA I & II* - Submarine Pipeline On-Bottom Stability Analysis Software Package
(vii) *Caesar II* - Pipeline Stress Analysis Package
(viii) *MathCad*

Summary of Experience

Dr. Jani is president and senior structural engineer, Engineering Consulting Services, Inc., in Metairie, Louisiana. He has extensive experience in structural design for the civil and marine/offshore engineering industries.

Relevant Projects

- Independent Technical Review (ITR) for USACE's Hurricane Protection Project: Structural Design of T-Walls, 56 feet Sector Gate, Pile Foundation, etc. (9% Submittal), "WBV 16.2 Segnette Pumping Station to New Westwego Pumping Station Flood Wall," N-Y Associates, New Orleans, LA.
- Independent Technical Review for USACE's Hurricane Protection Project: Structural Design of T-Walls, Pile Foundation, etc. (100% Submittal), "Fronting Protection at Cousins, Whitney Barataria and Estelle 1 & 2 Pumping Stations," N-Y Associates, New Orleans.
- Independent Technical Design Review for USACE's Hurricane Protection Project: "Reconnaissance Level Study for three (3) Hurricane Protection Alignments Western Tie-in," Jefferson and St. Charles Parishes, Lake Cataouatche Hurricane Protection Levee, N-Y Associates, New Orleans.
- Independent Technical Design Review for USACE's Project: Structural Design of "Inner Harbor Navigational Canal Replacement Lock, Riverside Gatebay Module," Brown Cunningham and Gannuch, Inc., New Orleans.
- Independent Technical Design Review for USACE's Project: Structural Design of "Harvey Canal Flood Walls," URS Corporation, New Orleans.
- International Matex, "Six-Oil" Project: Structural Design of Pipe Bridge (112 feet long), Pipe Racks, Electrical Platform, Reinforced Concrete Pump-Pit Foundation Slab and Containment Wall, Walkway, Pipe Supports, etc., W. S. Nelson and Co., New Orleans.
- Structural design of reinforced concrete pile-foundation of about 56,000 sq. ft. for a proposed new church to be located at Marrero, LA.
- Structural rehabilitation of a floor slab and the foundation for a commercial building by: (i) designing new reinforced concrete foundation slab and grade beams and, (ii) foundation Under-Pinning using concrete Segmented Piles, New Orleans.
- Structural design for reinforced concrete slab with or without pile foundation for: various carwash structures, vacuum canopy structure, etc., New Orleans.
- Structural design of a reinforced concrete foundation for an 8000 gallon insulated double-wall fuel storage tank, New Orleans.
- Structural design of weather station equipment support structure at various canals in New Orleans, Sutron Corporation, Sterling, VA.
- Residential structural assessment of more than 225 houses, to determine the extent of structural damage caused by hurricane-Katrina to the houses in New Orleans, a Federal Emergency Management Agency/Shaw Project, New Orleans.
- Structural integrity assessment of various shutters, doors, framings, etc.,

Professional Affiliations

ASCE, member
ACI, Louisiana Chapter
ASCE-SEI, New Orleans Chapter,
Chairman, 2008-2009
Vice Chairman, 2007-2008

Adjunct faculty, Dept. of Civil Engineering at University of New Orleans

for various wharf structures in Port of New Orleans, to determine the extent of structural damage caused by hurricane-Katrina, Port of New Orleans, Hurricane Reconstruction Program, BP Americas, New Orleans.

- Structural design of a proposed new casino building, and a food court building to be constructed in Baton Rouge, Louisiana, using PolySteel Form, Insulated Concrete Building System. Also designed roof system for both the structures using Vulcraft Steel Joists.
- Structural integrity assessment of all phases of offshore platform design for various projects including in-place analysis, transportation analysis, installation engineering (lift analysis, lift rigging design, etc.), pile foundation design, earthquake analysis of offshore platforms, etc., J.Ray, McDermott, Inc., New Orleans.
- Analysis and structural integrity assessment of Shell's Na Kika hull pipe support design based on PDMS model. Consultant to Deepwater Consultant Alliance (DCA), New Orleans.
- Design and analysis of A&R and SCR hooks for several deepwater pipeline installation projects, using J. Ray McDermott's J-Lay System. The pipeline hook design included a 775 Kips capacity A&R hook for one of Shell's subsea pipeline projects. Also performed a finite element analysis for 775 Kips hook, using 'COSMOS' FEA software to study the stress distribution in the hook in a more comprehensive manner.
- Reassessment of PEMEX's Bay of Campeche platforms and subsea pipelines. Responsibilities involved evaluation of structural integrity of potentially unstable marine pipelines subjected to a 100-year storm condition. The analysis included: (i) assessment of on-bottom stability of the pipelines subjected to a 100-year storm condition; (ii) determination of hydrodynamic loads; (iii) determination of the soil friction and passive resistance; (iv) estimation of maximum lateral movement and bending stress in the pipelines caused by a 100 year storm condition. Also performed a 1000-year return period earthquake analysis for the ductility assessment of Pemex's CA-AC-1 platform.
- Worked on all phases of structural design engineering in the field of offshore marine construction including: (i) analyses of offshore oil/gas pipelines; (ii) earthquake analysis of offshore platforms; (iii) installation engineering, including jacket/deck tow-safety analysis, jacket and deck lift analyses, hook evaluations, jacket/deck/pile tie-down design, jacket on-bottom stability analysis, barge structural integrity assessment, etc.
- Worked on all phases of naval architecture and structural design engineering in the field of offshore marine construction including mating of the deck-hull of Shell's "Auger" Tension-Leg-Platform (TLP), analyses off lateral mooring system for TLP-hull, deck transportation analyses, and miscellaneous installation procedures for "Auger" TLP installed in a water depth of 2,860 ft. in the Gulf of Mexico.

