

# **Independent External Peer Review: Final Construction Site Visit Summary Report**

## **Hurricane and Storm Damage Risk Reduction System (HSDRRS) Gulf Intracoastal Waterway (GIWW) West Closure Complex (WCC)**

Prepared by  
Battelle Memorial Institute  
505 King Avenue  
Columbus, OH 43201

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 No. 09085/DO No. 0699

December 22, 2011



This page intentionally left blank

## **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 0699, Contract No. W911NF-07-D-0001).

This page intentionally left blank

**SHORT TERM ANALYSIS SERVICE (STAS)**

**Independent External Peer Review:  
Final Construction Site Visit Summary Report**

**Hurricane and Storm Damage Risk Reduction System Gulf Intracoastal Waterway  
(GIWW) West Closure Complex (WCC)**

**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 22, 2011**

**Contract No. W911NF-07-D-0001  
TCN 09085/DO No. 0699  
Scientific Services Program**

The views, opinions, and/or findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

This page intentionally left blank

## TABLE OF CONTENTS

1.	INTRODUCTION .....	1
1.1.	Program Background .....	1
1.2.	Objective .....	1
1.3.	Activities .....	2
2.	IEPR SITE VISIT CONCLUSIONS .....	2
2.1.	Positive Observations.....	2
2.2.	Concerns Raised and Recommendations .....	3
2.2.1	Site Visit #1.....	3
2.2.2	Site Visit #2.....	5
2.2.3	Site Visit #3.....	8
2.3.	Outstanding Issues .....	9

## APPENDICES

Appendix A. Site Visit #1 Report  
Appendix B. Site Visit #2 Report  
Appendix C. Site Visit #3 Report

## ACRONYMS

CECW-CP	Corps of Engineers Civil Works – Coastal Protection
ECI	Early Contractor Involvement
EDC	Engineering During Construction
GIWW	Gulf Intracoastal Waterway
HSDRRS	Hurricane and Storm Damage Risk Reduction System
IEPR	Independent External Peer Review
PDA	Pile Driving Analyzer
PDT	Project Delivery Team
PIT	Pile Integrity Tester
SCADA	Supervisory Control and Data Acquisition
SWP	Spiral Welded Pipe
USACE	United States Army Corps of Engineers
WCC	West Closure Complex
WRDA	Water Resources Development Act



**Independent External Peer Review:  
Final Construction Site Visit Summary Report**

**Hurricane and Storm Damage Risk Reduction System (HSDRRS)  
Gulf Intracoastal Waterway (GIWW) West Closure Complex (WCC)**

**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 (HSDRRS). One of the vital components of this system is the Gulf Intracoastal Waterway (GIWW) West Closure Complex (WCC) project, a combination of navigable flood gates, a pump station, levees, floodwalls, and channels designed to provide a barrier to storm surges and sufficient pumping of interior drainage. USACE utilized the Early Contractor Involvement (ECI) method of project delivery.

Because of the uniqueness and complexity of this project, an Independent External Peer Review (IEPR) of the GIWW WCC project was conducted. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses and engineering utilized for project execution.

Battelle Memorial Institute (hereinafter Battelle), as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels, was engaged to execute and conduct the IEPR of the Greater New Orleans HSDRRS GIWW WCC. The IEPR followed the procedures described in the Department of the Army, USACE guidance *Peer Review of Decision Documents* (Engineering Circular [EC] 1105-2-410) dated August 22, 2008; *Peer Review Process* (Corps of Engineers Civil Works – Coastal Protection [CECW-CP] Memorandum) dated March 30, 2007; *Engineering and Design, Quality Management* (Engineering Regulation [ER] 1110-1-12) dated July 21, 2006; *Engineering and Design, DrChecks* (ER 1110-1-8159) dated May 10, 2001 and *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010.

This final GIWW WCC IEPR construction site visit summary report describes the objective of the three construction site visits and findings of Battelle’s external peer review experts (also known as the Panel or panel members). The three construction site visits were conducted throughout the following time period of the project: July 28, 2010, January 11, 2011, and September 23, 2011.

The purpose of the construction site visits were to allow the IEPR Panel to observe construction activity/progress and commissioning of major project features and testing activity/progress of the mechanical and electrical equipment for the GIWW WCC project. Each construction site visit was conducted over a two-day period: the first day consisted of a project status briefing and a site review; and the second-day consisted of out-briefings of findings to the USACE via in-person meetings or teleconference.

