Final Independent External Peer Review Report

Independent Peer Review of Greater New Orleans Hurricane Storm Damage Risk Reduction System Design Guidelines:

Spiral Welded Pipe Piles for Coastal Structures

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

Contract Number: W911NF-07-D-0001
Task Control Number: 08250
Delivery Order: 465

March 26, 2010

ACKNOWLEDGEMENTS

This work was supported by the U.S. Army Corps of Engineers (Harvey Johnson, Julie Fritz) under the auspices of the U.S. Army Research Office Scientific Services Program administered by Battelle (Delivery Order 465, Contract No. W911NF-07-D-0001)

SHORT TERM ANALYSIS SERVICE (STAS)

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for the

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ACRONYMS

CAPWAP	Case Pile Wave Analysis Program
CPT	Cone Penetrometer Test
DrChecks[SM]	Design Review and Checking System
FEA	Finite Element Analysis
GNOHSDRRS	Greater New Orleans Hurricane and Storm Damage Risk Reduction System
IEPR	Independent External Peer Review
IPQA	In-Process Quality Assurance
LOP	Lack of Root Pass Penetration
LWP	Longitudinally Welded Pipe
PDA	Pile Driving Analyzer
PDT	Project Delivery Team
PRQCP	Peer Review Quality Control Plan
QA	Quality Assurance
QC	Quality Control
SLT	Static Load Test
SPT	Standard Penetration Test
SWP	Spiral Welded Pipe
USACE	United States Army Corps of Engineers
WRDA	Water Resources Development Act

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Executive Summary

The U.S. Army Corps of Engineers (USACE) is currently designing and constructing the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS). A vital component of this system is the guidelines used to inform and guide the project designers. One portion of the GNOHSDRRS Design Guidelines (here after referred to as Design Guidelines) will be a section entitled Spiral Welded Pipe (SWP) Piles for Coastal Structures (hereafter referred to as SWP Pile Section), which is intended to be used in the design of about four miles of floodwalls and six major structures throughout the GNOHSDRRS.

SWP piles have not been previously used for the proposed installations in this area; therefore the USACE determined that it was necessary for this section to be subjected to independent external peer review (IEPR). Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

Battelle Memorial Institute (hereafter Battelle), as a non-profit science and technology organization with experience in establishing and administering independent external peer reviews, was engaged to coordinate the IEPR of the Design Guidelines and the SWP Pile Section. The IEPR followed the procedures described in the Department of the Army, USACE guidance *Review of Decision Documents* (EC 1105-2-410) dated August 22, 2008; CECW-CP Memorandum dated March 30, 2007; *Engineering and Design, Quality Management* (ER 1110-1-12) dated July 21, 2006; and *Engineering and Design, DrChecks* (ER 1110-1-8159) dated May 10, 2001. This final IEPR report describes the IEPR process followed by the external panel of experts, summarizes final comments of that IEPR panel, and describes the panel members and their selection.

The purpose of an IEPR is to strengthen the quality and credibility of the USACE's decision documents in support of its Civil Works program. The SWP review was conducted under a contract modification to the Design Guidelines Design Guidelines review which originated in August 2008. This IEPR panel reviewed the 25%, 75%, and 100% versions of the SWP Pile Section and the accompanying 75% specifications.

The two independent external peer reviewers (i.e., panel members) contracted to perform the SWP Pile Section review were identified and selected from the structural and geotechnical members of the original ten-member panel that performed the initial Design Guidelines review. The panel members were selected for their technical expertise, their confirmed availability, lack of potential conflicts of interest, and knowledge of the Greater New Orleans area.

For each review, the IEPR panel members focused on:

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

In order to maintain independence and control, the IEPR panel members were not permitted to have direct or unmonitored e-mail or phone contact with the USACE Project Delivery Team (PDT). All interaction between the IEPR panel and USACE either occurred in DrChecks, the USACE's web-based tool for facilitating design reviews, or via teleconference with Battelle and a USACE Baltimore representative present.

Below is a description of each review that was conducted.