Bijay K. Panigrahi, Ph.D., P.E., P.G., D.WRE

Hydraulic Engineer

Experience

28+ years

Expertise

Civil engineering
Geotechnical engineering
Environmental engineering
Water resources engineering
Ground water-surface water modeling
Peer review, expert testimony, and litigation support

Education

Ph.D. Civil Engineering, Drexel University, 1985
M.S. Civil Engineering & Geology, Oklahoma State Univ., 1981
M.E. Hydraulics Engineering, Asian Inst. of Tech., Thailand, 1978
B.S. Agricultural Engineering, Orissa Univ. of Ag. & Tech., India, 1976

Registration

Professional Engineer: Florida, Virginia, Michigan
Professional Geologist: Florida, North Carolina
Diplomate, Water Resources Engineering – AAWRE
Certification: HAZWOPER (29CFR 1910)

Special Skills

Extensive knowledge/experience with the following models/ software:
WASH123D, MIKESHE/11, ICPR, MODBRANCH, MODFLOW, SEEP2D, HEC-RAS/HMS, MT3D, BASINS, SWMM, LOWCAP, RSM, FLONET, GMS, ARCInfo, Statistics/ Geostatistics packages
Instructed and co-instructed a number of continuing education courses and training seminars nationwide including surface water and ground water modeling.

Professional Affiliations

Member, Florida Board of Professional Engineers, Gubernatorial Appointment, 2008-2011

Treasurer and Governing Board

Summary of Experience

Dr. Panigrahi, the president and principal engineer of BPC Group Inc. in Orlando, Florida, has more than 28 years of experience in the specialty areas of environmental, geotechnical and water resources engineering, including planning and design services and ground water and surface water modeling. He has directed and managed numerous multidisciplinary projects involving hydraulics and hydrologic modeling, stochastic modeling, flood protection studies, feasibility studies, stormwater management system design, water quality assessment and modeling, geotechnical and environmental design and studies, seepage and slope stability analyses, foundation analyses, scour and erosion control, water resources facility design, ecosystem restoration, and permitting. He has assessed and designed a number of canal conveyance systems and water resources control structures such as levees/dikes, gated spillways, weirs, culverts, reservoirs, and treatment systems.

Relevant Projects

- Served as an Independent External Peer Reviewer (IEPR) in Hydraulics Engineering for the Greater New Orleans Hurricane Storm Damage Risk Reduction System (HSDRRS) Desgn Guidelines document of June 2008. This work was completed for the USACE through a contract with Battelle.
- Peer reviewed 30+ hydraulic-hydrologic-hydrodynamic models on behalf of the IMC/SFWMD, which included surface water, ground water, integrated SW-GW, seepage, and watershed water quality models such as WASH123, SWMM, MODFLOW, LECsR, MIKESHE, HEC-HMS & RAS, RMA, SEEP2D, MODBRANCH, FESWMS, LOWCAP, and WaSh among others. Some of the projects included Biscayne Bay Coastal Wetlands, LECsR, C-11 and C-9 Impoundments, 3A/3B SMA, C-44 Canal Design, Lower Kissimmee Basin Ground Water Model, and STA 5&6 Expansion.
- Completed a feasibility study for repair, protection or replacement of the S-46 water control structure to ensure that this critical coastal structure does not fail. The scope included conceptual design of three alternatives involving scour control, hydraulic control, soil stabilization, and structure replacement. The study and design elements included hydrologc and hydraulic analyses, seepage and stability analyses, conceptual design, permitting requirements, construction scheduling, and cost estimates.
- Completed hydrologic and hydraulic modeling of the C-51 basin including ACME Basin B in support of Basin Rule modifications. Used HEC-HMS/HEC-RAS models for calibration to Hurricane Irene and further basin analyses.
- 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.
- Developed hydrologic-hydrogeologic model for design of the reservoir and the seepage canal for Site 1 Impoundment for SFWMD. Reviewed the hydraulic analyses and wave run analyses for the reservoir design.
- Completed an integrated hydraulic-hydrologic model to simulate the natural systems and future conditions for the Southwest Florida Feasibility Study area (>5000 sq mi) for the SFWMD.
- Developed conceptual engineering plans for the Four County Corner Stormwater Improvement project for the SFWMD that involved 3-mile long

