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

APPENDICES

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 2nd 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

Independent External Peer Review: Final Construction Site Visit Report #1

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 19, 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 Report #1

on

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 19, 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

LIST OF FIGURES

ACRONYMS

DPMT	Dynamic Pile Monitoring and Testing
ECI	Early Contractor Involvement
EDC	Engineering During Construction
FSI	Formed Suction Intake
GIWW	Gulf Intracoastal Waterway
HSDRRS	Hurricane and Storm Damage Risk Reduction System
IEPR	Independent external peer review
PDA	Pile Driving Analyzer
QA	Quality Assurance
QC	Quality Control
STAS	Short Term Analysis Service
SWP	Spiral welded pipe
USACE	U.S. Army Corps of Engineers
WCC	West Closure Complex
WRDA	Water Resources Development Act

1. INTRODUCTION

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 to provide a barrier to storm surges and sufficient pumping of interior drainage. The project will use the Early Contractor Involvement (ECI) method of delivery.

An independent external peer review (IEPR) of the GIWW-WCC project is currently being conducted to ensure the reliability of scientific analyses contained within the documents reviewed. 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 HSDRRS projects. Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels, was engaged to coordinate the IEPR of the GIWW-WCC project documents.

This construction site visit report summarizes the observations and findings of a planned visit of the current construction progress.

2. OBJECTIVE

The purpose of the construction site visit on July 28-29, 2010 was to observe construction activity/progress of the GIWW-WCC project. The construction site visit included a one day site visit with a follow up outbrief of findings on the second day.

3. ACTIVITIES

The first construction site visit for the GIWW program was conducted on July 28, 2010. On the morning of July 28, the team (Attachment 1 – Attendance list) convened in the Engineering During Construction (EDC) trailer (located in Belle Chasse, LA), for an initial briefing of the construction status by the USACE GIWW-WCC Project Manager (Attachment 2 – USACE Presentation). The presentation covered the aspects of the construction that are going well and also some key challenges. Overall the approach taken by USACE to have early contractor involvement and initiating construction while the design is being finalized is resulting in extreme success in meeting the construction schedule. At the time of the construction site visit the construction was 35% complete and the design was nearly 100% complete, with stop log storage, fuel dock and the waterline still in design phase. Some of the key challenges in the project are:

- **Stormwater Drainage:** The Harvey and Algiers Canals function as the primary drainage conduits for the West Bank; nine drainage-pumping stations discharge into these canals.
- **Navigation:** The Harvey and Algiers Canals are part of the GIWW; 30 commercial barge tows per day pass the project site.
- **Environmental:** The project interacts with the Bayou Aux Carpes 404(c) site, which is a wetland of national significance; there are only 11 wetlands of this type in the nation.

After the USACE presentation the construction leads for USACE, Battelle, and the Panel members boarded a boat and took a tour of the GIWW area. From the water, the team was able to view the completed features such as the temporary cofferdam, as well as features that were under construction such as the 404(c) floodwall. In addition to the boat tour, the Panel took a tour of the landside construction area where the Panel saw the inside of the temporary cofferdam, the construction that was occurring at the base of the excavation, the pump station construction, and the concrete materials storage and batching area. The following photographs illustrate some of the construction activities witnessed by the Panel.

Figure 1. Suite of equipment as viewed from the boat

Figure 2. Initial pickup of a precast concrete pile for the 404(c) floodwall

Figure 3. Swinging a precast concrete pile for the 404(c) floodwall into location

Figure 4. Installed precast concrete piles for the 404(c) floodwall

Figure 5. Waterside (exterior) view of the temporary cofferdam wall

Figure 6. Landside (interior) of the temporary cofferdam wall

Figure 7. Aggregate placement at the base of the excavation inside the temporary cofferdam

Figure 8. Construction activity inside the temporary cofferdam

4. SITE VISIT RESULTS

At the conclusion of the site visit the participants reconvened at the EDC trailer to discuss any questions/concerns and general observations of the visit (Attachment 3 – USACE Meeting Notes). Additionally, Battelle and the Panel met on the evening of July 28 and prepared a briefing (Attachment 4 – Battelle Outbrief) which was presented to USACE on Thursday, July 29. As a meeting follow up, USACE had an action item to provide the Panel with additional information. The documents Battelle and the Panel received were:

- *General Concrete Specifications*, WBV-90 GIWW West Closure Complex, November 2009, Contract: W912P8-09-C-0041
- *Pump House Pipe Pile Issue Resolutions*, Request for Information Report, RFI No. RFI-0166, January 2010, Contract: W912P8-09-C-0041
- A one-page document that provided:
    - a brief overview of how the sector gates would be set;

- an explanation of the bolts in the pump station structure that were used to hold supports for shipping and placement in the structure and how they would be removed and resulting holes sealed; and
- a basic description of the sequence of construction as it relates to navigation issues.

- Two memoranda about the use of spiral welded pipes (SWP) piles from the Department of the Army, Mississippi Valley Division, Corps of Engineers:
  - *Request for Deviation of HSDRRS Design Guidelines – Use of Spiral Welded Pipe for Permanent Construction at GIWW West Closure Complex Project – WBV 90,* September 16, 2009
  - *Notification of the Use of Spiral Welded Pipe for Cofferdam Construction at GIWW West Closure Complex Project – WBV 90,* September 21, 2009
- A copy of the USACE-prepared PowerPoint presentation, *GIWW West Closure Complex,* July 28, 2010, which was used to conduct the IEPR briefing for the construction site visit

The following sections summarize the outcome of the construction site visit, based on the Panel's observations and review of reference documents, and include positive feedback, general observations, questions/concerns, and recommendations for future visits.

5. POSITIVE FEEDBACK

- It appears that the ECI process is allowing the design team to meet its objectives. USACE EDC personnel told us the design is progressing while construction is ongoing, and overall, construction is on or ahead of schedule.
- It appears that the construction operations are well organized and orchestrated. This was evident by the many concurrent activities the Panel observed and the absence of noticeable delays while they were onsite.
- It appears 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.
- It appears there is an awareness of various factors that can influence the performance and durability of the completed project. Examples include:
  - Lateral movements of the temporary cofferdam are being monitored and there reportedly are contingency plans in the event that movements exceed allowable criteria.
  - Some pump station foundation piles moved laterally after installation; this was noted and reportedly evaluated and resolved.
  - Because of hot-weather concrete placement concerns, the Panel were told that ice is added during the concrete mixing process and the aggregate stockpiles are sprayed with water in an effort to lower the temperature of the concrete when batched, and when deemed necessary, concrete placement activities reportedly occur at night when it is cooler.

- Thermocouples are embedded in “mass” concrete to monitor and document concrete temperatures during curing and the data are compared to the results of thermal analyses conducted during the design phase.

6. OBSERVATIONS

- Weather and water levels were stable and good for progressing the construction.
- Site has a lot of room for staging and laydown of materials so operations do not get in each other’s way and construction is organized and efficiently mobilized.
- A lot of simultaneous activities were ongoing, including the marine activities along the length of the 404(c) floodwall and the various structures constructed within the cofferdam.
- Concrete work looked good with very minimal cracking or surface patching from honeycombing or bug holes. One location that did have a little cracking though was on the north side entrance conduits in the pump station.
- Standing puddles of water near the concrete aggregate piles indicates that potable water is being used to help cool the aggregates prior to use at the concrete batch plants on-site.
- On-site precast piling was in various stages of installation on the 404(c) floodwall and installation appeared to go smoothly.
- Concrete pour heights on the dividing walls of the pumping station are quite large (up to 43 feet for the west end wall, reportedly), but no cracking or other quality issues were observed.

7. QUESTIONS AND CONCERNS

Question/Concern: The Panel wondered about the purpose of the bolts observed in the intake of the formed suction intake (FSI) at the pump station (Figure 9).

Figure 9. Bolts in the FSI at the Pump Station

Resolution/Recommendation: USACE explained the process for removing and covering the holes for the bolts, and the Panel agreed with the path forward.

Question/Concern: The Panel expressed concern over the placement of the sector gates and how it would be accomplished (in the dry condition or flooded) considering their unique size. Additionally, the Panel had questions about the sequence of sector gate flooding versus closure wall construction and maintenance of navigation.

Resolution/Recommendation: USACE provided documentation to explain the sequencing of events that also further explain the placement of the gates and approach for accomplishing this given the unique situation/size.

Question/Concern: Although static pile load tests were conducted and some dynamic pile monitoring and testing (DPMT) using a pile driving analyzer (PDA) has occurred, there is no statistically significant program of random sampling/monitoring/documenting for installation of the foundation piles other than maintaining driving logs of blow versus penetration. On a project of this magnitude, complexity, and importance and with the tight project schedule, what are the reasons that a comprehensive PDA program is not being used?

Resolution/Recommendation: The Panel recommends instituting a requirement to conduct DPMT during pile installation using a PDA. The PDA can provide quality control (QC) and quality assurance (QA) information about driving stresses, pile integrity, pile capacity, hammer efficiency, etc. that would enhance the likelihood of achieving a quality foundation system that satisfies the design assumptions. On routine as well as non-routine projects, the use of a PDA as a QC and QA tool has become commonplace. Typically, specifications require between 2 and 10% of piles to be tested, although 5 to 10% seems to be more common. DPMT specifications also often include supplemental language that addresses other times when the PDA should be used, *e.g.*, at least once per week for each pile type driven, whenever there is a change in hammer, whenever changes in driving resistance occurs, for each structure, etc.

Question/Concern: Although the issue of lateral movement of some pump station foundation piles after installation was reportedly addressed, details were not readily available to the Panel during the site visit. What are the likely cause(s) of the movements? What was the deflected shape of the piles? What is the engineering significance of the movements? How was the issue resolved? What will be done differently to reduce the potential of this occurring again in the future on this and other projects?

Resolution/Recommendation: For completeness and documentation purposes, the Panel recommends preparing a supplemental engineering report about the post-installation lateral movement of foundation piles. This supplemental document should provide the information identified in the above list, and this report should be made available to the Panel for review and comment.

Question/Concern: Although SWP piles have been approved for some applications on HSDRRS projects, it appears they are being used in applications that in addition to subjecting SWP piles to axial loads, they are being subjected to lateral loads and bending. Have SWP piles been approved for these applications?

Resolution/Recommendation: The memoranda about the use of SWP piles references a study undertaken by an Innovation Team that was recruited and assigned the task of investigating

the use of SWP piles in southeast Louisiana. At the time the memoranda were issued, the referenced study was still in progress, although interim results led to the approval for using SWP piles for various applications on the GIWW-WCC project. However, based on the Panel's familiarity with the SWP study and its recommendations, it is the Panel's understanding that it applies to SWP piles subjected to axial loads, not lateral loads or bending. If testing, monitoring, and analysis has not been conducted by USACE on SWP piles subjected to lateral loads and bending, then the Panel's recommendation is to initiate such a study and subject the study to the IEPR process.

Question/Concern: The Panel had questions about the possible reuse of steel piling from the cofferdam for the closure structure, especially for any damaged piling and for previously loaded/stressed spiral welded pipe piling. What criteria will be used to allow the reuse of this piling for the permanent structures?

Resolution/Recommendation: USACE provided an explanation that no damaged pilings would be reused and the same specifications initially required will apply to any reused materials.

Question/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 yet for the large sector gate foundation.

Resolution/Recommendation: USACE provided documentation on the sequencing of events that further explains the placement of the gates and approach for accomplishing this given the unique situation/size.

8. RECOMMENDATIONS FOR FUTURE SITE VISITS

In an effort to improve the quality of future construction site visits, Battelle and the Panel provide the following recommendations:

- The majority of personnel who participated in the briefings were design oriented and many of the Panel's questions revolved around the construction activities so it would be most useful to have both design and construction personnel represented at the briefings.
- Since a lot of the issues revolved around foundation issues, the visit was well-timed. The next scheduled visit should coincide with substantial mechanical and electrical progress and a final visit should occur during the operational start-up and testing phase,
- The Panel should be provided with a "site-visit package" in advance of the site visit. The package should comprise information that briefly reviews the activities that will be observed and then confirm that any additionally desired or needed information will be available to the Panel before beginning travel for the site meeting. Accomplishing this recommendation will take preparation by the Panel members and the assistance of others (Battelle, USACE, and the designer).
- USACE should furnish a one-page summary of each feature that the Panel will be observing during the site visit. This one page summary should contain:
    - a description of the feature(s) or structure(s) as well as a site plan that shows the locations of these items;

- the significant design or construction issue(s) or challenge(s) (actual as well as expected) associated with the feature(s) or structure(s), in addition to good, clear sketches as appropriate;
- the approach to assessing, analyzing, and/or addressing the design or construction issue(s) or challenge(s), as well as the recommended, planned and/or adopted approach or solution; and,
- an evaluation or "lessons learned" section about the assessment/analysis of the problem and the effectiveness or appropriateness of the recommended and/or adopted approach

- The Panel suggests supplementing the one-page summary with supporting information such as boring or CPT logs for geotechnical or subsurface issues; the results of key computations; pertinent construction details, records, and/or test results; and discussions about problems or unexpected conditions and their resolution.
- USACE should consider providing several representative weekly summary reports, including those that reflect non-conforming issues that have been resolved and/or are pending.
- The Panel would have benefitted from having plans and specifications, construction reports, QA/QC documents, etc., available for on-site review before and after the site visit activities.
- The Panel suggests involving EDC personnel as well as other construction personnel during the briefing and meetings associated with the construction site visit. This would allow the Panel the opportunity to get a more complete understanding of the project and assess the reporting and communication procedures that are in place.
- USACE should consider allowing for closer inspections of some of the concrete and exposed foundation elements, even if only as a sampling of the constructed components. This was true for the 404(c) floodwall, the sector gate foundations, and the interior of the pumping station.