During each site visit, the Panel made observations and raised concerns regarding the construction and/or commissioning of the GIWW WCC, which were documented for each respective site visit in Site Visit Reports #1, #2, and #3 (provided in Appendices A-C). All of

the IEPR panel members indicated the construction site visits were informative and valuable for the IEPR process, even though the site visits were limited in time and scope. Several critical observations were made and discussed during the out-brief meetings held after each construction site visit, which led to Panel recommendations. As of the close of this project, the USACE Project Delivery Team (PDT) had not committed to adopting two of the Panel's recommendations including (1) providing physical protection of the fuel farm electrical service, and (2) specific control system modifications to aid in the prevention of fuel spills from the fuel oil return tanks.

# 1. INTRODUCTION

## 1.1. Program Background

The U.S. Army Corps of Engineers (USACE) is currently designing and constructing the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS). One of the vital components of this system is the Gulf Intracoastal Waterway (GIWW) West Closure Complex (WCC) project, a combination of navigable flood gates, a pump station, levees, floodwalls, and channels designed to provide a barrier to storm surges and sufficient pumping of interior drainage. USACE utilized the Early Contractor Involvement (ECI) method of project delivery.

Because of the uniqueness and complexity of this project, an Independent External Peer Review (IEPR) of the GIWW WCC project was conducted. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses and engineering.

Battelle Memorial Institute (hereinafter Battelle), as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels, was engaged to execute and conduct the IEPR of the Greater New Orleans HSDRRS GIWW WCC. The IEPR followed the procedures described in the Department of the Army, USACE guidance *Peer Review of Decision Documents* (Engineering Circular [EC] 1105-2-410) dated August 22, 2008; *Peer Review Process* (Corps of Engineers Civil Works – Coastal Protection [CECW-CP] Memorandum) dated March 30, 2007; *Engineering and Design, Quality Management* (Engineering Regulation [ER] 1110-1-12) dated July 21, 2006; *Engineering and Design, DrChecks* (ER 1110-1-8159) dated May 10, 2001 and *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010.

This final GIWW WCC IEPR construction site visit summary report describes the objective of the three construction site visits and findings of Battelle's external peer review experts (also known as the Panel or panel members). The three construction site visits were conducted throughout the following time period of the project: July 28, 2010, January 11, 2011, and September 23, 2011.

## 1.2. Objective

The GIWW WCC project is located on the west bank of the Mississippi River near New Orleans, Louisiana. The GIWW WCC project is located west of the Algiers and Harvey canals and is intended to provide a barrier to storm surges and sufficient pumping of interior drainage. The GIWW WCC project consists of the following five major features:

- 19,140 cubic-foot-per-second drainage pumping station containing large mixed-flow, vertical-type pumps;
- 225-foot navigable sector gate;
- Sluice gate;
- Flood wall to protect an area identified as the 404(c) area; and,
- Closure wall to connect the floodwall and the 225-foot sector gate.

The purpose of the construction site visits was to allow the IEPR Panel to observe construction activity/progress of the major features listed above and commissioning and testing activity/progress of the mechanical and electrical equipment for the GIWW WCC project. Each construction site visit was conducted over a two-day period: the first day consisted of a project status briefing and a site review; and the second-day consisted of out-briefings of findings to the USACE via in-person meetings or teleconference.

### **1.3. Activities**

As part of the overall GIWW WCC IEPR, the IEPR Panel was tasked with making site visits (two per panel member) to review construction activities. Two of the three construction site visits were concurrently executed with the review of the project design documents, which provided an excellent opportunity for the IEPR panel members to better assess the information in the design documentation. The third construction site visit was executed during the commissioning and testing of the mechanical and electrical equipment. Individual construction site visit reports were prepared following each site visit outlining the specific activities observed during each review. These reports are provided in Appendices A (Site Visit #1), B (Site Visit #2), and C (Site Visit #3).

## **2. IEPR SITE VISIT CONCLUSIONS**

During each site visit, the Panel made observations and raised concerns regarding the construction and/or commissioning of the GIWW WCC, which were documented for each respective site visit in Site Visit Reports #1, #2, and #3 (provided in Appendices A-C). A summary of these conclusions are noted below for:

- Positive observations,
- Concerns raised and recommendations, and
- Outstanding issues.