25% SWP Pile Section Review

The 25% SWP Pile Section IEPR review began on July 23, 2009 when the panel members were provided with hard and/or electronic copies of the 25% version. Twenty-one comments were entered by the two panel members into DrChecks by August 5, 2009. A teleconference to discuss the comments and possible changes was held on August 13, 2009. USACE provided additional testing reports on August 28 and 31, 2009 and held a second teleconference on September 1, 2009 to further discuss the response to comments and changes. On September 14, 2009, the USACE completed its evaluations and the panel members' entered Backcheck responses in DrChecks between September 28, 2009 and November 16, 2009.

75% SWP Pile Section Review

The 75% SWP Pile Section IEPR review began on September 9, 2009 when the panel members were provided with hard and/or electronic copies of the file "75%SPECS," which was followed by the 75% version on October 6, 2009. Comments on the 75%SPECS were provided using the "track changes" feature in the Microsoft Word© document and were not entered into DrChecks. However, 53 comments were developed on the 75% version and were entered into DrChecks by October 19, 2009. On October 23, 2009, USACE completed its evaluations and a teleconference to discuss some of the comments and possible changes was held on October 28, 2009. The panel members entered Backcheck responses in DrChecks by November 16, 2009; however, five comments remain open as of March 3, 2010 waiting for USACE concurrence.

100% SWP Pile Section Review

The 100% SWP Pile Section IEPR review began on December 2, 2009 when the panel members were provided with hard and/or electronic copies of the 100% version. The 100% Geotechnical Appendix for review was received on December 15, 2009.

Seventy-one comments on the 100% version were entered by the two panel members into DrChecks by December 29, 2009. A teleconference to discuss the comments and possible changes was held on January 15, 2010. On January 27, 2010, the USACE completed its evaluations and the panel members' entered Backcheck responses in DrChecks by January 29, 2010.

Comments from the Reviews

Throughout the comments on the three reviews, the IEPR panel members recommended various additional details/clarifications be added to improve the design guidance and future use of the SWP piles. Below are those items noted by the panel as being most important:

- Ensure that the guidance conveys that pile capacity values are time-dependent and the capacity that is determined from Case Pile Wave Analysis Program (CAPWAP) analysis is the capacity that exists at the time the data were collected, not necessarily the ultimate pile capacity.
- Recognize that CAPWAP is a curve-fitting technique with more than one possible solution. So while the total CAPWAP capacity may be close to the static load test (SLT) or predicted capacity, which consists of a skin-friction component and an end-bearing component, it is possible for multiple load-distribution combinations to give the same total capacity value. Given this possibility and given that data from the pile driving analyzer (PDA) and CAPWAP analyses are being used as part of the USACE's quality assurance (QA) and pile acceptance procedures during construction, a separate study should be initiated to compare the CAPWAP load distributions with those from the static pile capacity methods based on the geotechnical design soil parameters and those from instrumented load tests to see how they compare and to support the reliance on the PDA and CAPWAP.
- Provide guidance about the planning and execution of future pile installation and load test programs to ensure that they are well conceived and comprehensive to maximize their value. Additionally, the programs should be structured such that contract and logistical issues do not diminish the value of the test program.
- Address the absence of comprehensive In-Process Quality Assurance (IPQA) for the spiral weld operation, given that this is a major concern as there is a significant risk that potential weld defects along the spiral may go undetected.
- Address issues related to lack of complete joint penetration along the spiral weld, which has been a major problem associated with the spiral welded pipes.
- Add guidance to the Design Guidelines document for geotechnical and structural engineers about conducting soil- structure interactions (SSI) analyses using SWP and other pile types.

Note that it was recognized that some of the items noted above will need to be addressed in other sections of the Design Guidelines or in reports other than the SWP Pile section. The remaining comments focused on offering recommendations to clarify the design guidance and ensure interagency approval.