ATTACHMENT 1

Attendance List

This page intentionally left blank

GIWW Construction Site Visit	
Attendance Sheet	
July 28, 2010	
Name	**Company**
B. Hoffman	USACE
K. Wagner	USACE
B. Anderson	USACE
A. Miller	USACE
D. Miller	USACE
M. Veal	USACE
T. Connell	USACE
B. Lester	USACE
F. Vojkovich	USACE
B. Richardson	USACE
D. Lovett	USACE
C. Hyer	Task Force Hope (TFH)
T. Wilson-Prater	TFH
J. Brakeman	USACE
S. Rice-McDonnell	USACE - PCX
Bill Miles	IEPR Panel
Ebow Coleman	IEPR Panel
Alan Hall	IEPR Panel
Michael Ports	IEPR Panel
David Lourie	IEPR Panel
J. Monzon	Office of Coastal Protection and Restoration
Monica Malhotra	Battelle
Mario Lopez	Battelle

This page intentionally left blank

ATTACHMENT 2

USACE Pre-Construction Site Briefing

This page intentionally left blank

Greater New Orleans Hurricane & Storm Damage Risk Reduction System

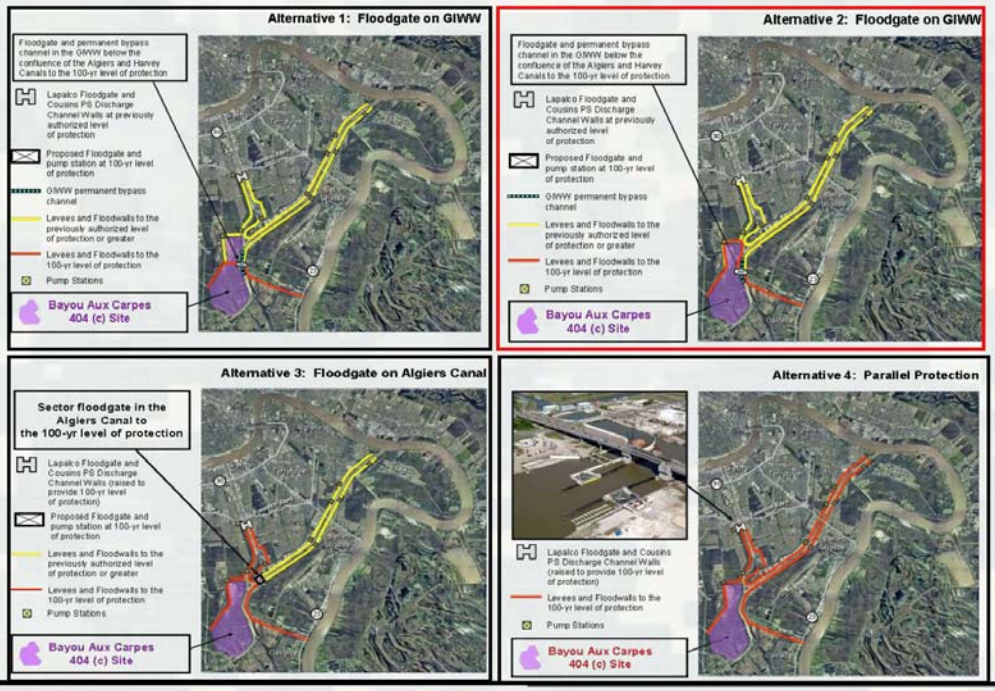
GIWW West Closure Complex

July 28, 2010

US Army Corps of Engineers
BUILDING STRONG®

Greater New Orleans Hurricane & Storm Damage Risk Reduction System

Alternatives Evaluated



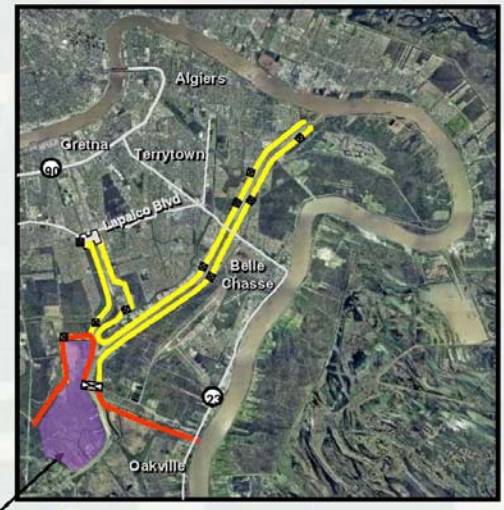
West Closure Complex Alternative

- Provides the greatest risk reduction
- The least impact to natural environment
- The least impact to human environment
- Cost comparable to Algiers option
- Provides greatest chance of achieving June 2011

GIWW - West Closure Complex

Key Project Influences / Challenges

- **Stormwater Drainage:** Harvey and Algiers Canals function as the primary drainage conduits for the West Bank. 9 drainage pumping stations discharge into these canals.
- **Navigation:** The Harvey and Algiers Canals are part of the Gulf Intracoastal Waterway. 30 commercial barge tows per day pass the project site.
- **Environmental:** The project interacts with the Bayou Aux Carpes 404 (c) site. A wetland of national significance, only 11 of this type in the nation.



Bayou Aux Carpes 404 (c) site

Pump Stations
Detention basin
100-yr level of protection

5

BUILDING STRONG®

Stakeholder Engagement and Coordination

- State and Local Governmental Agencies
  - State of Louisiana
  - SLFPA West
  - Jefferson, Orleans and Plaquemines drainage entities
- Navigation Community
  - Gulf Intracoastal Canal Association (GICA)
  - American Waterways Operators (AWO)
  - Harvey Canal Industrial Association (HCIA)
- Environmental Community
  - Environmental Protection Agency (EPA)
  - Other State and Federal environmental agencies.
  - Non-Governmental environmental groups
- General Public
  - Neighborhood groups
  - Civic associations
  - Church groups

6

BUILDING STRONG®

GIWW West Closure Complex Project Objectives

- Provide risk reduction for the 1% hurricane surge event.
- Minimize impacts to the natural and human environment.
- Provide pump capacity at WCC to effectively evacuate a 10 year rainfall event.
- Minimize impacts to commercial navigation.
- Reduce project cost and construction duration.
- Get it done by 1 June 2011

Early Contractor Involvement Construction Methodology

- ECI is an integrated project delivery method
- Creates a team consisting of the owner, designer, and contractor at the early stages of the project
- Allows construction to start before complete design achieved - allows for faster start and completion of project
- Preconstruction Services
- Construction Contract
- Final contract price negotiated after start of construction

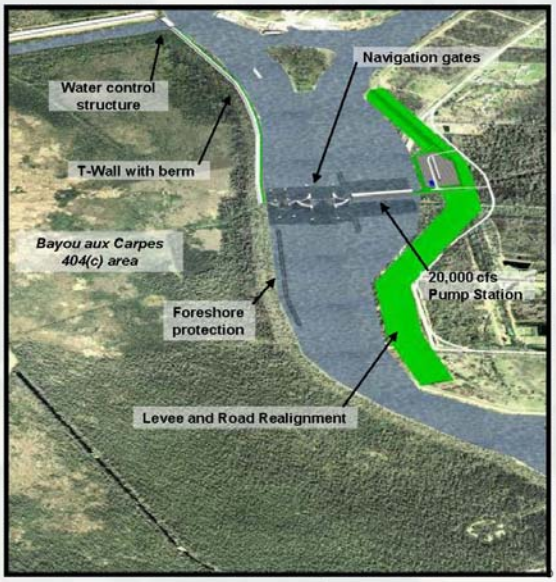
ECI - Design Effort

- Design effort coordinated by Rock Island (RINOS) MVR
- Personnel from all Districts within MVD
  - MVN – Main navigation gate and sluice gates, sitework, levees, hydraulic modeling
  - MVK – 404c floodwall, hydraulic modeling
  - MVS – Closure wall and small sector gate, hydraulic modeling
  - MVR – Management of pump station AE contract
  - MVM – Miscellaneous design and review support
  - MVP – Miscellaneous engineering and review
- Cost engineering support from MVD and multiple districts
- ERDC provided risk analysis and hydraulic modeling
- AE design firms – BioArcadis / HNTB and others
- Gulf Intracoastal Constructors ECI team
- Pump, engine and gear manufacturers
- Other technical experts

GIWW - West Closure Complex (original)

Project Features:

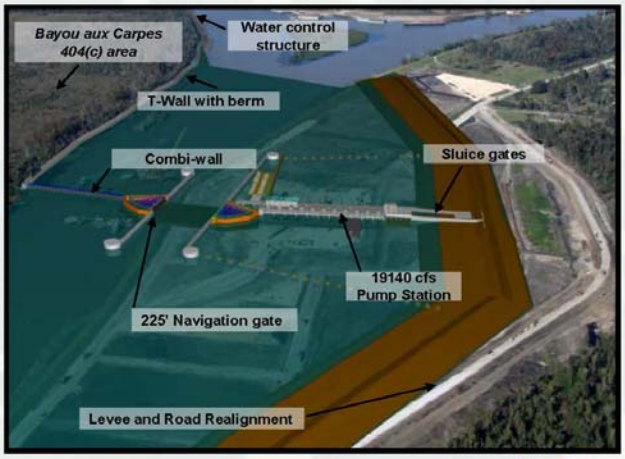
- 20,000 cfs Drainage Pumping Station (13 x 1540 cfs vertical "Flower Pot" pumps)
- 225-foot primary navigation gate
- 75-foot secondary navigation gate
- T-wall along edge of Bayou aux Carpes CWA 404(c) wetlands (4200' X 100' construction corridor)
- Water Control Structure
- Levee and East Bayou Road Realignment
- Environmental Mitigation and Augmentations
- Foreshore Protection
- Algiers Canal dredging



GIWW - West Closure Complex
(revised)

Project Features:

- 19,140 cfs Drainage Pumping Station (11 x 1740 cfs vertical "Flower Pot" pumps)
- 225-foot primary navigation gate
- Sluice gates (5 – 16' x 16')
- T-wall along edge of Bayou aux Carpes CWA 404(c) wetlands (4200' X 100' construction corridor)
- Water Control Structure
- Levee and East Bayou Road Realignment
- Environmental Mitigation and Augmentations
- Foreshore Protection
- Algiers Canal dredging



On-site Inspection
Quality Control/Quality Assurance

- Provides the structure necessary to ensure a quality project is constructed.
- GIC provides quality control via it's own extensive QC organization.
- Local sponsors provide their own independent QA inspection program.
- Fully staffed on site EDC office.
- 22 COE QA staff currently on site.

July 2009

13 BUILDING STRONG®

November 2009

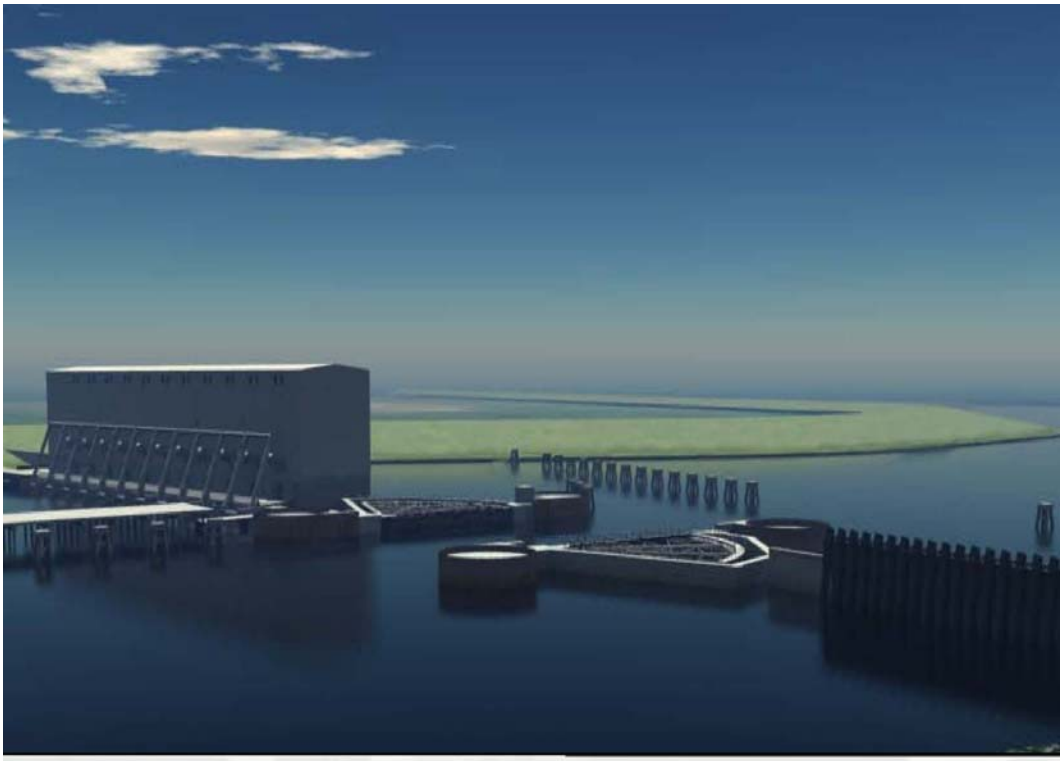
14 BUILDING STRONG®

June 2010

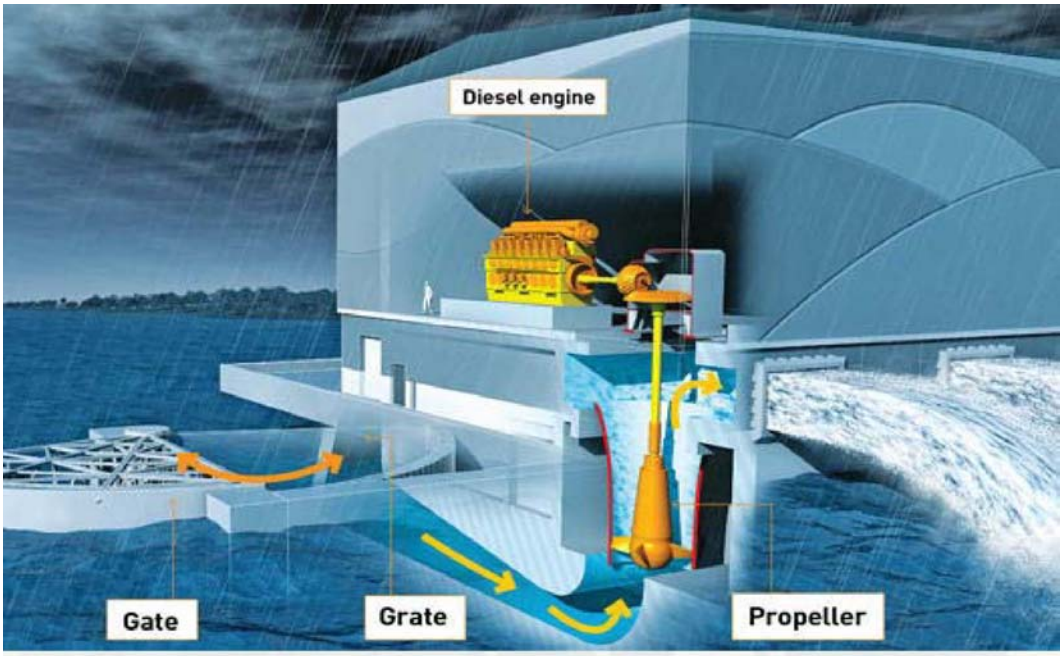
Project Facts

- 2,300,000CY of on-site excavation/dredging
- 610,000LF of piling
- 140,000 CY of concrete
- 18,028,000 LB of rebar
- 770,000 CY of levee embankment
- Nearly 3,000,000 man hours

17 BUILDING STRONG®



18 BUILDING STRONG®



Discussion

Detention Basin Analysis

10 Local Parish Pump Stations
[10% Chance Exceedence Rainfall Actual Peak Discharge output]

- **6 on Algiers Canal**
  - PS#11 = 1,310 cfs
  - PS#13 = 3,704 cfs
  - Belle Chasse #1 = 3,500 cfs
  - Belle Chasse #2 = 999 cfs
  - Whitney-Barataria = 3,750 cfs
  - Planters PS = 2,360 cfs
- **4 on Harvey Canal**
  - Cousins PS = 5,474 cfs
  - Hero PS = 2,377 cfs
  - Estelle PS = 1,140 cfs
  - *Old Estelle PS = 514 cfs
- **Total Flow = 25,128 cfs**

(Note: *Old Estelle flows are being routed out of the system for the design alternative, resulting in a total inflow of **24,614 cfs** to the system.)