### **2.1. Positive Observations**

Throughout the construction site visits, the Panel noted the following positive observations:

- The ECI process allowed the Project Delivery Team (PDT) to meet its objectives and schedule.
- Construction operations throughout the project were well organized and orchestrated.
- It was evident that the contractor and its subcontractors take pride in their work; the construction site was clean and orderly, and the features that the Panel observed (concrete finishes, material storage areas, etc.) looked good.
- The contractor and its subcontractors were aware of various factors that can influence the performance and durability of the completed project and actively monitored, reported, and resolved these issues.

## 2.2. Concerns Raised and Recommendations

Throughout the construction site visits, the Panel raised the following concerns and recommendations:

### 2.2.1 Site Visit #1

#### *Pump Station*

- The Panel inquired about the purpose of the bolts observed in the intake of the formed suction intake at the pump station and learned the bolts would be removed and the holes covered prior to completion of the project. Given this information, the Panel agreed with this approach.
- Although spiral-welded pipe (SWP) piles have been approved for axial loads, some applications on HSDRRS projects involve lateral loads and bending. The Panel inquired whether the SWP piles have been approved for these applications. If testing, monitoring, and analysis have not been conducted by USACE on SWP piles subjected to lateral loads and bending, then the Panel's recommendation was to initiate such a study and subject the study to the IEPR process. USACE reported during Site Visit #2 that it reviewed usage with an established SWP Pile Panel and implied the usage is acceptable. Furthermore, the PDT reported that an additional study is being conducted by Purdue University.
- Details on how the issue of lateral movement of some pump station foundation piles after installation was addressed were not readily available. For completeness and documentation purposes, the Panel recommended preparing and providing for review a supplemental engineering report about the post-installation lateral movement of foundation piles. In response, USACE provided the Panel with a copy of the Contractor's Request for Information (RFI) that provides written documentation of the oral direction given to the contractor in a pile task force meeting on January 8, 2010, to address three types of pile location issues, including 5 to 7 inch of post-installation lateral displacement of some pump station foundation piles. Essentially, the directive was to increase the horizontal tolerance from the 3 inches specified in the contract documents to 1 foot. While the increased horizontal tolerance and actual pile displacements may be acceptable, the Panel believes the project documentation should contain an engineering report that supports the decision.

#### *Sector Gate*

- The Panel expressed concern over the placement of the sector gates and the sequence of sector gate flooding versus closure wall construction and maintenance of navigation. USACE provided documentation on the sequencing of events that further explained the placement of the gates and approach for accomplishing this given the unique situation/size. The documentation provided by USACE satisfied the Panel's concern.
- The Panel was concerned about the potential for cracking from thermal or expansion stresses in the thick (10 feet) closure pours to be made for the large sector gate foundation. USACE provided documentation on the sequencing of events that further explained the placement of the gates and approach for accomplishing this given the unique situation/size. During Site Visit #2, the Panel's limited inspection of placed concrete indicated that cracking did not appear to be a problem and the USACE PDT further confirmed that

cracking had not been an issue. The Panel was satisfied with the information provided by USACE.

### ***Foundation Piles***

- The Panel questioned why a statistically significant program of random sampling/monitoring/documenting for installation of the foundation piles other than maintaining driving logs of blow versus penetration was not being used. The Panel recommended instituting a requirement to conduct Dynamic Pile Monitoring and Testing during pile installation using a Pile Driving Analyzer (PDA).

After the 2<sup>nd</sup> site visit USACE PDT responded to the panel member's recommendation with the following: "A statistically significant random sampling/monitoring program using a PDA was not performed for the project. However, a systematic dynamic pile testing program was performed on the project to provide a baseline for comparing pile driving records to driving criteria during construction. Initial drive PDA tests were performed on the first three piles driven with every hammer used for construction of the 404c project. A total of four hammers have been used during construction of the 404c project and the first piles driven with each of these hammers were tested. This included PDA testing of the first piles jetted at the water control structure. The results of the initial drive PDA testing were utilized during construction to verify appropriate driving criteria to insure pile integrity. Appropriate stroke settings for each hammer and minimum cushion thickness were determined based on the results of the PDA testing. When violations of acceptable stroke settings and cushion thickness were noted by quality assurance/quality control personnel on the driving records then additional testing using a pile integrity tester (PIT) was performed to verify integrity of piles in question."