In total, across the three reviews, the USACE PDT evaluated and responded to 145 comments: concurring with 116 comments; agreeing to provide additional information in

support of four comments; stating they needed to check and resolve issues raised on five comments; and non-concurring with 20 comments, for which an explanation was provided with each. Upon review of the USACE PDT responses, the IEPR panel members determined that some comments needed further discussion as the comments were inadequately addressed. Four IEPR teleconferences were conducted throughout the three reviews for the IEPR panel and USACE PDT to discuss those comments that were either identified by the panel as being inadequately addressed or for which the USACE PDT needed further explanation. Upon completion of the IEPR teleconference and subsequent evaluations by the USACE PDT, the IEPR panel members considered most of the comments adequately addressed and closed all of the comments except five that are awaiting response from USACE. In general, the IEPR panel members agreed that axially loaded SWP piles appear to be acceptable and viable alternatives to H-piles, LWP piles, and other piles for coastal structures in the USACE's GNOHSDRRS projects. The IEPR panel members base this conclusion on their review and interpretation of the data developed during this study, which was presented to the panel. Furthermore, the panel members' conclusion about the use of SWP piles is subject to following limitations:

(1) The sites must have geotechnical conditions similar to those at the test sites, and the installation and monitoring of the piles during installation must be consistent with the methods used to install the test piles; and

(2) The spiral welding operations and the resulting spiral welded joints must be subjected to adequate quality control and quality assurance programs.

1. INTRODUCTION

1.1 Background of Program

The U.S. Army Corps of Engineers (USACE) is currently designing and constructing the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS). A vital component of this system is the guidelines used to inform and guide the project designers. One portion of the Design Guidelines will be a section entitled Spiral Welded Pipe (SWP) Piles for Coastal Structures (hereafter referred to as SWP Piles Section), which is intended to be used in the design of about four miles of floodwalls and six major structures throughout the GNOHSDRRS.

SWP piles have not been previously used for the proposed installations in this area; therefore the USACE determined that it was necessary for this section to be subjected to independent external peer review (IEPR). Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

Battelle Memorial Institute (hereafter Battelle), as a non-profit science and technology organization with experience in establishing and administering independent external peer reviews, was engaged to coordinate the IEPR of the Design Guidelines. The IEPR followed the procedures described in the Department of the Army, USACE guidance *Review of Decision Documents* (EC 1105-2-410) dated August 22, 2008; CECW-CP Memorandum dated March 30, 2007; *Engineering and Design, Quality Management* (ER 1110-1-12) dated July 21, 2006; and *Engineering and Design, DrChecks* (ER 1110-1-8159) dated May 10, 2001.

This final IEPR report describes the IEPR process followed by the external panel of experts, summarizes final comments of that IEPR panel, and describes the panel members and their selection.

1.2 Project Description

GNOHSDRRS Design Guidelines, herein after referred to as the "Design Guidelines," is a compendium of design guidance and standards for engineers and designers engaged in work for the U.S. Army Corps of Engineers New Orleans District. This IEPR reviewed the 25%, 75%, and 100% version of the Design Guidelines SWP Pile Section and the accompanying 75% specifications.

1.3 Purpose of the Independent External Peer Review

The purpose of an IEPR is to strengthen the quality and credibility of the USACE's decision documents in support of its Civil Works program. To help ensure that USACE documents are supported by the best scientific and technical information, a peer review process has been implemented by the USACE. This process utilizes an IEPR to complement the agency technical review, as described in the Department of the Army, USACE guidance *Review of Decision Documents* (EC 1105-2-410) dated August 22, 2008, and CECW-CP Memorandum dated March

30, 2007. In this case, the IEPR of the SWP Pile Section was conducted and managed using contract support from an independent 501(c)(3) organization, Battelle, to ensure independent objectivity, along with a high degree of flexibility and responsiveness, which was essential for the USACE to meet deadlines.