Nameplate Capacity = 29,212 cfs

Pump Station and Detention Basin Model Results Summary

90% Assurance Peak Stages for Final Project Conditions

(10% Chance Exceedence Rainfall Event with Gates Closed and Pumps Operating)
Design Water Surface Elevation (DWSE) = 5.8 feet NAVD88, 2004.65 Epoch

	Original Model	*Refined Model	Alternative 3	Alternative 4
# of Pumps	13	13	12	11
**Individual Pump Q (cfs)	1,540	1,540	1,740	1,740
**Total Pump Capacity (cfs)	20,020	20,020	20,880	19,140
Algiers Canal Stage***	5.8	5.0	4.9	5.1
Harvey Canal Stage***	3.9	4.0	3.9	3.9
GIWW Canal Stage***	3.6	3.6	3.5	3.7

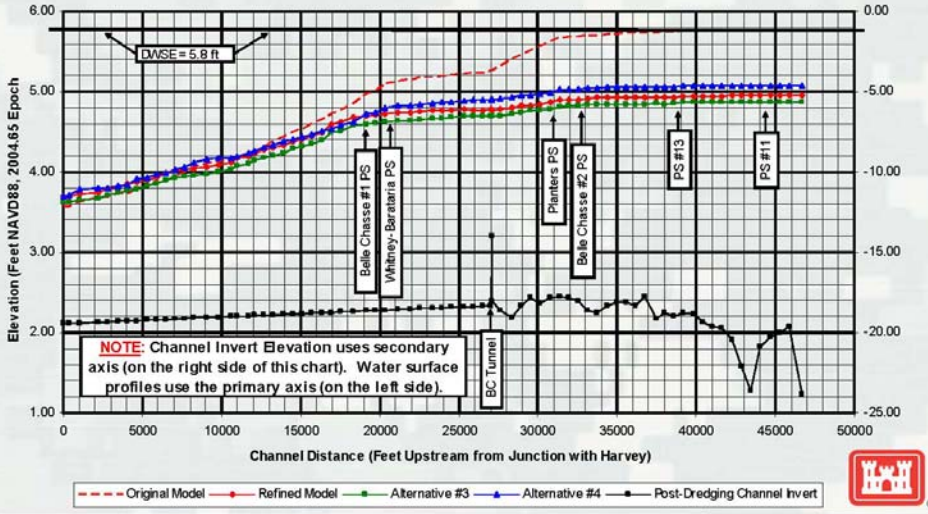
Notes: *Change in results from "Original Model" to "Refined Model" can be attributed to model refinements resulting in a more accurate computation of canal storage
** Nameplate capacities are based on an intake elevation of 2.0 feet.
*** All Stages are reported in the NAVD88 Datum, 2004.65 Epoch

Assumptions:
1. PS#13 improvements are included in the analysis.
2. Dredging on Algiers Canal is included.
3. Old Estelle Pump Station outflow is routed out of the system, through the 404c area.
4. Original & Refined Model: Pumps turn on at 2.0, 2.5, and 3.0 ft; turn off at -1.0, -0.5, and 0.0 feet.
5. Alternatives #3 and #4: Pumps turn on at 2.0, 2.5, and 3.0 feet, turn off at 0.0 feet.

Algiers Canal Water Levels

90% Assurance Peak Water Surface Profile Plots on Algiers Canal

10% Chance Exceedance Rainfall, Gates Closed, All WCC Pumps Operating



This page intentionally left blank

ATTACHMENT 3

USACE Meeting Notes

This page intentionally left blank

MEETING Notes
WCC IEPR Construction Site Visit on 28 Jul 10

U.S. Army Corps of
Engineers

Date: 28 Jul 10

Attendees:
USACE: B. Hoffman, K. Wagner, B. Anderson, A. Miller, D. Miller, M. Veal, T. Connell, B. Lester, F. Vojkovich, B. Richardson, D. Lovett, C. Hyer (TFH), T. Wilson-Prater (TFH), J. Brakeman, S. Rice-McDonnell (NAN)
IEPR Reviewers: Bill Miles – Bergmann, Ebow Coleman – C3S, Alan Hall – C.A Hall, Michael Ports, David Lourie – Lourie Consultants,
Battelle: Monica Malhotra, Mario Lopez
OCPR: J. Monzon

Notes By: Mike Veal

The following meeting notes set forth our understanding of the discussions and decisions made at this meeting. If no objections, questions, additions, or comments are received within 1 working day from issuance of the meeting notes, we will assume that our understandings are correct. We are proceeding based on the contents of these meeting notes.

1. Large Gate
    a. E. Coleman – asked about use of Type I, II & III cement usage & if aggregate is cooled. Concrete specs will be provided. Aggregate is cooled (A. Miller)
    b. D. Lourie – asked about heat monitoring QC. Performed by contractor.
    c. E. Coleman – Asked if non-destructive tests are being performed – B. Hoffman confirmed testing is provided by contractor
    d. E. Coleman – Asked is thermal control plans have been provided. B. Hoffman confirmed plans have been submitted.
    e. D. Lourie – Asked if PDA's are being performed. F. Vojkovich stated only if blow counts and pile driving records indicate some irregularity.
    f. A. Hall – Inquired about construction sequencing of gate. B. Hoffman described the sequence.
    g. D. Lourie – Asked about Spiral Welded Pipe (SWP) use on LG and questioned SWP use for lateral loads. D. Lovett responded that SWP was used for both vertical and battered pile. A waiver was granted for SWP use on permanent WCC structures. .
    h. A. Hall – Asked if any cracking has occurred. B. Richardson noted that nothing significant has been seen.
    i. E. Coleman – asked for explanation on why/how contractor was used as a consultant. T. Connell responded that GIC was used as part of the design process during the pre-construction phase of ECI.
    j. D. Lourie – mentioned cofferdam movement, but asked if any other features are showing unanticipated movement, i.e: bottom heave. B. Hoffman stated the pump station slab settled approximately 0.5", but not concerned. There was pile shift on the pump station due the high density of piles, up to 9"
2. Overall
    a. E. Coleman – Asked if construction was ahead or behind schedule. K. Wagner stated that GIC is basically ahead of schedule.

b. IEPR team noted that the site is clean and impressive.
c. E. Coleman – asked if any prototyping was done. K. Wagner commented that renderings were made. A. Miller shared some of the graphics with the group during the meeting.
d. D. Lourie asked the design team what keeps them up at night? - K. Wagner responded the placement of the large gate leaves (750 T) and pintle setting.
e. M. Ports asked what the Achilles heel is for the project? T. Connell mentioned the closing of the gates (i.e. debris)
f. D. Lourie asked how corrosion is being handled. K. Wagner responded stating that there are coatings and sacrificial thicknesses in the designs. Also, local sponsors agreed with plans.

3. Pump Station
    a. No questions were asked by the IEPR team
4. 404c T-Wall
    a. D. Lourie asked about PDA performed on 404c piles. B. Hoffman stated that 9 PDA have been completed on production piles.
    b. A. Hall asked for an explanation of the construction sequence. K. Wagner explained GIC's plan.
5. Out-Brief to be held on 29 Jul 10.
6. IEPR Reviewers will provide a field report by 13 Aug 10

This page intentionally left blank

ATTACHMENT 4

Battelle Outbrief

This page intentionally left blank

IEPR GIWW

Construction Site Visit Outbrief

July 29, 2010

Agenda

- Introductions
- Purpose
- Positive Feedback
- Question/Concerns

Introductions

- Battelle
  - Mario Lopez – Project Manager
  - Monica Malhotra (filling in for Richard Rossman) – Deputy Project Manager
- Peer Reviewers

Name	IPR Discipline
David Lourie	Geotechnical Engineer
Bill Miles	Structural Engineer
Michael Ports	Hydraulic Engineer
Alan Hall	O&M Engineer
Ebow Coleman	Material Engineer
Bill Schaefer	Civil Engineer
Robbie Cameruca	Electrical Engineer
Paul Carson	Mechanical Engineer

Purpose

- To provide an out-briefing of the results of the construction site visit
- Recommend improved processes for future construction site visits

Site Review – Positive Feedback

- It appears that the ECI process is allowing the design team to meet their objects. (i.e. the design is 35% complete and on schedule)
- Site is organized and orderly
- Structures 'look nice'
- Construction operations appear to be well orchestrated
- Thermal issues are being considered based on the use of thermocouples and analyses being performed for the large sector gate
- Scheduling activities (i.e. pouring concrete at night) shows conditional awareness and how it can the quality of concrete

Site Review – Questions/Concerns

- The lack of statistically significant random sampling/monitoring/documenting for installation of foundation pile
- Lateral movement of already driven piles
- Use of spiral welded pipe piles subjected to lateral loading and bending stresses
- What criteria is being used to allow the reuse of the coffer dam piling for permanent structures
- Use of various types of cement (Type 1 vs Type 2)
- The potential cracking of final pours for the foundation of the large sector gate due to the size of the pours

Site Review – Questions/Concerns

- The meaning of mass concrete is not well defined, as demonstrated by the lack of thermal monitoring by the 404C field personnel
- The purpose of the bolts in the invert of the FSI at the pump station
- The sequence of construction in a way that maintains navigation through the project area
- The ability to properly set the two sector gate leaves

Bolts in the FSI at the Pump Station

APPENDIX B

Site Visit #2 Report

This page intentionally left blank

Independent External Peer Review: Final Construction Site Visit Report #2

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 19, 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 Report #2

on

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 19, 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

ATTACHMENTS

TABLE OF FIGURES

ACRONYMS

DDR	Design Documentation Report
ECI	Early Contractor Involvement
EDC	Engineering During Construction
ERDC	Engineering Research and Development Center
GIWW	Gulf Intracoastal Waterway
HSDRRS	Hurricane and Storm Damage Risk Reduction System
I&C	Instrumentation & Control
IEPR	Independent external peer review
PDT	Project Delivery Team
STAS	Short Term Analysis Service
SWP	Spiral welded pipe
USACE	U.S. Army Corps of Engineers
WCC	West Closure Complex
WRDA	Water Resources Development Act

1. INTRODUCTION

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 to provide a barrier to storm surges and sufficient pumping of interior drainage. The project used the Early Contractor Involvement (ECI) method of delivery.

An independent external peer review (IEPR) of the GIWW-WCC project was conducted to ensure the reliability of scientific analyses contained within the documents reviewed. 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 HSDRRS projects. Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing, conducting, and administering peer review panels, was engaged to conduct the IEPR of the GIWW-WCC project documents.

This second construction site visit report summarizes the observations and findings of the IEPR panel members (hereinafter, the Panel or panel members) resulting from a planned visit of the GIWW site to assess construction progress.

2. OBJECTIVE

The purpose of the second construction site visit that occurred on January 11, 2011, was to observe construction activity/progress of the GIWW-WCC project. The construction site visit included a one day site visit with a follow up out-brief of findings on January 12, 2011.

3. ACTIVITIES

The second construction site visit for the GIWW program was conducted on January 11, 2011 in accordance with the agenda provided by USACE (Attachment 1 – Site Tour Agenda). On the morning of January 11, the IEPR panel members (Attachment 2 – Attendance List) convened in the Engineering During Construction (EDC) trailer (located in Belle Chasse, LA), for a safety briefing and a general project overview provided by the USACE GIWW-EDC team (Attachment 3 – USACE WCC Standard Brief).

The project overview presentation provided a short, non-technical summary on the GIWW-WCC project, construction activities performed to date, and the planned upcoming activities. In general, the USACE personnel conveyed that the ECI approach continued to work well, construction progress had been good, and no major construction problems had occurred. From the USACE's presentation, the Panel learned:

- Significant progress occurred since the Panel's last site visit in July 2010, and the project was about 61 percent complete.
- Project design activities continued to occur on some non-critical features.
- The initial "watering up" of the excavation was scheduled to begin on January 14, 2011.

- Large portions of the construction site were inaccessible for various reasons: boat tours were no longer provided to take the Panel to the 404(c) wall and other marine-based construction activity; observation of the lowest level of the pump station was not allowed, and close-up views of the sector gate area were not allowed due to safety concerns.

After the USACE safety briefing and overview presentation, members of the IEPR Panel, USACE EDC, and Task Force Hope toured the GIWW-WCC project site and its partially completed structures. Due to ongoing construction, the panel was largely limited to examining the site from the observation decks. The team briefly toured the operating level of the pump station. Figures 1 through 12 show the general nature of the activities and features observed during the field trip.

Figure 1. Landside (interior, protected side) of the temporary cofferdam wall

Figure 2. Landside (interior, flood side) of the temporary cofferdam wall

Figure 3. Landside (interior, flood side) of the temporary cofferdam wall

Figure 4. Large sector gate with temporary cofferdam and gate bulkhead structures

Figure 5. Protected side excavation and intake channel area

Figure 6. Protected side excavation and intake channel area

Figure 7. Flood side excavation and discharge channel

Figure 8. Flood side riprap placement and protection dolphins

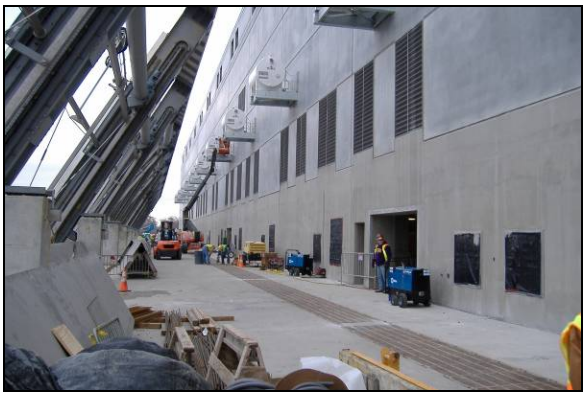


Figure 9. Trash racks (left side) and pump station exterior wall (right side)

Figure 10. Operating level of pump station

Figure 11. Pump discharge

Figure 12. Pump station access bridge

At the conclusion of the site visit, the participants reconvened at the EDC trailer to discuss any questions/concerns and general observations resulting from the site visit.

4. SITE VISIT RESULTS

After the site visit on January 11, 2011, the IEPR Panel convened offsite and prepared an out-brief package (Attachment 4 – USACE Out-brief Agenda; Attachment 5 – Battelle Out-brief) which was used to present the results of the site tour to USACE the next day (Attachment 6 – Out-brief Attendance List). The briefing provided the results in the following order:

- Positive feedback on the construction site visit
- Review of items previously identified from the July 2010 site visit (#1)
- Concerns raised at the January 2011 site visit (#2)
- Recommendations for future site visits

The discussion of the site visit #2 results, in the following section, is presented in the same order established in the out-brief developed after the site tour.

4.1 Positive Feedback

The IEPR panel members recognized that a significant amount of progress had been made since the July 2010 site visit. During the July 2010 site visit, the USACE estimated that construction was 35% complete and during the January 2011 site visit the USACE estimated that construction was 61% complete, representing a significant amount of work accomplished in a short period of time. Construction continued to be well orchestrated and the site maintained in a neat and orderly manner, which has resulted in an impressive safety record of one lost time incident to date for the project. The concrete structures appeared to be well finished. Additionally, the ECI process was allowing the USACE Project Delivery Team (PDT) to meet their project objectives.