The IEPR Panel appreciated USACE's response and recognized that USACE's program contained elements of what the Panel expected. Furthermore, USACE's response documented what was done. However, the Panel's opinion is that USACE's program was not as comprehensive as it should have been nor was it necessarily consistent with the current state-of-the-practice for driven pile foundations for major or critical structures with life-safety implications. Finally, due to the timing of the GIWW-WCC IEPR, the piles had already been installed when USACE provided its response. Therefore, the Panel had to accept the fact that there was no longer an opportunity to implement their recommendations, which resulted in a missed opportunity to enhance the quality assurance and documentation aspects of the pile foundations on this project, as well as contribute to the knowledge base that can be used on future USACE projects.

### ***Cofferdam***

- The Panel questioned what criteria would be used to allow the possible reuse of steel piling from the cofferdam for the closure structure, especially for any damaged piling and for previously loaded/stressed SWP piling. USACE provided an explanation that no damaged pilings would be reused and the same specifications initially required would apply to any reused materials. The IEPR Panel was satisfied with USACE's explanation.

## 2.2.2 Site Visit #2

### *Pump Station*

- The smooth concrete apron and adjacent riprap on the discharge side (flood side) was of concern to the IEPR Panel due to the large anticipated water velocities and energy values during pumping operations. The Panel recommended that an underwater survey be conducted of the pump station splash pad and associated riprap after the first significant discharge event. The purpose would be to identify unanticipated degradation or movement of any scour protection material, and to develop corrective actions. IEPR Panel's concern was addressed by the PDT response generally stating periodic surveys and surveys after any major storm event would be performed to identify unanticipated degradation or movement of any scour protection material.
- The IEPR Panel was concerned with the excavation of the inflow and discharge channels meeting the design. The IEPR Panel recommended that, at a minimum, the contractor be required to provide an as-built bathymetric survey of these areas to ensure they were constructed to the design elevations. USACE responded that the contractor must provide a final compliance survey showing they constructed with in design elevations and tolerances of the contract; this response satisfied the IEPR Panel.
- The IEPR Panel observed some areas of patched surface concrete that appeared to be caused by honeycombing of the concrete in the underside of one of the pumping station chamber slabs. The Panel questioned whether honeycombing was an issue with larger pumping station pours. The PDT responded that very few cases of any concrete placement problems have been observed or had to be repaired. The Panel also asked if there had been any other recurring problems with concrete placements. The PDT responded that there had not been any recurring problems and they were satisfied with the quality of the placed concrete on the project. The IEPR Panel was satisfied with USACE's response.
- The IEPR Panel questioned why the external precast panels on the pumping station walls do not start from a uniform elevation at the top of the cast-in-place pours. Consensus between the PDT and the IEPR panel member was that any cracking was likely to be minimal and not require any changes.
- The IEPR Panel recommended that the status of the utility progress be closely monitored as it can result in delays. The IEPR Panel also recommended a final short-circuit and coordination study be completed based on the actual equipment furnished and installed on the project, as early as practical. Early completion of the studies will allow for the trip settings on relays and adjustable devices to be determined and tested well prior to the start up of the systems. The PDT responded that the Entergy utility supply was completed and initial short circuit study was conducted with few discrepancies and will continue with corrections and modifications as warranted. The IEPR Panel was satisfied with the PDT response.
- The medium voltage utility service to the pump station is routed in conduit mounted on the top of a unistrut rack on the south face of the access bridge. While not necessarily exposed to flooding, the pathway is potentially exposed to flying debris during severe weather conditions. The IEPR Panel recommends additional physical protection of power and

control conduits on the access bridge. This issue was revisited during the last site visit and agreement between USACE and the IEPR panel was not reached. This issue remains open.