2. INDEPENDENT EXTERNAL PEER REVIEW PROCESS

This section describes the methodology followed in selecting IEPR panel members, and in planning and conducting the IEPR. The IEPR followed the process described in the Peer Review Quality Control Plan (PRQCP), which Battelle developed in August 2008 for the original Design Guidelines Manual review. It also was conducted following procedures described in the USACE's guidance cited above (Section 1.1) and in accordance with the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review*, released December 16, 2004. In addition, supplemental guidance on the evaluation of conflicts of interest from the National Academies' *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports*, dated May 12, 2003 was followed.

2.1 Planning and Schedule

The SWP review was conducted under a contract modification to the Design Guidelines review which originated in August 2008. Table 1 defines the schedule followed by Battelle in executing the IEPR for each respective review version of the SWP Pile Section.

Table 1. Schedule

Activities	25% Review	75% Review	100% Review
Documents Received	July 23, 2009; August 28, 2009; August 31, 2009	September 9, 2009 (75%SPECS); October 5, 2009	December 2, 2009; December 9, 2009; December 15, 2009; January 8, 2010
Review Start Date	July 23, 2009	September 9, 2009 (75%SPECS); October 6, 2009	December 2, 2009
Review End Date/ DrChecks Comments Entered	August 5, 2009	September 18, 2009 (75%SPECS; not in DrChecks); October 19, 2009	December 29, 2009
Number of DrChecks Comments Entered	21	53	71
Teleconference Call(s)	August 13, 2009, September 1, 2009	October 28, 2009	January 15, 2010
USACE Complete Comment Evaluation	September 14, 2009	October 23, 2009	January 27, 2010
Panel Members Complete Backchecks	September 28, 2009 to November 16, 2009	November 16, 2009	January 29, 2010
DrChecks Comments that Remain Open	0	5	0

2.2 Identification and Selection of Independent External Peer Reviewers

The two independent external peer reviewers (i.e., IEPR panel members) contracted to perform the SWP Pile Section review were identified and selected from the structural and geotechnical members of the ten member panel selected for the original Design Guidelines review. The panel members were selected for their technical expertise, their confirmed availability, lack of potential conflicts of interest, and knowledge of the Greater New Orleans area.

The two reviewers selected for the final IEPR panel were independent engineering consultants. Corresponding to the technical content of the SWP Pile Section, the areas of technical expertise of the selected panel members included: geotechnical engineering and structural engineering (see Section 3 for names and biographical information of the selected panel members). Battelle established subcontracts with the panel members after they had indicated their willingness to participate and reconfirmed the absence of conflicts of interest (through e-mail as they had previously signed conflict of interest forms on file for the original Design Guidelines reviews).

2.3 Review

Three separate reviews were conducted of the SWP Pile Section. Reviews of the 25%, 75%, and 100% version were conducted, each resulting in comments which were entered separately into DrChecks^{SM} (Design Review and Checking System) under the Design Guidelines project. For each review, the IEPR panel members focused on:

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

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

Below is a description of each review that was conducted.

25% SWP Pile Section Review

The 25% SWP Pile Section IEPR review began on July 23, 2009 when the panel members were provided with hard and/or electronic copies of the 25% version. Twenty-one comments were entered by the two panel members into DrChecks by August 5, 2009. A teleconference to discuss the comments and possible changes was held on August 13, 2009. USACE provided

testing reports on August 28 and 31, 2009 and a second teleconference was held on September 1, 2009 to further discuss the response to comments and changes. On September 14, 2009, the USACE completed its evaluations and the panel members' entered Backcheck responses in DrChecks between September 28, 2009 and November 16, 2009.

75% SWP Pile Section Review

The 75% SWP Pile Section IEPR review began on September 9, 2009 when the panel members were provided with hard and/or electronic copies of the file "75%SPECS," which was followed by the 75% version on October 6, 2009. Comments on the 75%SPECS were provided using the "track changes" feature in the Microsoft Word© document and were not entered into DrChecks. However, 53 comments were developed on the 75% version and were entered into DrChecks by October 19, 2009. On October 23, 2009, USACE completed its evaluations and a teleconference to discuss some of the comments and possible changes was held on October 28, 2009. The panel members entered Backcheck responses in DrChecks by November 16, 2009; however, five comments remain open as of March 3, 2010 waiting for USACE concurrence.