4.2 Review of Concerns Raised During July 2010 Site Visit (#1)

During the January 2011 site visit, the Panel revisited concerns raised during the first site visit in July 2010. A majority of the concerns raised during the first site visit were addressed prior to the January 2011 site visit, however those concerns not addressed or concerns occurring as the Panel

gained new insight during the January visit are discussed below. Comments previously deemed adequately addressed are not covered in this report.

Italicized text calls attention to outstanding requests by the IEPR panel members for further information from USACE.

- **Lack of statistically significant random sampling/monitoring/documenting program for installation of the foundation piles:** During the July 2010 site visit, the IEPR panel members noted the apparent absence of a program for conducting statistically significant random sampling/monitoring/documenting activities associated with the installation of the foundation piles on the project. During the January 2011 visit the PDT indicated foundation pile issues would be documented in the Stand-Alone Foundation Report, which will be compiled about a feature-specific basis. There was no new information on the statistically significant random sampling activities that have been and/or are occurring.

  The Panel requested a status report on the random sampling activities for the foundation piles.

- **Lateral movement of the temporary cofferdam wall:** During the July 2010 site visit, it was indicated that 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 are consistent with an excavation of this depth, so while the movements are being monitored, there is not a concern. During the January 2011 site visit, the PDT reported that wall movements are continuing and so is the monitoring. The maximum measured lateral movement was reportedly about 5.5 inches at Bent 66. PDT personnel said they believed the movements were related to the depth of the excavation rather than differences resulting from the modeling or analytical procedures, and 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" could be applied to future projects.

- **Use of spiral welded pipe (SWP) piles subjected to lateral loading and bending stresses:** During the July 2010 site visit, it was noted by the IEPR Panel that although SWP piles have been approved for some loading applications on Greater New Orleans HSDRRS projects, it appeared the SWP piles were being used in loading applications not tested or examined. In addition to subjecting the SWP piles to axial loads which were previously tested, the SWP piles are now being subjected to lateral loads and bending which are loading conditions not previously tested. This caused the Panel to raise the issue of whether the SWP piles had been approved for these lateral and bending load applications. During the January 2011 site visit, the PDT indicated it reviewed usage with an established SWP Pile Team and implied the usage is acceptable. Furthermore, the PDT reported that an additional study was being conducted by Purdue University.

- **Reuse of the cofferdam piling for permanent structures:** During the July 2010 site visit, the Panel asked what criteria was being used to determine if the cofferdam piles could be reused. The PDT did not address the issue until the January 2011 site visit.

During the January 2011 site visit the Panel discussed with the PDT the criteria to allow the reuse of the cofferdam piling for permanent structures. The PDT said the criteria established for reuse of the cofferdam piles included non-destructive testing, visual testing, as well as tests to measure compliance with roundness and straightness.

- **Potential cracking of the Large Sector Gate foundations:** During the July 2010 site visit, the Panel was concerned about cracking of critical foundations at the large sector gate. During the January 2011 site visit, the Panel's limited inspection of placed concrete indicated cracking did not appear to be a problem and the USACE PDT confirmed that cracking had not been an issue.

- **Placement of the Large Sector Gate leaves:** During the July 2010 site visit the Panel raised a concern about the ability to properly set the large sector gate leaves, given their size and weight. During the January 2011 site visit, the PDT indicated to the Panel that an installation plan was being developed by the Sector Gate Team and would be vetted by individuals with a wide range of experience.

4.3 Concerns Raised at the January 2011 Site Visit (#2)

After the site tour, the IEPR panel members had an opportunity to ask questions of the PDT and discuss concerns raised. The concerns the Panel raised are discussed in the text below. *Italicized* text calls attention to Panel recommendations or outstanding requests for further information from USACE.

- **The need for energy dissipaters on the flood side of the pump station**: The smooth concrete apron and adjacent riprap on the discharge side (flood side) was of concern to the Panel due to the large anticipated water velocities and energy values during pumping operations. The USACE PDT indicated that modeling had been conducted and that there were no plans to include energy dissipaters.

  The Panel recommended during the out-brief 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.

  Further research by a IEPR panel member after the out-brief indicates that the USACE Engineering Research and Development Center (ERDC) also shared the same concern. The ERDC conducted physical modeling on the flower pot pump design to determine the stability of the riprap design downstream of the pump discharge (see Attachment 7, which contains excerpts of critical pages from a draft memorandum on the physical model testing for the discharge conditions). The Panel had not reviewed the 100% plans to determine if the general recommendations from the ERDC modeling studies had carried through to the finished construction of the riprap and adjacent materials.

  Consequently, at this stage of construction with the re-watering of the site underway, the best recommendation is to conduct an underwater survey of the pump station splash pad and associated riprap after the first significant discharge event to identify unanticipated

degradation or movement of any scour protection material and to develop corrective actions.

- **Excavation of remaining materials in the inflow and discharge areas after site watering has occurred:** The Panel was concerned with the excavation of the inflow and discharge meeting the design. The physical modeling that was performed for both navigation and design of the sluice gate requires specific flow patterns be maintained via these channels.

  The Panel recommends 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.

- **Recurring problems with concrete placement and honeycombing:** The 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. Therefore, 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 had been observed and 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.

- **Placement of reinforcing steel in the sector gate bearing block:** The 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.

- **Pump station exterior precast panels:** The Panel questioned why the external precast panels on the pumping station walls did not start from a uniform elevation (Figure 13) at the top of the cast-in-place pours. The notched cast-in-place concrete may cause cracking at the interior corners, a minor amount of which had already been observed. The PDT did not know for sure why the concrete was detailed that way, but the final sizing of the louvers and the impact of rework to change the cast-in-place top elevation and precast panel sizes were likely the reasons. Consensus between the PDT and the Panel was that any cracking was likely to be minimal and not require any changes. The Panel also commented on the sound appearance of the precast panels.

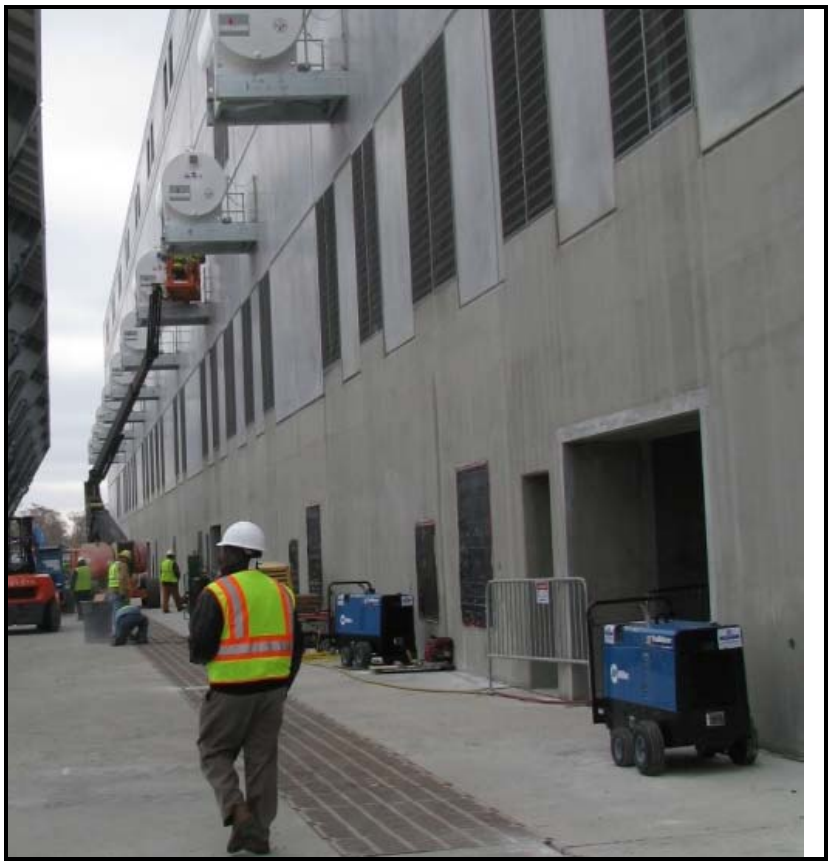


Figure 13. Pump station precast concrete wall panels do not sit on a uniform top of cast-in-place elevation

- **Expansion/cracking of the 404(c) Floodwall**: The Panel was not able to view the 404(c) floodwall during the January 2011 site visit and questioned whether checkerboard concrete placements in the cap and wall placements in the 404(c) floodwall were sufficient to limit expansion, contraction, and cracking issues. This concern was also raised during the July 2010 site visit and out-brief meetings, but the Panel was not able to observe the concrete conditions up-close during the July 2010 site visit either, due to limited access. The PDT had not observed any such issues with the 404(c) floodwall concrete structure to-date, and would continue to monitor for them.

- **Electrical and Instrumentation & Control (I&C) Construction:** Electrical and I&C construction were at the expected level of completion based on the progress of the remainder of construction. Several items require special attention in order to achieve desired and aggressive schedule of completion. These items are as follows:

    - Utility coordination: Site observations indicated that the new utility service construction from the south had not been completed by the utility company (Entergy). There is a three-phase service from the north serving a temporary construction service to the site. The PDT explained that the electrical contractor was in final negotiations with the utility and no delays were anticipated. Past experience of the Panel indicated the utility coordination could create a project

delay for the contractor primarily because the utility does not have a contractual obligation to USACE to complete the work to meet the schedule.

It is the Panel's recommendation that the status of the utility progress be closely monitored.

- System analysis (short circuit and relay coordination studies): The 100% Design Documentation Report (DDR) included short-circuit analysis based on unlimited primary and utility transformer assumptions. No relay or overcurrent protection coordination studies were included. If problems occur with coordination trip settings, the electrical equipment will potentially experience nuisance trips that will take the station off line and cause schedule delays.

  The Panel recommends final short-circuit and coordination studies 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.

- **Medium voltage service:** 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 (Figure 14). This access bridge is on the protected side. While not necessarily exposed to flooding, the pathway is potentially exposed to flying debris during severe weather conditions. If the pathway is compromised, there is a potential for medium voltage cabling to be damaged and exposed. This same pathway is used for power and control wiring to the fuel farm and, if compromised, loss of the fuel source to the pump station is possible.

  The Panel recommends additional physical protection of power and control conduits on access bridge.

Figure 14. Medium voltage service and power and control wiring to the pump farm on access bridge is vulnerable to damage

- **Settlement affecting sector gate seal:** The Panel asked if there is a risk of the 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" 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.

- **Pump Station settlement affecting equipment installation and operation:** The IEPR Team 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" of settlement has occurred in the pump station structure and that structural settlement of the building continues with a total of 2 inch expected. As each lift in the pump station concrete was placed, the lifts were brought to the design elevation. This has resulted in a "stretching" of the vertical height of the pump station of ¾ to 1 inch. The equipment has been adjusted to compensate for this increase in height between the suction intake level and the engine floor of the pump station. From the out-brief discussion it appears that the final elevation of the engines, gearboxes, and pumps has changed or that the equipment dimensions have been modified to accommodate this change in the structure dimensions.

  The Panel requests that details of these adjustments be provided. Specifically, the following information is requested: a description of the equipment modifications and adjustments made, and a copy of the BioArcadis report on pump station settlement.

- **Manufacture's support for equipment during installation:** The Panel requested confirmation that field service technicians for the engines, gearboxes, and pumps will be present on site to help with the assembly and alignment of the equipment. The PDT confirmed that equipment representatives will be on site for equipment testing, but were not certain if the manufacturer's technicians would be on site for the assembly and alignment.

  The Panel requested that USACE provide confirmation that manufacturer's technicians would be on site for the assembly and alignment.

- **Pump station fire suppression design:** The Panel had not found information in the DDR or design documents that adequately describe the fire protection system. This was considered a critical concern for the pump station. From the site visit it was not possible to discern what protection will be in place to prevent a single-engine fuel or lube oil fire from spreading to adjacent engine sets. Loss of one engine to a fire would be a problem; loss of several engines to a large fire event could represent a mission-critical failure.

  The Panel is requesting information that shows the design, construction, and associated operational strategy of the fire suppression system that will prevent the spread of a single point fire (i.e., involving one engine initially).

- **Movement of the temporary cofferdam wall.** During the July 2010 site visit, the USACE 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 are consistent with an excavation of this depth, so while the movements are being monitored, there is not a concern. During the January 2011 site visit, the Panel asked if the cofferdam wall continued to move. The PDT reported that wall movements are 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 are related to the depth of the excavation rather than differences resulting from the modeling or analytical procedures. They have not identified any negative consequences due to the movements. The PDT further noted they intend to compile the data for evaluation and analysis so that the "lessons learned" can be applied to future projects.

- **Pile penetration and capacity issues for the 404(c) floodwall foundation piles:** During the July 2010 site visit, the USACE EDC personnel reported that 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 personal 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 pile integrity testing nor the use of a pile driving analyzer identified problems, so the PDT concluded that the cracking occurred before driving and was probably caused by material or handling issues.

4.4 Recommendations for Future IEPR Site Visits

To improve the IEPR process and provide greater value to USACE, the IEPR panel members have made recommendations for future site visits. Some of the recommendations below were previously documented in the first (July 2010) site visit report, but those recommendations that remain a concern are revisited along with several additional recommendations.

- The Panel should be provided with a "site-visit package" in advance of the site visit. The package should comprise information that briefly reviews the activities that will be observed and then confirm that any additionally desired or needed information will be available to the Panel before beginning travel for the site meeting. Accomplishing this recommendation will take preparation by the Panel members and the assistance of others (Battelle, USACE, and the designer).

- The IEPR site visits should include viewing construction activities as they relate to the design currently being reviewed by the Panel. The Panel recommends that both design and construction personnel be represented at the site tour and also available for discussions after the site visit. This would allow the Panel the opportunity to get a more complete understanding of the project and assess the reporting and communication procedures that are in place.

- The mechanical-electrical construction and equipment installation in the pump station and sector gate areas was just getting underway at the time of the January 2011 site visit. The Panel recommends a future site visit be scheduled when the mechanical-electrical construction is more advanced. The IEPR panel members with mechanical and electrical expertise suggested that this visit occur when the first one or two pumps are in the functional testing phase.

- USACE should furnish a one-page summary of each feature that the Panel will be observing during the site visit. This one page summary should contain:

    - a description of the feature(s) or structure(s) as well as a site plan that shows the locations of these items;
    - the significant design or construction issue(s) or challenge(s) (actual as well as expected) associated with the feature(s) or structure(s), in addition to good, clear sketches as appropriate;
    - the approach to assessing, analyzing, and/or addressing the design or construction issue(s) or challenge(s), as well as the recommended, planned and/or adopted approach or solution; and,
    - an evaluation or "lessons learned" section about the assessment/analysis of the problem and the effectiveness or appropriateness of the recommended and/or adopted approach.

- The Panel suggests supplementing the one-page summary with supporting information such as boring or cone penetration test logs for geotechnical or subsurface issues; the results of key computations; pertinent construction details,

records, and/or test results; and discussions about problems or unexpected conditions and their resolution.

- USACE should consider providing several representative weekly summary reports, including those that reflect non-conforming issues that have been resolved and/or are pending.

- The Panel would have benefitted from having plans and specifications, construction reports, Quality Assurance/Quality Control documents, etc., available for on-site review before and after the site visit activities.