- The IEPR Panel requested confirmation that field manufacturers' technicians for the engines, gearboxes, and pumps would be present on site to help with the assembly and alignment of the equipment. The IEPR Panel was satisfied with the PDT response that the field service technicians were on site during assembly and alignment of engines, gearboxes and pumps from Caterpillar, Lufkin and Fairbanks-Morse, respectively.
- The IEPR Panel asked if there had been any settlement in the Pump Station that may affect the equipment installation and operation. The PDT stated that 3/4 to 1 inch of settlement had occurred in the pump station structure and that structural settlement of the building continues with a total of 2 inches expected. The Panel requested that details of adjustments resulting from this settlement be provided. In addition to providing settlement reports prepared by USACE's Architectural/Engineering firm, Arcadis, the PDT responded that the only real equipment adjustments involved setting the formed suction intake (FSI)/pump mating flanges at the upper limit and providing a fillet (via mod) at the -18.0 slab via a sloped transition from the slab to the horizontal FSI inlet. All other dimensions were taken up (via field adjustments) in existing equipment and setting tolerances from the pump bowl thru the gear reducer to the engine. No other equipment modifications were required. The IEPR Panel was satisfied with the PDT response and Arcadis' Settlement Reports that were provided. Furthermore, the IEPR Panel concurs with the recommendation in Arcadis' Settlement Reports that the control benchmark should be verified on a monthly basis.
- The IEPR Panel did not find information in the Design Documentation Report or design documents that adequately describe the fire protection system. This was considered a critical concern for the pump station. The Panel requested information that shows the design, construction, and associated operational strategy of the fire suppression system that would prevent the spread of a single point fire (i.e., involving one engine initially). The IEPR Panel was not satisfied with the initial PDT response that the National Fire Protection Association code establishes the pump house as a low hazard rating and only fire extinguishers are needed. The issue was revisited during the last site visit in September. During the September site visit, the IEPR Panel confirmed adequate control systems and operational plan elements are in place that can stop fuel delivery to any individual pump engine in the event of a fuel leak or fire. These include:
  - Auto shutdown of fuel flow with engine shutdown
  - Multiple emergency stop control locations for site staff
  - Video monitoring of all engines
  - Planned continuous staffing of the pump station during pump operation
  - Robust fuel piping system (primarily socket welded steel pipe)
  - Local fuel spill containment at each pump engine

The IEPR Panel was satisfied that the risk of a fuel fire in the pump station is adequately addressed by the design and construction of the pump station.



### *Sector Gate*

- The IEPR Panel was not able to observe the sector gate bearing block areas during the site visit due to access issues, so they inquired whether there were any anticipated issues with the highly reinforced concrete in those critical areas. The PDT indicated that a large amount of reinforcing steel was in the sector gate bearing block pours and that the concrete had not yet been placed. The PDT explained the placement process for the concrete (following installation and alignment of the gate leaves) and indicated that no problems are anticipated. The panel was satisfied with USACE's explanation of the concrete placement process.
- The IEPR Panel asked if there was a risk of sector gate structure settlement affecting the operation of the gate. PDT personnel stated that settlement of the sector gate structure had occurred during construction and that the sector gate seal sill had been set at a uniform level to provide a 2 inch gate seal clearance per design. The Panel considers this the proper resolution of the structure settlement, provided that the gate's pintle bearing and upper bearing assemblies are set relative to the gate seal sill, and not any other point on the structure.

### *404(c) Wall*

- The IEPR Panel questioned whether checkerboard concrete placements in the cap and wall placements in the 404(c) wall were sufficient to limit expansion, contraction, and cracking issues. The PDT has not observed any such issues with the 404(c) wall concrete structure to-date, and will continue to monitor for them. The PDT response fully addressed the Panel's question.
- Some of the precast concrete piles for the 404(c) floodwall met "refusal" above the design pile-tip elevation. They indicated the cause was the top of the granular bearing stratum was somewhat higher (shallower) than anticipated at those locations. They also indicated that subsequent evaluation indicated that pile capacity would be adequate and foundation performance would be consistent with design expectations. During the January site visit, the PDT indicated there were several issues with the 404(c) floodwall piles, i.e., pile penetration/installation, axial capacity, and damaged piles.
  - The PDT reiterated that pile penetration/installation issues occurred due to the varying depth of the sand strata. The PDT reported the installation issues were resolved by controlled jetting of the piles, i.e., inserting jet pipes through the center of the piles (polyvinyl chloride pipes were used initially, but they broke during pile installation, so steel pipes were used), stopping the jetting about 10 ft above the design pile-tip penetration, etc.
  - When axial pile capacity was a concern, the issue was resolved by driving "sister" or companion piles that were designed to provide additional axial pile capacity.
  - The PDT indicated that field personnel occasionally saw some visibly damaged piles, i.e., piles that contained cracks. In those cases, the damaged piles were left in place, but any possible capacity contribution was ignored and new piles were driven to accept the design load of the original pile. The PDT noted that neither PIT nor the use of a PDA identified problems, so the PDT concluded that the

cracking occurred before driving and was probably caused by material or handling issues.

The responses provided by the PDT adequately addressed the issues and were determined to be appropriate by the Panel.