Member, ASCE-EWRI, 2009-2010
Member, Executive Committee, ASCE-EWRI, 2003-2005
Chair, Watershed Council, ASCE-EWRI, 2000-2003 (Vice-Chair, 1999-2000)
Chair, Ground Water Quality Committee, ASCE-EWRI and EED, 1998-2000 (Vice-Chair, 1994-1998; Secretary, 1992-1994)
Chair, Task Group, Contaminated Ground Water Modeling, ASCE-EED, 1991-1993
Blue Ribbon Panel Member, Natural Attenuation of Hazardous Wastes, ASCE, 2002
Blue Ribbon Panel Member, Environmental Site Characterization and Remediation Design Guidance Manual, ASCE, 1998-99
Co-Chair, 5th International Perspective on Water Resources and the Environment, EWRI-ASCE, Marrakech, Morocco, January 2012
Chair, An International Perspective on Environmental and Water Resources, EWRI-ASCE, Bangkok, Thailand, January 2009
Technical Program Co-Chair, An International Perspective on Environmental and Water Resources, EWRI-ASCE, New Delhi, India, December 2006
Program Co-Chair, An International Perspective on Environmental Engineering, Joint CSCE & ASCE International Conference, Niagara Falls, Canada, July 2002
Chair, Technical Program, Integrated Surface and Ground Water Management, ASCE Specialty Symposium, Orlando, May 2001
Control Member, Non-Aqueous Phase Liquids (NAPLs) in Subsurface Environment: Assessment and Remediation, ASCE Conference, Washington, Nov. 1996

Honors/Awards

Engineering Achievement Award Nomination, NSPE, USA; Project: Design of the Subway Tunnel, Baltimore City, 1990

Engineering Achievement Award Nomination, NSPE, USA; Project:

flow-way and 5 weir structures.

- Developed a FEMA-approved floodplain model using ICPR to delineate 100-year floodplain and then to prepare ESRI/ArcView floodplain maps for revisions to FIRM for Lake Notasulga, Texas basin, and Rock Lake basins for the City of Orlando.
- Conducted stormwater structural inventory survey and database development, performed water quality modeling for existing and future conditions including proposed BMPs, and developed 100year floodplain maps for revisions to FIRM for Big Econlockhatchee River basin in Orange County, Florida.
- Provided comprehensive geotechnical and hydrological engineering services for roadways, culverts, bridges, levees and dikes, reservoirs, canals, stormwater treatment ponds, and rapid infiltration basins for a number of projects in Orange, Hillsborough, Lake, and Duval Counties in Florida.
- Provided civil and geotechnical engineering services for Little Wekiva River realignment project, including bank stabilization, seepage and slope stability analyses, foundation analyses for multiple bridge crossings in Orange County, Florida.
- Provided expert testimony and litigation support services for sinkhole projects in Lakeland, Florida and Safe Harbor, Florida.
- Provided expert witness and litigation support services for an accidental fire in a chemical storage and distribution facility in Niles, Michigan containing DNAPLs. Constructed hydrologic and fate-transport models for the project.
- Performed a 3-dimensional shallow aquifer model of a 6.75 square mile area to evaluate the impact of 20± acre stormwater retention pond on a landfill and the cumulative impact on the subject property next to the landfill in Orange County, Florida.
- Designed and recommended an optimal ground water recovery system for a site in Plant City that also involved evaluation of the impacts of the recovery system on Cone Ranch wellfield and the surrounding wetlands using 3-D model (1200 ft deep, 282 sq mi).
- Directed a low-head earthen dike design project in support of a permit application for Lake Micaela in Brandon, Florida. Performed field exploration plan, data evaluation, seepage and slope stability analyses, design of dike, base and sheet pile, construction specification, and QA/QC plan.
- Provided construction inspection services for Northeast Regional Park in Orange County involving pavilion, restrooms, playgrounds, basketball courts, tracks, and paved roadways.
- Provided construction inspections services for Lamb Island dairy remediation site that consisted of berms, grading, and stormwater treatment ponds for the SFWMD.
- Developed a multifunctional water management master plan for hydrologic restoration of the Yucca pens area (57,660 acres). The project consisted of a reconnaissance study of the water characteristics in the basin, a planning level evaluation of the issues relating to water supply,

Design of the Hazardous Waste Landfill, Dow Chemical, 1985

Publications

Authored more than 50 technical manuals, monographs, and papers for peer-reviewed journals and proceedings.

flood protection, water quality, and natural systems. The scope of work included hydrologic and hydraulic analyses and watershed water quality modeling along with conceptual design of alternatives.