- The Panel recommends better accessibility to critical features of the site. During the January site visit the Panel was not able to gain access to the large sector gate area to see critical foundations. Also for the pump station, the Panel was only able to spend a short amount of time reviewing equipment in the operations level, and could not access the operator tower or the lower chambers. All of these areas are critical to the pump station meeting its mission.

5. CONCLUSION

All of the IEPR panel members indicated the construction site visit, though limited in time and scope, was informative and valuable for the IEPR process. Several critical observations were made and discussed during the meeting after the construction site visit. The Panel has made several recommendations with regard to critical observations and in several instances requested further information to aid in their review and assessment of the construction activities. The Panel has also provided recommendations to make future construction site visits more effective, efficient, and valuable to USACE's requirement to conduct IEPRs.

This page is intentionally left blank.

ATTACHMENT 1

Site Tour Agenda

This page is intentionally left blank.

WCC IEPR Construction In-Brief
11 Jan 11
Project Site @ 9:30

9:30 am - Safety Brief and PPE (Safety Officer) (15 mins) EDC Trailer Conference Room

10:00 am - Site Visit (K. Crumholdt/M. Veal/A. Miller) (2.0 hrs)

12:00 pm - Lunch (1.5 hrs)

1:30 pm - Meet with Key Design Personnel (M. Veal/A. Miller) (1hrs) EDC Trailer Conference Room

2:30pm - Wrap-up/Final Comments (All) (30 mins) EDC Trailer Conference Room

This page is intentionally left blank.

ATTACHMENT 2

In Brief and Site Tour Attendance List

This page is intentionally left blank.

IEPR In-Brief
11 Jan 11

Name	Company
Paul Carson	IEPR Panel
Richard Rossman	Battelle
Bill Miles	IEPR Panel
Ebow Coleman	IEPR Panel
Mario Lopez	Battelle
Alan Hall	IEPR Panel
David E. Lourie	IEPR Panel
Robbie Cameruca	IEPR Panel
Dan Miller	USACE-MVN
Sheila Rice McDonnell	USACE-PCX
Dave Lovett	USACE-MVN
Frank Vojkovich	USACE-MVN
Tom Ruf	USACE-MVS
Brad Arcement	USACE-MVK
Bob Hoffman	USACE-MVR
Mike Veal	USACE-MVR
Dani Alexander	USACE-MVN
Alex Miller	USACE-MVN
Matthew Soraghan	USACE-MVN
Carly Hyer	USACE-MVN
Tawanda Wilson-Prater	USACE-MVN

Names highlighted in red attended the site visit.

This page is intentionally left blank.

ATTACHMENT 3

USACE WCC Standard Brief

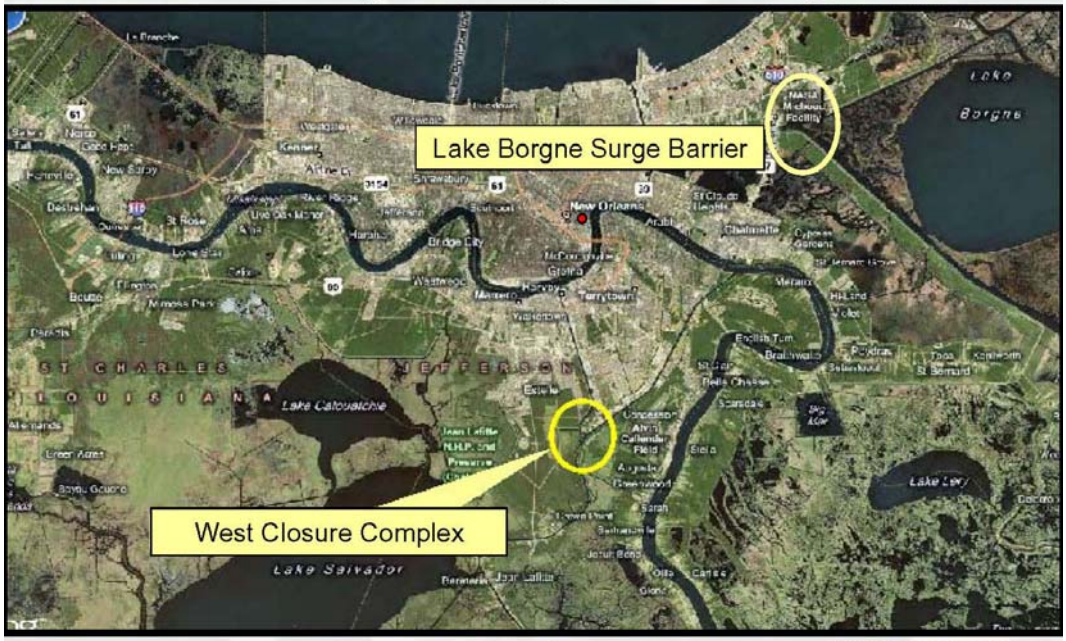
This page intentionally blank

Greater New Orleans Hurricane & Storm Damage Risk Reduction System

GIWW West Closure Complex

US Army Corps of Engineers
BUILDING STRONG®

Greater New Orleans Area GIWW Major Navigable Floodgates



West Bank & Vicinity Risk Reduction System

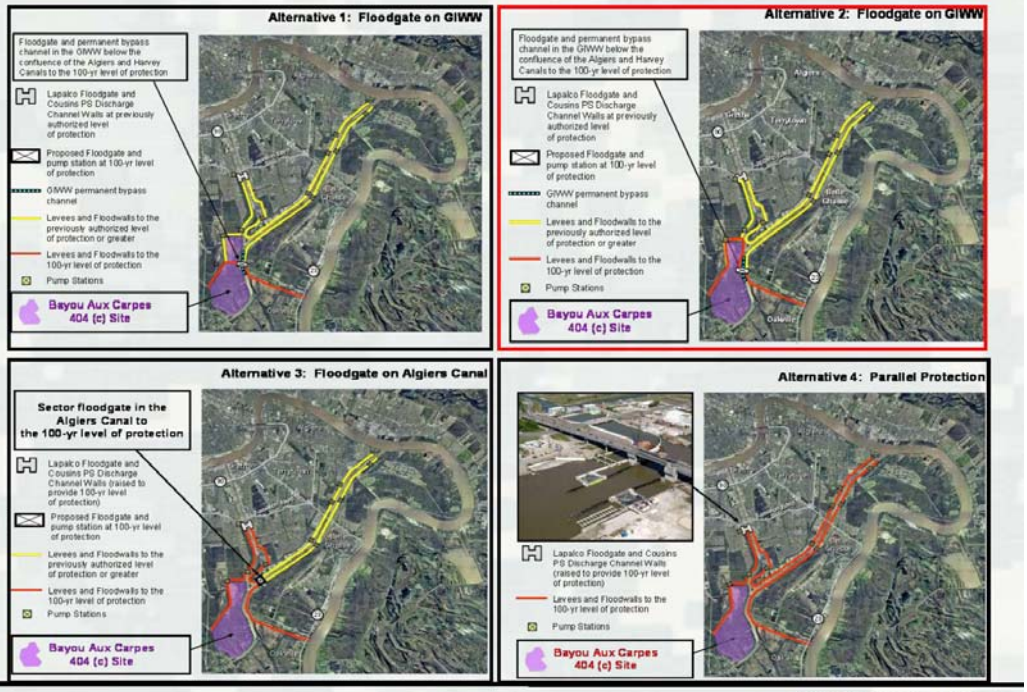
Current Status

West Closure Complex is 61% physically complete

Key Factors

- Project was fully funded as part of the $14.6 billion Greater New Orleans Hurricane Storm Damage Risk Reduction System – no recurring annual funding appropriations needed.
- Modified NEPA Compliance Process – Individual Environmental Reports. (IER)
- Non-typical, effective ECI contracting method utilized.

Alternatives Evaluated



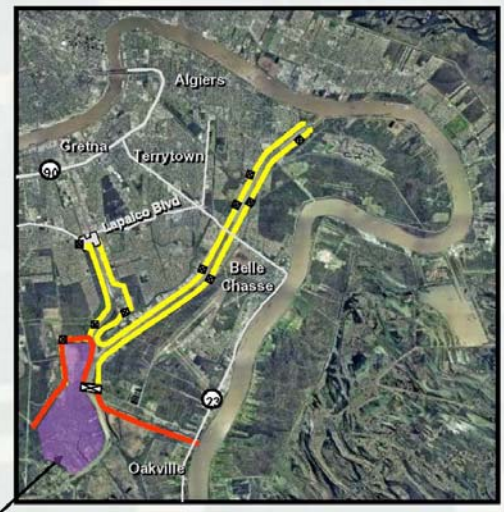
Stakeholder Engagement and Coordination

- State and Local Governmental Agencies
  - State of Louisiana
  - SLFPA West
  - Jefferson, Orleans and Plaquemines drainage entities
- Navigation Community
  - Gulf Intracoastal Canal Association (GICA)
  - American Waterways Operators (AWO)
  - Harvey Canal Industrial Association (HCIA)
- Environmental Community
  - Environmental Protection Agency (EPA)
  - Other State and Federal environmental agencies.
  - Non-Governmental environmental groups
- General Public
  - Neighborhood groups
  - Civic associations
  - Church groups

GIWW - West Closure Complex

Key Project Influences / Challenges

- **Stormwater Drainage:** Harvey and Algiers Canals function as the primary drainage conduits for the West Bank. 9 drainage pumping stations discharge into these canals.
- **Navigation:** The Harvey and Algiers Canals are part of the Gulf Intracoastal Waterway. 30 commercial barge tows per day pass the project site.
- **Environmental:** The project interacts with the Bayou Aux Carpes 404 (c) site. A wetland of national significance, only 11 of this type in the nation.
- **Timing:** Had to provide 100yr level of protection by 1 June 2011.



Bayou Aux Carpes 404 (c) site

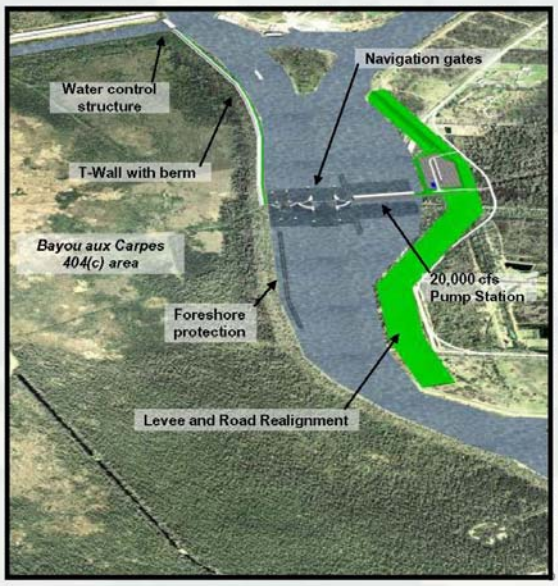
Early Contractor Involvement Construction Methodology

- Creates a team consisting of the owner, designer, and contractor at the early stages of the project
- Allows construction to start before complete design achieved - allows for faster start and completion of project
- Preconstruction Services
- Construction Contract
- Final contract price negotiated after start of construction

GIWW - West Closure Complex (original)

Project Features:

- 20,000 cfs Drainage Pumping Station (13 x 1540 cfs vertical "Flower Pot" pumps)
- 225-foot primary navigation gate
- 75-foot secondary navigation gate
- T-wall along edge of Bayou aux Carpes CWA 404(c) wetlands (4200' X 100' construction corridor)
- Water Control Structure
- Levee and East Bayou Road Realignment
- Environmental Mitigation and Augmentations
- Foreshore Protection
- Algiers Canal dredging



GIWW - West Closure Complex (revised)

Project Features:

- 19,140 cfs Drainage Pumping Station (11 x 1740 cfs vertical "Flower Pot" pumps)
- 225-foot primary navigation gate
- Sluice gates (5 – 16' x 16')
- T-wall along edge of Bayou aux Carpes CWA 404(c) wetlands (4200' X 100' construction corridor)
- Water Control Structure
- Levee and East Bayou Road Realignment
- Environmental Mitigation and Augmentations
- Foreshore Protection
- Algiers Canal dredging