### ***Cofferdam***

- During the July 2010 site tour, the USACE Engineering During Construction (EDC) indicated the temporary cofferdam wall was moving laterally more than expected. USACE EDC personnel explained the excavation sequence had changed, which resulted in a deeper excavation at this stage of construction than assumed in the design. However, the wall movements reportedly were consistent with an excavation of this depth, so while the movements were being monitored, there was not a concern. During the January 2011 site tour, the Panel asked if the cofferdam wall continued to move. The PDT reported that wall movements were continuing and they continue to monitor it. To date, the maximum measured lateral movement is approximately 5.5 inches at Bent 66. PDT personnel said they believe the movements were related to the depth of the excavation rather than differences resulting from the modeling or analytical procedures. The PDT had not identified any negative consequences due to the movements. The PDT further noted they intended to compile the data for evaluation and analysis so that the “lessons learned” can be applied to future projects. The Panel was satisfied with the PDT response.

### **2.2.3 Site Visit #3**

#### ***Pump Station***

- During the IEPR visit, the Panel learned of an issue with the controls of the fuel return system. The issue was that the fuel oil return pump controls have been left in manual mode or in the OFF position, leading to overflow from the fuel oil return tanks and fuel spills into the pump station. The Panel also learned that the alarms for the fuel oil return system are local to the return tank and do not show up on the control screens near the diesel pumps or in the operator’s room where operators are more likely to hear/see them. The Panel recommended that the following should be incorporated in the control system to aid in the prevention of return tank overflows: (1) Integrate a permissive into the pump controls that prevents starting the dewatering pumps unless the fuel return pump is in automatic mode, and (2) add additional alarms for high-high fuel levels in the fuel return tanks and make them audible/visual in the control room and on the operator stations local to the pumps. The issue was further discussed during the site visit and during the out-brief on September 26, 2011. The PDT expressed the intention to wait until the integration of the control system is complete before making any control system changes. The Panel reiterated its position that the recommended changes to the control system be implemented to aid in preventing further fuel oil spills. Subsequent to the site visit, the USACE indicated that in lieu of implementing these recommendations, the project will be modified to provide an alarm for “not in auto” and procedure controls prior to starting the main pumps. The Panel was made aware of the USACE modifications to the control system but is of the opinion that the modification does not fully address the issues. The Panel feels that their recommendation should be part of the solution to prevent fuel oil spills. This issue remains open. The Panel noted the fire pump is installed at level -2.0 and in a space shared with the sewage lift

station which exposes it to flooding and possible flammable vapors. Fire pumps are typically installed in rated spaces, separated from other building systems but failure of this system would represent multiple levels of failures of other features. The Panel is of the opinion that the risk of this is limited but may be an issue revisited with local fire authorities.

### 2.3. Outstanding Issues

**Physical protection of the tank farm electrical service** - The Panel previously recommended additional physical protection of power and control conduits on the access bridge be considered. The Panel was concerned about the potential failure of the control and power wiring to the fuel farm during a storm event. The issue was revisited during the September 2011 site visit and the Panel is still of the opinion that additional protection of these features should be considered. Failure of the fuel service would create a systemic failure of the entire pump station.

**Fuel oil return system issues** - During the final IEPR visit, the Panel learned of fuel spills from the fuel oil return tank. The cause of the spills was due to the fuel oil return pump controls being left in manual mode or in the OFF position when the dewatering pumps were started. The Panel also learned that the alarms for the fuel oil return system are local to the return tank and do not show up on the control screens near the diesel pumps or in the operator's room where operators are more likely to hear/see them. The panel made two recommended changes to the control system which they believe would prevent the overflow of the tank from occurring and also warn the operators in multiple areas that the tank was in danger of overflowing. The USACE recognized the issue and is implementing their own solution which would warn the operators if the fuel oil return pumps are not in auto and provide procedure controls for starting the main pumps. The Panel acknowledged the USACE solution but is still of the opinion that their specific recommendations should be implemented.

All of the IEPR panel members indicated the construction site visits were informative and valuable for the IEPR process, even though the site visits were limited in time and scope. Several critical observations were made and discussed during the out-brief meetings held after each construction site visit, which led to Panel recommendations. As of the close of this project, the USACE PDT had not committed to adopting two of the Panel's recommendations including (1) providing physical protection of the fuel farm electrical service, and (2) specific control system modifications to aid in the prevention of fuel spills from the fuel oil return tanks.

This page intentionally left blank

## **APPENDIX A**

### **Site Visit #1 Report**

This page intentionally left blank

## **APPENDIX B**

### **Site Visit #2 Report**

This page intentionally left blank



This page intentionally left blank

## **APPENDIX C**

### **Site Visit #3 Report**

This page intentionally left blank