100% SWP Pile Section Review

The 100% SWP Pile Section IEPR review began on December 2, 2009 when the panel members were provided with hard and/or electronic copies of the 100% version. The final Geotechnical Appendix for review was received on December 15, 2009.

Seventy-one comments on the 100% version were entered by the two panel members into DrChecks by December 29, 2009. A teleconference to discuss the comments and possible changes was held on January 15, 2010. On January 27, 2010, the USACE completed its evaluations and the panel members' entered Backcheck responses in DrChecks by January 29, 2010.

Critical Comments

In total, the panel members produced 145 individual comments across the three reviews. Of these, the peer reviewers developed 22 comments which they considered to be critical. Critical comments are defined by the Water Resources Development Act (WRDA) 2007 (Public Law 110-114), Section 2035 (i.e., Type II IEPR), as being associated with issues that address public safety, health, and welfare. Figure 1 shows an example of a critical comment from the review. Note that the name of the IEPR panel member, the USACE PDT member who provided the response, and names provided within the response have been removed in this example.

2.4 IEPR Teleconferences

Battelle led four IEPR teleconferences between members of the USACE PDT who responded to the DrChecks comments and the IEPR panel members. Each IEPR teleconference provided an interactive, real-time forum for a discussion of those comments that the IEPR panel members considered inadequately addressed regarding the review, or for which the USACE requested further discussion. These teleconference also provided an opportunity for the IEPR panel members to understand some of the responses from the USACE PDT. Overall the teleconferences were successful in clarifying and resolving many of the issues. The USACE had some comments that needed further research, but in general at the conclusion of a teleconference, the IEPR panel members considered most of their comments adequately addressed.

Figure 1. Example of a Critical Comment from the Review

2686663	Structural	n/a'	n/a	n/a
The effects of weld-profile and pipe thickness on fatigue strength must be addressed for areas where pile foundation may be subjected to cyclic loading (e.g. dynamic wave loadings, etc.) Submitted On: 05-Aug-09				
1-0	Evaluation **Concurred** Evaluation by … SWP Team: For welded joints with a sharp notch at the weld toe, scaling up the size of the weld and the size of the notch results in a decrease in fatigue strength. Improved weld profiles will keep the notch effect constant over a wide range of thickness, mitigating the size effect. In a fully ground weld profiles or for those profiles which merge smoothly with the adjoining base metal, the size effect is drastically reduced or becomes structurally insignificant. For tubular connections, "AWS D1.1 Provision 2.20.6.7 Size and Profile Effects" provides thickness limit to various stress (fatigue) categories. For butt splices with CJP groove welds in the as-welded condition (stress category C1) is limited to 2 inches in thickness. For applications exceeding this limit, consideration should be given to reducing the allowable stresses or improving the weld profile. This AWS provision does not cover spirally welded pipes. Since the spiral weld is at 45° angle to the load direction under longitudinal bending or compression, the size effect is expected to be smaller as compared with the seam and splice welds. Therefore, the 2-inch thickness limitation for stress category C1 should be applicable to the spiral welds. For the pile foundations subjected to cyclic loading (e.g. dynamic wave loading), this stress category C1 is suitable for design. Since the practical wall thicknesses of the spirally welded pipe piles are smaller than the 2-inch size limitation, stress category C1 may be used without considering the size effect. Submitted On: 14-Sep-09			
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted On: 12-Oct-09			
	Current Comment Status: **Comment Closed**			

2.5 IEPR Final Report

After concluding the 100% review, Battelle prepared this final report on the overall IEPR process and the IEPR panel member's findings. This report was reviewed by each IEPR panel member and Battelle technical and editorial reviewers prior to submission of this report to the USACE.