July 2009
11
BUILDING STRONG®


December 2009
12
BUILDING STRONG®

January 2011

13 BUILDING STRONG®

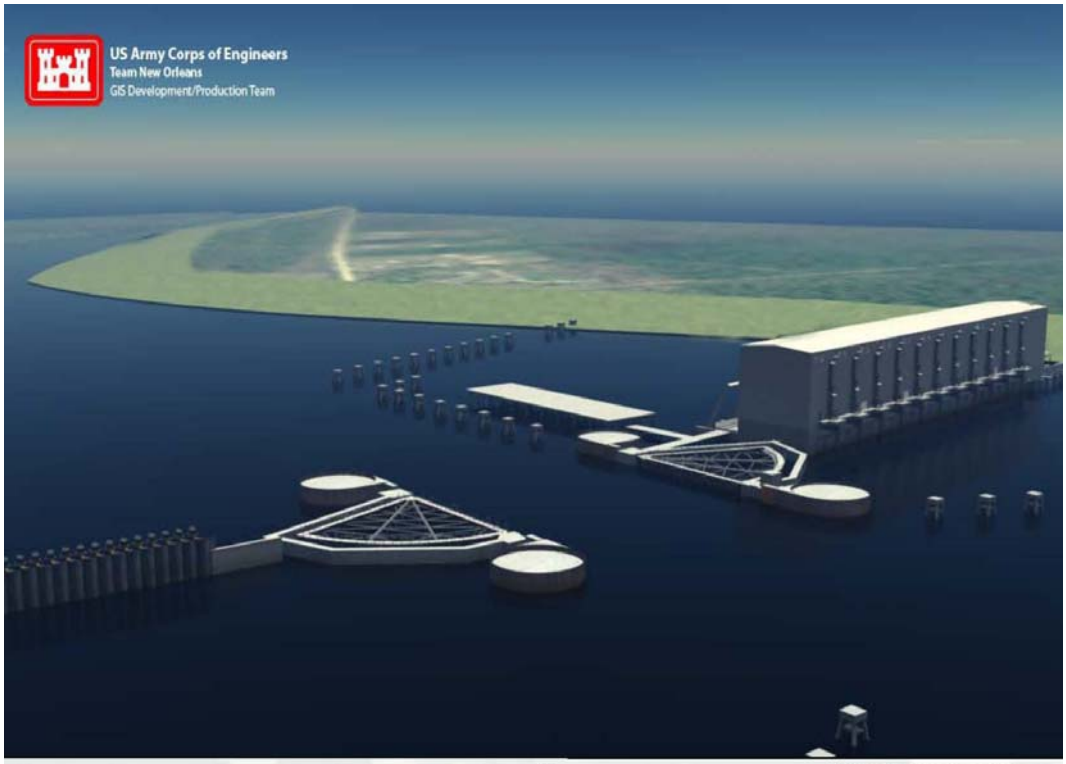
Completed West Closure Complex

Summer 2011 - Projected

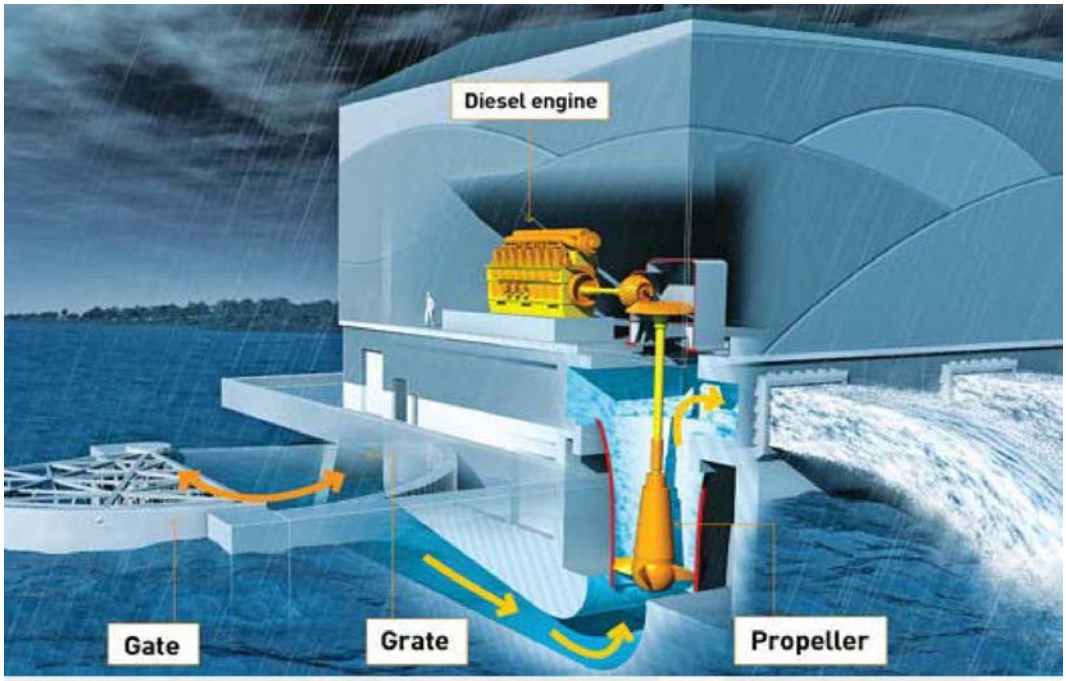
14 BUILDING STRONG®

Project Facts

- 2,300,000CY of on-site excavation/dredging
  - Span from New Orleans to Chicago
- 610,000LF of piling
  - Span from New Orleans to Pascagoula, MS
- 140,000 CY of concrete
- 18,028,000 LB of rebar
  - Equivalent to 30 747's
- 770,000 CY of levee embankment
  - Enough to fill Empire State Building
- Nearly 3,000,000 man hours



17 BUILDING STRONG®



Discussion

18 BUILDING STRONG®

This page intentionally left blank

ATTACHMENT 4

USACE Out-brief Agenda

This page intentionally left blank

WCC IEPR Construction Out-Brief
12 Jan 11
MVN District Office Room 381 @ 9:30

9:30 Opening Comments (J. Fritz/T. Wilson-Prater)

9:45 Out-Brief/Findings (Peer Reviewers)

11:15 Closing Remarks (All)

This page is intentionally left blank.

ATTACHMENT 5

Battelle Out-brief

This page is intentionally left blank.

IEPR GIWW

Construction Site Visit Outbrief

January 12, 2011

Agenda

- Introductions
- Purpose
- Positive Feedback
- Question/Concerns
- Recommendations for Future Site Visits

Introductions

- Battelle
  - Mario Lopez – Project Manager
  - Richard Rossman – Deputy Project Manager
- Peer Reviewers

Name	IPR Discipline
David Lourie	Geotechnical Engineer
Bill Miles	Structural Engineer
Michael Ports	Hydraulic Engineer (*)
Alan Hall	O&M/Civil Engineer
Ebow Coleman	Material Engineer
Robbie Cameruca	Electrical Engineer
Paul Carson	Mechanical Engineer

(* weather prevented attendance)

Purpose of Out-Brief

- To provide results of the construction site visit
- Recommend improved processes for future construction site visits

Site Review – Positive Feedback

- Significant progress has been made in the 6 months since the IEPR team's last site visit
- It appears that the ECI process is allowing the Project Delivery Team to meet their objectives (i.e. construction is 61% complete)
- Site continues to be organized and orderly
- Concrete structures appear well finished
- Construction operations continue to be well orchestrated
- Impressive safety record

Review of Issues from July 2010 Visit

- The lack of statistically significant random sampling/monitoring/documenting for installation of foundation piles
  - PDT said installation of foundation pile issues will be documented in the Stand-Alone Foundation Report
  - IEPR team requests status of statistically significant random sampling activities
- Lateral movement of already driven piles
  - Follow-up document was provided to IEPR team
- Use of spiral welded pipe (SWP) piles subjected to lateral loading and bending stresses
  - PDT reviewed usage with the SWP Pile Team
  - Additional study being conducted by Purdue University

Review of Issues from July 2010 Visit

- What criteria is being used to allow the reuse of the cofferdam piling for permanent structures
  - PDT established criteria that includes NDT, VT, roundness, straightness
- Use of various types of cement (Type 1 vs Type 2)
  - Report provided to the IEPR team indicated type 2 cement is being used for the project
- The potential cracking of final pours for the foundation of the large sector gate due to the size of placements
  - IEPR team's limited inspection of placed concrete indicated cracking is not a problem
  - PDT also indicated cracking has not been an issue

Review of Issues from July 2010 Visit

- The meaning of mass concrete is not well defined, as demonstrated by the lack of thermal monitoring by the 404C field personnel
  - Clarified in DrChecks by the PDT
- The purpose of the bolts in the invert of the FSI at the pump station
  - Covered during discussions at the July 2010 site visit
- Construction sequence that maintains navigation through the project area
  - Covered during discussions at the July 2010 site visit
- The ability to properly set the two sector gate leaves
  - Installation plan will be developed by Sector Gate Team

Issues/Concerns From Jan 2011 Visit

- Need for energy dissipaters on the flood side of the pump station
  - IEPR team recommends underwater survey of pump station splash pad after first significant discharge event to identify unanticipated degradation of scour protection material
- Excavation of remaining materials in the inflow and discharge areas after site watering
  - IEPR team recommends as-built bathymetric survey upon completion to confirm the design elevations
- Recurring problems with concrete placement during construction
  - No issues have been identified by PDT

Issues/Concerns From Jan 2011 Visit

- Quantity of concrete remaining to be placed
  - 25 of 74 monoliths on the 404c Wall
  - Closure Wall
  - Estelle Control Structure
  - Sector Gate trunnion anchors
- Was honeycombing of concrete a recurring issue
  - Relatively small percentage of rework needed (were patched)
- Are issues anticipated with the critical placement of reinforced concrete in sector gate bearing block
  - Process for placing concrete explained; no problems anticipated

Issues/Concerns From Jan 2011 Visit

- Pump Station exterior precast panels do not start from uniform elevation and could cause cracking of cast-in-place concrete

Issues/Concerns From Jan 2011 Visit

- Were checkerboard placements for 404c Wall sufficient to limit expansion, contraction, and cracking issues due to length of wall
  - No problems identified by the PDT
- Electrical and I&C was at the expected level of completion; to achieve desired schedule, the following items need attention
  - Utility coordination
  - System analysis (short circuit and relay coordination studies)

Issues/Concerns From Jan 2011 Visit

- IEPR team recommends additional physical protection of power and control conduits on access bridge

Issues/Concerns From Jan 2011 Visit

- Is there a risk of the sector gate structure settlement affecting the operation of the gate
  - PDT stated that the gate seal sill has been set at a uniform level to provide a 2” seal clearance per design
- Has there been any settlement of the Pump Station that might affect the equipment operation
  - PDT stated that ¾” to 1” of settlement has occurred and continues with a total of 2” expected. The equipment has been adjusted to compensate. IEPR team requests details of these adjustments.
  - IEPR team requests BioArcadis report on settlement evaluation

Issues/Concerns From Jan 2011 Visit

- Field service representatives for equipment
  - PDT confirmed that equipment representatives will be on site for equipment testing
  - IEPR recommends that the equipment representatives be onsite for the mechanical installation and alignment
- Pump Station fire protection
  - IEPR team requests information that shows the design and construction that the fire suppression system will prevent the spread of a single point fire (i.e. involving one engine initially)

Issues/Concerns From Jan 2011 Visit

- PDT said lateral movement of the temporary cofferdam wall is larger than expected (5.5” at Bent 66) primarily because of excavation depth
  - PDT has not identified any negative consequence
  - PDT plans to compile data to evaluate and use on future projects as lessons learned
- 404c Wall pile issues identified by the PDT
  - Penetration issues occurred due to varying depth of sand layers; resolved using jetting of piles and steel jet pipes in place of PVC
  - Axial pile capacity concerns; resolved using sister piles
  - Cracked piles were identified at several locations and damaged piles were replaced; PDT believed cracking was due to material or handling issues

Recommendations for Future IEPR Site Visits

- Provide a technical briefing of current status of design and construction since the last IEPR visit
- Panel's questions revolved around the construction activities, IEPR team recommends having design and construction personnel at the briefings
- An IEPR visit should coincide with substantial mechanical and electrical progress and a final visit during the operational start-up and testing phase
- Furnish an enhanced briefing package that includes a one-page summary of each feature that the IEPR panel members will have the opportunity to observe during the site visit

Recommendations for Future IEPR Site Visits

- Prior to the site visit, provide several recent weekly summary reports including those that reflect non-conforming issues that have been resolved and/or are pending
- Have plans and specifications, construction reports, QA/QC documents, etc., available for on-site review by the IEPR panel members before and after the site visit activities

This page intentionally left blank

ATTACHMENT 6

USACE Out-brief Attendance List

This page is intentionally left blank.

IEPR Out-Brief
12 Jan 11

Name	Company
Ebow Coleman	IEPR Panel
Alan Hall	IEPR Panel
Bill Miles	IEPR Panel
David Lourie	IEPR Panel
Sheila Rice McDonnell	USACE-PCX
John Monzon	OCPR
Mario Lopez	Battelle
Richard D. Rossman	Battelle
Carly Hyer	USACE-MVN
Tawanda Wilson-Prater	USACE-MVN
Walter Baumy	USACE-MVN
Richard Pinner	USACE-MVN
Robbie Cameruca	IEPR Panel
Paul Carson	IEPR Panel
Jeremy Fall	OCPR
Denny Lundberg	USACE-MVR
Bob Hoffman	USACE-MVR
Julie Fritz	USACE-PCX
Mike Veal	USACE-MVR
Bob Castro	USACE-MVR
Barb Lester	USACE-MVR
Michael Ports	IEPR Panel
Bruce Terrell	USACE-MVN
Jackie Gunter	USACE-MVN
Dani Alexander	USACE-MVN
Kevin Wagner	USACE-MVN

This page is intentionally left blank.

ATTACHMENT 7

USACE EDRC Pump Discharge Outflow Modeling

This page is intentionally left blank.

“Riprap Design for Downstream of the WCC Flowerpot Discharge Outlet Based on Testing in the 1:15 Scale Model”

From:
Subject: Draft Report on Physical Model Study of Flowerpot Discharge Outlet, Western Closure Complex, New Orleans, La, ERDC, Pages 40 to 47

Riprap Design for Downstream of the WCC Flowerpot Discharge Outlet Based on Testing in the 1:15 Scale Model

Introduction

Riprap stability tests were conducted on the downstream side of the pump station where the flowerpot discharge outlet (FPDO) discharges into the downstream tailwater (Figure 39). The floor of the FPDO is at el 11.0 and the exiting jet falls into tailwater that can be as low as el -1.5 and as high as el 11.0. The peak discharge in the FPDO is 1815 cfs that occurs when the sump is at el 7.0. At the design sump level of 2.0, pump discharge is 1740 cfs. At the minimum sump elevation of 0.0, pump discharge is 1710 cfs. Because these discharges vary over a small range, all riprap stability tests were conducted with a discharge of 1815 cfs. The jet falls on to a 40-ft long concrete slab at el -18. The top of riprap is also at el -18. The unit discharge for the downstream area is 1815/41.5 = 43.7 cfs/ft. The unit discharge leaving the FPDO is 1815/(38.5-6) = 55.8 cfs/ft. (The subtraction of 6 ft is due to the width of the two piers in the FPDO.) This is not a large unit discharge but the plunging nature of the jet and the lack of baffle blocks and/or an end sill result in significant potential for excessive scour downstream of the structure. The objective of this portion of the study is to find the stable riprap size and required downstream length.

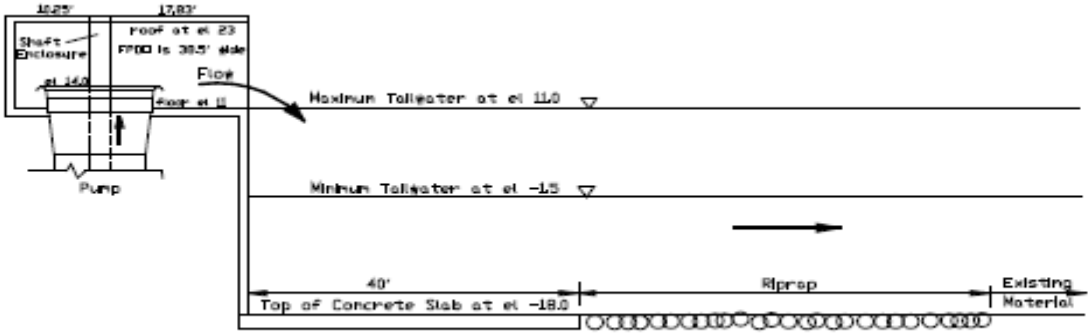


Figure 39. Schematic of FPDO and discharge area downstream of pump station.

Model Description and Scale Effects

The model used for the riprap stability tests was the 1:15 scale model described previously that has the pump immediately below the FPDO. Note that the inner flume is 41.5-ft wide that is the width of the FPDO plus 1/2 of a divider wall width on each side. This results in the inner flume representing the correct width of the discharge channel for one pump. At all but the highest tailwater, the FPDO has a plunging jet that entrains significant quantities of air. Although the model used for the riprap tests is relatively large, models generally entrain less quantities of air than the full size system. With less air in the model, the water-air mixture is more dense in the model. Although the density increase is not large, the greater density should produce greater stress on the rock and make model results conservative. The amount of conservatism is unknown.

Description of Riprap Gradations

Standard USACE gradations given in EM 1110-2-1601, "Hydraulic Design of Flood Control Channels", will be used in the WCC project. Upper and lower gradation limits for 18" maximum stone size and 24" maximum stone size USACE gradations are shown in Figure 40 along with the gradations tested in the model. The gradations tested in the model were mixtures of several rock sizes from a sieving operation. The model riprap has a unit stone weight of 165 lbs/cu ft. The model gradations are mixed to follow the lower or minimum limit curve in the USACE standard gradations. The sizes from the sieving operation are converted to weight based on a sphere and a unit stone weight of 165 lbs/cu ft.

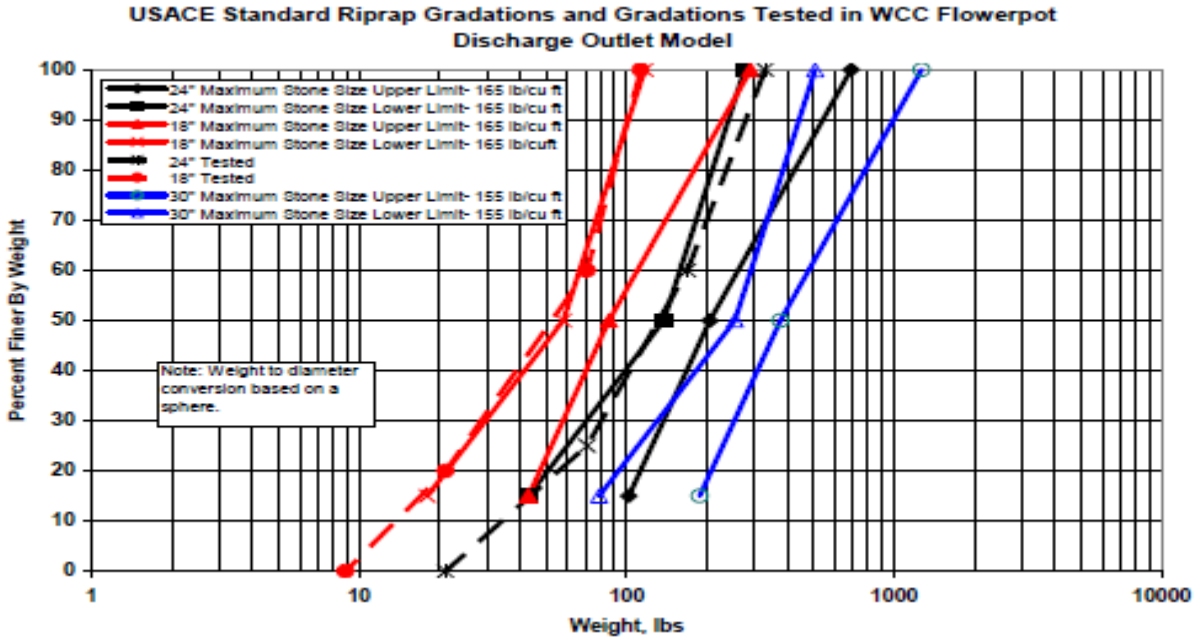


Figure 40. Gradation limits and gradations used in FPDO model.

Test Descriptions and Results

The Type 1 riprap design used the 18" USACE gradation placed 25-ft downstream from the slab. The 18" maximum stone size gradation with unit stone weight of 165 lbs/cu ft has a D_{50}(min) = 0.88 ft. Tests were conducted at tailwater elevations of -1.5, 3, and 9. The 18" maximum size riprap placed to a thickness of 18" failed and exposed the underlying plywood base as shown in Figure 41. Because failure occurred at the end of the slab, this test indicates that the 18" riprap size was not adequate. Several alternatives were available to insure stability of the downstream channel. First, baffle blocks and/or an end sill could be placed at the downstream end of the slab and the 18" riprap might be stable. Second, the concrete slab could be extended further downstream. Third, the riprap size could be increased. The District stated that increasing the riprap size would likely be the most cost effective solution.

Figure 41. Failure of Type 1 riprap design consisting of 18” maximum stone size gradation placed downstream of 40-ft concrete slab for a distance of 25-ft.

The Type 2 riprap design used the 24” USACE gradation placed 25-ft downstream from the slab. The 24” maximum size riprap placed to a thickness of 24” was tested at a range of tailwater. Although minor movement of stones was seen with the 24” maximum stone size, the underlaying plywood base was never exposed after more than 12.5 hours (model) of testing and is concluded to be stable. The remaining issue is the required distance downstream of the 24” riprap.

The Type 2 riprap design was tested with 25-ft of sand placed downstream of the riprap to a scaled depth of 7.5”. Scour of the non-cohesive sand in the model cannot be related to scour of the existing, far more complex, material in the WCC channel but is used as a qualitative indicator of scour potential. The model was run for 30 minutes at a tailwater elevation of -1.5. The time scale for converting scour time in the model to scour time in the prototype in a Froude model with sand used as a scour indicator is unknown. Sand scoured as shown in Figure 42. The plywood beneath the sand was exposed in similar locations as the riprap failure with the 18” riprap.

Figure 42. Scour of sand downstream of Type 2 riprap design after 30 minutes of flow in model.

The Type 3 riprap design used the 24" USACE gradation placed 50-ft downstream from the slab. The Type 3 riprap design was tested with 25-ft of sand placed downstream of the 24" riprap to a scaled depth of 7.5". The model was run at tailwater elevation of -1.5 until the scour pattern had similar total area of exposed plywood to the scour pattern from the Type 2 riprap. Similar scour pattern required 2 hours with the Type 3 riprap design and is shown in Figure 43. The scour with the Type 3 riprap design still shows significant lateral variations in scour.

Figure 43. Scour of sand downstream of Type 3 riprap design after 2 hours in model.

The Type 4 riprap design used the 24" USACE gradation placed 75-ft downstream from the slab. The Type 4 riprap design was tested with 25-ft of sand placed downstream of the 24" riprap to a scaled depth of 7.5". The model was run at tailwater elevation of -1.5 until the scour pattern had similar total area of exposed plywood to the scour patterns from the Type 2 and Type 3 riprap designs. Similar scour pattern required 8 hours with the Type 4 riprap design and is shown in Figure 4. Although the amount of plywood base exposed was similar, the exposed areas were well downstream of the end of the riprap. The scour with the Type 4 riprap design had less lateral variation of scour.

Figure 44. Scour of sand downstream of Type 4 riprap design after 8 hours in model.

Adjustment for Unit Stone Weight

The riprap readily available to the New Orleans area has a unit stone weight of 155 lbs/cu ft. The tests were conducted using model rock having a unit weight of 165 lbs/cu ft. The gradation limits shown in Figure 40 from EM 1110-2-1601 for the 18" and 24" gradations are based on a unit stone weight of 165 lbs/cu ft. Converting results from one unit weight to another must be done using a stone size equation. The Isbash Equation is the applicable equation from USACE Hydraulic Design Chart 712- 1. The equation for riprap size versus bottom velocity in highly turbulent zones like downstream of the WCC pump station is

$$V = 0.86\left[2g\left(\frac{\gamma_s - \gamma_w}{\gamma_w}\right)\right]^{1/2}(D_{50})^{1/2} \qquad \text{Eq 1}$$

The 24" gradation determined during the model testing has a D_{50}(min) = 1.17 ft. Substituting D_{50}(min) and 165 lbs/cu ft into the equation is used to back calculate a reference velocity of 9.57 ft/sec. Inserting this reference velocity and unit stone weight of 155 lbs/cu ft into the equation results in a D_{50}(min) of 1.30 ft. This corresponds to a W_{50}(min) of 177 lbs. From EM 1110-2-1601, the gradation having a W_{50}(min) >= 177 lbs and 155 lbs/cu ft is the 27" maximum stone size.

Velocity Measurement and Calculated Stone Size

A pitot tube was installed in the model to attempt to measure the bottom velocity and use stone stability equations to calculate the riprap size. The pitot tube was positioned 2-ft (prototype) above the concrete slab at the downstream end of the slab and the tailwater elevation was -1.5 ft. The flow in the model (Figure 45) is so highly aerated the pitot tube would immediately fill up with air and a valid reading could not be obtained. A second method used a 2" (model) wide board placed down into the water at the downstream end of the slab to determine where the flow transitioned from the upstream directed roller in the upper part of the depth to the downstream directed submerged jet that was riding along the concrete slab. The transition point was at about 30% of the depth above the bottom. It was also apparent that the flow got stronger close to the slab and the flow was highly turbulent. Forces on the board varied significantly with time. As stated previously, the average unit discharge across the FPDO outlet is 55.8 cfs/ft and across the 41.5 ft wide discharge channel is 43.7 cfs/ft. The failure shown in Figure 41 shows the unit discharge must be non-uniform across the 41.5 ft width. Using a value of unit discharge halfway between the above two values results in 49.8 cfs/ft. If this unit discharge occurs in the lower 30% of the depth, the velocity in the bottom jet is 10.1 ft/sec. Using equation 1 and unit stone weight of 155 lbs/cu ft, the calculated D_{50}(min) is 1.45 ft that is similar to the

1.30 ft from the model. This exercise was done as a check of the model test results.

Figure 45. Aeration and turbulence of flow in the 1:15 scale FPDO model.

Adjustment for 3D Effects

The model used herein is a model of one of the 11 FPDOs. Consideration must be given to the effects of how multiple outlets might affect the riprap requirements. Since the failure shown in Figure 41 occurred at the edges of the flume, it is possible that two outlets operating next to each other could result in increased turbulence and more stress on the rock. Under another scenario, if the station is operated with less than all pumps on such as 5 or 6 pumps operating on the west side or 5 or 6 pumps operating on the east side, an eddy would form in the area where the pumps are not operating. This eddy would move flow along the downstream face of the structure toward the operating pumps. This flow has momentum and tends to contract the jet of the first operating pump that it runs into. Any contraction of the jet will likely result in increased stress on the riprap. Because the diving jet exiting the FPDO is highly three-dimensional, any 2D numerical analysis of the eddy phenomenon may not be applicable. This author does not believe these 3D effects are major and the effects should be addressed by increasing the velocity by about 5%. The reference velocity becomes 10.05 ft/sec. The required D_{50}(min) for 155 lbs/cu ft is 1.43 ft. The corresponding W_{50}(min) is 238 lbs. From EM 1110-2-1601, the gradation having a W_{50}(min) >= 238 lbs and 155 lbs/cu ft is the 30” maximum stone size gradation. The 30” maximum stone size gradation limits having unit weight of 155 lbs/cu ft is shown in Figure 40.

End Protection

Although not tested, the downstream end of the riprap should be terminated with a thickened section to insure stability of the downstream end of the riprap. Figure 46 shows a thickened section that should allow at least 5-ft of scour at the downstream end of the riprap. While the 24” maximum stone size riprap in the model (increased to 30” due to unit weight and 3D effects) was stable, the area just downstream of the slab is the primary point of possible instability that could cause problems to the structure if it were to fail. Riprap is not a uniform material and thus has the possibility of certain areas having primarily the small rocks in a gradation. ERDC recommends that this possibility be handled by also using the thickened section at the upstream end of the riprap where it abuts the concrete slab. On the upstream end, the full 5-ft thickness of the thickened toe would abut the downstream face of

the slab.

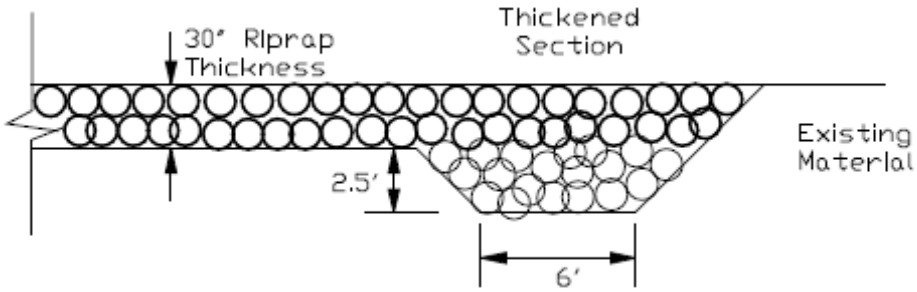


Figure 46. Thickened section of riprap recommended for both the upstream and downstream ends of the rip

This page intentionally left blank

APPENDIX C

Site Visit #3 Report

This page intentionally left blank

Independent External Peer Review: Final Construction Site Visit Report #3

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 19, 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 Report #3

on

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 19, 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

LIST OF FIGURES

ACRONYMS

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
PDT	Project Delivery Team
STAS	Short Term Analysis Service
USACE	U.S. Army Corps of Engineers
WCC	West Closure Complex
WRDA	Water Resources Development Act

1. INTRODUCTION

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), a combination of navigable flood gates, a pump station, levees, floodwalls and channels to provide a barrier to storm surges and sufficient pumping of interior drainage. The USACE used the Early Contractor Involvement (ECI) method of project delivery.

An independent external peer review (IEPR) of the GIWW-WCC project is currently being conducted to ensure the reliability of engineering and scientific analyses contained within the design and construction documents reviewed. 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 HSDRRS projects. Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing, conducting, and administering peer review panels, was engaged to coordinate the IEPR of the GIWW-WCC project documents.

This construction site visit report summarizes the construction progress observations and findings by the IEPR Panel resulting from the third and last scheduled review of the GIWW construction site.

2. OBJECTIVE

The purpose of the third construction site visit on September 23, 2011 was to observe commissioning and testing activity/progress of the mechanical and electrical equipment for the GIWW-WCC project. The construction site visit was conducted in one day, with a follow up outbrief of findings to the USACE via teleconference on September 26, 2011.

3. ACTIVITIES

The third and last construction site visit for the GIWW program was conducted on September 23, 2011, in accordance with the agenda provided by USACE (Attachment 1 – Attendance list). On the morning of September 23, the IEPR Panel (Attachment 2 – Attendance list) convened in the Engineering During Construction (EDC) trailer (located in Belle Chasse, LA) for a site visit technical discussion and a safety briefing before conducting the site visit.

During the technical discussion prior to the site visit, the Panel had the opportunity to ask questions to better help them understand the planned operation, testing, and completion schedule of the pump station. The following specific topics were discussed:

- **Manning of the facility –** The facility is manned by four operators, 40 hours/week. The safe house is designed to accommodate 10 people during a weather event.[1]

[1] After the site visit, USACE noted that the exact number of personnel to be on site during an event has yet to be finalized. The recommendation is that an electrical and mechanical technician is on site during an event.

- **Testing / Exercise Schedule** – Pump testing is currently occurring twice a month.
- **Pump station operation to date** – Eight of the 11 pumps have completed a simultaneous test run.
- **Fire rating of the control room** – The control room is fire rated in compliance with building codes.
- **Emergency procedures should a fuel rupture at an engine occur** – The design/ construction includes a series of E-stop switches that close solenoid valves at the engine, the day tank and the fuel farm tank. The E-stop switches are located both at the local pump control panels and at the control panel in the control room.
- **Remote communications** – Remote communications have not been established with 9A, 9B, Algiers Canal, Harvey Canal and the water monitoring system. This work remains to be completed and tested.
- **Water levels and protection of the pump station** – The water level on the protected side is +6.5 ft, the levee system is built to +9.5 ft on WCC, and the spaces in the pump station at +11.75 ft have been built water tight in the event of the levee overtopping.
- **Status of minor modifications of the sector gate** - The Sector Gate does not run absolutely true which affects the gear mesh in the drive systems. The Project Delivery Team (PDT) is determining the best approach for correcting the gear mesh.

After the technical discussion and USACE safety briefing, members of the Panel, USACE EDC and Task Force Hope toured the GIWW-WCC project site. The panel members in attendance were able to tour the tank farm, main pump hall, operator control room, observation decks, and sector gate area on the pump side.

Figures 1 through 10 show the general nature of the activities and features observed during the field trip.

Figure 1. Tank Farm

Figure 2. Barge Refueling Piping

Figure 3. Pump Hall

Figure 4. Sector Gate

Figure 5. Sector Gate Gear

Figure 6. Fuel Return Tank Located in Pump House Lower Level

Figure 7. Operator's Room

Figure 8. Control Panel in Operator Room

Figure 9. Pump Station Shown from Sector Gate with Operating Pump

Figure 10. Day Tanks and Trash Racks

At the conclusion of the site visit the participants reconvened at the EDC trailer to discuss any questions/concerns and general observations resulting from the site visit. The following specific topics were discussed:

- **Physical protection of the fuel line and control wiring between the station and the tank farm –** The fuel lines and control wiring to the tank farm are exposed on the north side of the access ramp to the pump station. The PDT also mentioned that double-walled piping for fuel and robust conduits per electric code also added protection. Concern was expressed that the exposure creates a situation in which damage could occur rendering the pump station inoperable; damage to the fuel lines would create a loss of fuel and damage to the control system rendering the fuel farm inoperable. The PDT expressed its opinion that the dolphins would prevent any large objects from striking and damaging the exposed fuel system.
- **Physical protection of the pump station transformer –** The transformer is installed adjacent to the trash racks at the west end of the access ramp. This equipment currently is only protected from vehicular traffic by concrete blocks. The PDT confirmed that there is a plan in place to install bollards to protect this equipment.
- **Fire pump location –** The fire pump is not physically fire separated and is installed in the lower level with other equipment in the space. The pump serves 10 sprinkler heads in the control room and the size of the system negates the requirement for fire protection.
- **Electrical coordination study –** The electrical coordination study has not been completed and final adjustments to breaker settings have not been made. The PDT indicated that there is a plan in place to complete this work.
- **Heating, Ventilating, and Air Conditioning (HVAC) unit in the server –** The HVAC unit in the server room did not appear to be functioning properly as the room was overheated. The PDT also noted the high temperature in the room and was investigating

why the unit was not functioning properly.

- **Fuel return tank and pumping system –** The PDT reported that there have been one or more instances where fuel overflowed from the return tank system into the pump station structure. The PDT attributed this to the controls shake-out and the Contractor's inattention during startup work and expects that the implementation of proper construction, installation, and testing of operating procedures will address this issue. The PDT confirmed that the fuel return tank high level alarm is not transmitted to the control room via the supervisory control and data acquisition (SCADA) system. Also, having the fuel return pumps in "AUTO" is not required for starting the main pumps.

4. SITE VISIT RESULTS

Subsequent to the site visit on September 23, 2011, the IEPR Panel prepared an outbrief package (Attachment 3 – Battelle Outbrief) which was used to present the results of the IEPR site tour to the USACE via teleconference on the morning of September 26, 2011 (Attachment 4 – Outbrief Attendance List). The briefing provided the results in the following order:

- Positive feedback on the construction site visit
- Review of concerns addressed as well as those remaining open since the January 2011 site visit (#2)
- Discussion of issues/concerns raised during the September 2011 site visit (#3)
- Discussion of issues that will potentially remain open from all site visits.

The discussion of the September 2011 site visit (#3) results described in the following section is presented in the same order as for the outbrief on September 26.

4.1. POSITIVE FEED BACK

The IEPR Panel recognized that a significant amount of progress has been made since the January 2011 site visit (#2). During the January 2011 site visit, the USACE estimated that construction was 61% complete; during the September 2011 site visit, it was apparent that construction was substantially complete and the commissioning process was proceeding smoothly.

Following the site visit in January 2011, the Panel provided several recommendations for improving the outcomes of future site visits such as providing project status updates prior to the site visit and hosting a specific visit for the mechanical and electrical reviewers. The Panel positively noted that USACE provided several status reports to them via e-mail prior to the site visit which aided their review. The Panel also appreciated USACE's commitment to the IEPR process by supporting the specific mechanical and electrical peer reviewer visit as requested during the site visit in January.

4.2. REVIEW OF CONCERNS RAISED DURING JANUARY 2011 SITE VISIT #2

During the September 2011 site visit (#3), the IEPR Team revisited concerns raised during the January 2011 site visit (#2). The majority of the concerns raised were addressed prior to the

September 2011 site visit; however, concerns related to fire protection and the physical protection of power and control circuits on the access bridge were not addressed to the Panel's satisfaction. Those concerns were revisited with USACE personnel during the September 2011 site visit and are discussed further in the next section of this report.

4.3. CONCERNS RAISED AT THE SEPTEMBER 2011 SITE VISIT #3

After the site tour the Panel had an opportunity to ask further questions of the PDT and discuss concerns. During those discussions, the Panel revisited outstanding issues raised previously during the January 2011 site visit (#2) in addition to citing new concerns during the September 2011 visit (#3). Those issues and concerns raised by the Panel are discussed in the text below.

4.3.1. OUTSTANDING ISSUES FROM THE JANUARY 2011 SITE VISIT #2 REVISITED

Potential for a fuel or lubrication oil fire to spread - The Panel was concerned that a single engine fuel or lubrication fire could spread to adjacent pump sets and had requested details of the fire suppression system planned. The 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 September 2011 site visit and the 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:

- Automatic 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.

Overall, the 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.

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.

4.3.2. NEW CONCERNS RAISED DURING THE SEPTEMBER 2011 SITE VISIT #3

Fuel oil return system issues - During the IEPR visit, the Panel learned of an issue with the controls of the fuel return system. During the commissioning process, 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:

- Integrate a permissive into the pump controls that prevents starting the dewatering pumps unless the fuel return pump is in automatic mode.
- 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 outbrief 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.[2] The Panel reiterated its position that the recommended changes to the control system be implemented to aid in preventing further fuel oil spills.

Fire pump location and space rating - 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. The system serves 10 sprinkler heads in the safe house and flammable materials are very limited. Fire pumps are typically installed in rated spaces, separated from other building systems.

- 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.

5. CONCLUSION

The panel members in attendance indicated the construction site visit proved necessary, was informative, and valuable for the assessment of design-construction criteria for the IEPR process. Open items from the previous site visit were revisited and several new critical observations were identified and discussed.

The Panel made several recommendations that the USACE PDT has not committed to adopting. Those recommendations include providing physical protection of the fuel farm electrical service, and specific control system modifications discussed in Section 4.3.2 to aid in the prevention of fuel spills from the fuel oil return tanks[2].

[2] USACE did not commit to doing what the Panel recommended. USACE chose to provide an alarm for "not in auto" and procedure controls prior to starting main pumps. The USACE has requested a modification for "not in auto" alarm.

This page intentionally left blank

ATTACHMENT 1

Site Tour Agenda

This page intentionally left blank

WCC IEPR Construction In-Brief
23 Sep 11
Project Site @ 0800

0800 - Introductions (15 min) EDC Trailer Conference Room

0815 - Discussion about Pump Test and Status of Electrical and Mechanical (15 min)

0830 - Safety Brief and PPE (Wagner/Soraghan) (15 min)

0845 - Site Visit (Wagner w/ ED & CD staff) (3 hrs)

1145 - Lunch (1 hr)

1245 - Meet with Key Design Personnel (All) (30 min) EDC Trailer Conference Room

1315 - Wrap-up/Final Comments (All) (30 min) EDC Trailer Conference Room

Conf Call Information for 12:45 Meeting w/ Design Personnel
Call-in #: (877) 322 - 9648
Code: 671 261

Note to all site visit participants:
Please wear long pants and steel toed shoes. No open toe shoes, high heels, tank tops, or Capri pants. Please keep in mind that this is an active construction site. Personal Protective Equipment (PPE) consisting of safety vests, hard hats, safety glasses, and earplugs will be provided on site.

ATTACHMENT 2

Site Tour Attendance List

This page intentionally left blank

GIWW – West Closure Complex

IEPR Site Visit #3

23 Sep 11

Printed Name	Signature	Organization
Sheila Rice McDonnell	Sheila Rice McDonnell	USACE-MVK
Richard Rossman		BATTELLE IEPR
Paul Carson		IEPR Reviewer
Robbie Camerlca		IEPR Reviewer
Stefan Miller		USACE Designer
James McMenis	James McMenis	CPRA
David Lovett		USACE
Danny Caluda	Danny Caluda Jr.	SLFPA-W
Richard Cordes	Richard R Cordes	USACE-ED-T
Matt Sonnier	Matt Sonnier	USACE-EC-Atchafa
Aaron Heidenreich	Aaron Heidenreich	USACE-MVR-EC-N
Jeremy Fall	Jeremy B Fall	CPRA
Tawanda Wilson-Prater	Tawanda Wilson-Prater	USACE-TFH
Doug Young		ARCADIS
Bob Castro (phoned-in)		USACE-MVR

ATTACHMENT 3

Battelle Out-brief

This page intentionally left blank

IEPR GIWW

Construction Site Visit 3 Outbrief

September 26, 2011

Agenda

- Introductions
- Purpose
- Positive Feedback
- Question/Concerns
- Remaining Open Issues

Introductions

- Battelle
  - Richard Rossman – Deputy Project Manager
- Peer Reviewers

Name	IPR Discipline
David Lourie	Geotechnical Engineer*
Bill Miles	Structural Engineer*
Michael Ports	Hydraulic Engineer*
Alan Hall	O&M/Civil Engineer*
Ebow Coleman	Material Engineer*
Robbie Cameruca	Electrical Engineer
Paul Carson	Mechanical Engineer

(*- were not in attendance , as planned, at the September 23, 2011 site visit and are not part of the outbrief teleconference)

Purpose of Out-Brief

- Document the resolution of issues identified during the last site Visit in January 2011
- To provide results of the September 23, 2011 construction site visit
- Identify remaining Open Issues

Site Review – Positive Feedback

- The IEPR Team appreciates the USACE commitment to the IEPR process by supporting the mechanical and electrical panel member visit as requested at the previous site visit.
- The project is impressive and appears to be on its way to completion.

Concerns Addressed After Jan 2011 Site Visit

- Lack of statistically significant random sampling/monitoring/documenting program for installation of the foundation piles
  - The USACE Provided the following response "A statistically significant random sampling/monitoring program using a pile driving analyzer (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 QA/QC 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 Team appreciates the response and it clarifies what was done. However, the Team's opinion is that the program was not as complete or as comprehensive as it should have been. Consequently, it fails to provide the degree of quality assurance that the IEPR Team believes is merited on a project of this importance and magnitude. The IEPR Team has concerns that the program was not consistent with the current state-of-the-practice for driven pile foundations for major or critical structures with life-safety implications.

Concerns Addressed After Jan 2011 Site Visit

- The IEPR Team raised the concern that energy dissipaters were needed on the flood side of the pump station
  - IEPR Team's concern was addressed by the PDT response generally stating periodic surveys and surveys after any major storm event would be performed.
- The IEPR Team was concerned with the excavation of the inflow and discharge meeting the design.
  - IEPR Team was satisfied with the PDT response generally stating that the contractor must provide a final compliance survey showing they constructed with in design elevations and tolerances of the contract.

Concerns Addressed After Jan 2011 Site Visit

- IEPR Team was concerned about the coordination of the utility installation and recommended that it be closely monitored
  - IEPR Team was satisfied with the PDT response that the Entergy utility supply was completed in early May, 2011
- IEPR Team was concerned about the status of the final short-circuit and coordination study.
  - IEPR Team was satisfied with the PDT response generally stating that the initial short circuit study has been competed with few discrepancies and will continue with corrections and modifications as warranted.

Concerns Addressed After Jan 2011 Site Visit

- The IEPR Team was concerned the Pump Station settlement may affect equipment installation and operation
  - The IEPR Team was generally satisfied with the PDT response and the Arcadis Settlement Reports provided. The IEPR Team concurs with the recommendation in the Arcadis Settlement reports to verify the control benchmark on a monthly basis.
- The IEPR team requested confirmation that field service technicians for the engines, gearboxes, and pumps will be present on site to help with the assembly and alignment of the equipment.
  - The IEPR team 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.

Open Issues/Concerns From Jan 2011 Visit

- The IEPR Team is concerned that a single engine fuel or lubrication fire could spread to adjacent sets. The IEPR Team requested details of the fire suppression system planned.
  - IPER Team was not satisfied with the Initial PDT response that the NFPA code establishes the pump house as a low hazard rating and only fire extinguishers are needed . The issue was revisited during the September 2011 Site visit. During the September site visit the IEPR Team 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

  Overall, the risk of a fuel fire in the pump station is adequately addressed by the design and construction of the pump station.

Open Issues/Concerns From Jan 2011 Visit

- IEPR team recommends additional physical protection of power and control conduits on access bridge
  - The panel member is concerned about the control wiring to the fuel farm. They believe it is still exposed to a risk of failure during a storm event and revisited the issue during the September 23rd site visit. The IEPR Team is still believes additional protection of these features should be considered. Failure of the fuel service would create a systemic failure of the pump station.

Issues/Concerns From September 2011 Visit

- During the IEPR Visit the Team learned of a startup and commissioning issue with the controls of the fuel return system. The IEPR team concurs with the design team's statement that the fuel return pumping system will be better integrated into the pump operational scheme. Specifically:
  - A pump start permissive may be added that requires the fuel return pumps to be in "auto"
  - Additional alarms may be added for high-high fuel levels in the fuel return tanks

Issues/Concerns From September 2011 Visit

- The IEPR Team 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. The system only serves 10 sprinkler heads in the safe house and flammable materials are very limited. Fire pumps are typically installed in rated spaces, separated from other building systems.
  - Failure of this system would represent multiple levels of failures of other features. The IEPR team believes the risk of this is limited but may be an issue revisited with local fire authorities.

Issues/Concerns From September 2011 Visit

- The IEPR Team noted the absence of protection of the utility transformer. The transformer is pad mounted on the access ramp adjacent to the trash rack.
  - The PDT noted that plans are in place to provide bollards to protect this equipment.
- HVAC unit cooling the server room was in fault mode (Hi-head lockout) and not properly cooling.
  - Maintenance was planned to check the unit

Issues that Remain "Open" From All Site Visits

It is anticipated that there will not be further dialogue to address the issues below. They will be noted in the Final Site Visit Report.

- Lack of statistically significant random sampling/monitoring/documenting program for installation of the foundation piles.
- Recommend additional physical protection of power and control conduits on access bridge be reconsidered.

ATTACHMENT 4

USACE Outbrief Attendance List

This page intentionally left blank

Attendence Record

Date(s)	Sponsoring Organization	Location
26 Sep 11	TFH/PRD	Room 381

Purpose: WCC IEPR Construction Site Visit #3 Out-Brief

	Name	Organization	Telephone No.
1	Darren White	SLFPA-W	
2	Matt Soraghan	MVN Const.	
3	Jules Boudreaux	MVN CD	
4	Pat		
5	Bob Castro	USACE-MVR	
6	James McMenis	CPRA	
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			

Attendence Record

Date(s)	Sponsoring Organization	Location
26 Sep 11	TFH/PRD	Room 381

Purpose: WCC IEPR Construction Site Visit #3 Out-Brief

	Name	Organization	Telephone No.
1	Dani Alexander	PRD	x21161
2	Tawanda Wilson Prater	TFH	x2926
3	Steve Conravey	CD	x 2235
4	Carly Hyer	Task Force Hope	x1488
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			

Also in attendance:

Julie Fritz	USACE PCX
Sheila Rice McDonnell	USACE PCX