3. IEPR PANEL MEMBER SELECTION

At the USACE's request, Battelle identified and selected two of the original Design Guidelines panel members to serve as reviewers of the three SWP Pile Section versions. One geotechnical engineer out of the three geotechnical engineers on the original panel and one structural engineer out of the two structural engineers on the original panel were chosen. Both IEPR panel members met the following minimum requirements:

- Registered professional (or equivalent in home country)
- Masters degree
- 15 years of experience and responsible charge of engineering work

Panel members in each discipline also were required to have specific technical experience in the areas of expertise specified in the scope of work. This expertise and the panel members chosen

are summarized in Tables 2 and 3 below. A summary of the credentials of the two reviewers selected for the IEPR panel and their qualifications in relation to the technical evaluation criteria is presented below. Resumes including more detailed biographical information for each reviewer and his technical areas of expertise are presented in Appendix A.

Table 2. Required Technical Experience for IEPR Panel Members

Discipline (# of Reviewers)	Required Experience
Geotechnical Engineer (1)	• Very soft Louisiana-type clay soil foundations • Large diameter pile design • Axial and lateral load testing for piles • T-wall and L-wall design • Subsurface investigations in very soft soil • Seepage design • Wave impact/armoring • Slope stability analyses for very soft soils • Pile foundations
Structural Engineer (1)	• Sector gates and/or lift gates subject to high wind and wave loading • T-wall and L-wall floodwall design • Welding

Table 3. Final List of IEPR Panel Members

Discipline/Name	Affiliation	Location	Education	P.E.	Years of Experience
Geotechnical/Civil Engineer					
David E. Lourie	Lourie Consultants	Metairie, LA	BSCE, MSCE	Yes	30
Structural Engineer					
Jay Jani	Engineering Consulting Services, Inc.	Metairie, LA	BSCE, MSCE, Ph.D	Yes	25+

Dr. Jay Jani, P.E., is a structural engineer with over 25 years of design experience in civil and marine/offshore engineering industries. For the past nine years, Dr. Jani has been the President and Senior Structural Engineer of Engineering Consulting Services, Inc. and has worked on a variety of structural design and assessment projects, as well as performed independent technical reviews (ITRs) for several structural design projects in the New Orleans area. For example, Dr. Jani performed the ITRs of the structural design of T-walls for several pumping stations in New Orleans, as well as reviews of the Inner Harbor Navigational Canal Replacement Lock, Riverside Gatebay Module and the Harvey Canal Flood Wall Design in New Orleans. Dr. Jani has also performed the structural design of Internet Protocol Network Weather Station Equipment Support Structures and Lateral Support Systems at various canals in New Orleans, LA. Dr. Jani served as Chairman and Vice Chairman of ASCE-SEI, New Orleans Chapter during their 2008-2009 and 2007-2008 terms respectively. He also served as an adjunct faculty in the Civil Engineering Department at University of New Orleans.

David E. Lourie, P.E., is a practicing engineer with 30 years of consulting experience. He has expertise in South Louisiana soil conditions, local area geology, and geotechnical conditions. He has performed complex geotechnical investigations for the petrochemical industry, airports, ports, State and Federal agencies, and others in the region. Before forming Lourie Consultants in 1992, he spent 9 years directing the technical and financial operations of Fugro-McClelland (Southeast), Inc. and McClelland Engineers in Louisiana. Before that, he worked as an onshore and offshore geotechnical engineer for McClelland Engineers in Houston, Texas, and as a soil and materials engineer for STS Consultants in Chicago, Illinois. He serves as a Liaison to the Peer Review Committee of ASFE/The Geoprofessional Business Association and is its current national president. Mr. Lourie has been an adjunct associate professor at Tulane University, a visiting professor at McNeese State University, and a guest lecturer at Louisiana State University and the University of New Orleans. He is an active member of numerous professional and technical societies, including the Louisiana Engineering Society, American Society of Civil Engineers, Geo-Institute, Geotechnical Activities Group of New Orleans, American Council of Engineering Companies, and ASFE.

4. RESULTS – SUMMARY OF REVIEW

The IEPR panel members followed the processes described in Sections 2.3 through 2.5 to conduct their review, execute the IEPR teleconferences, and to finalize remaining comments in DrChecks. These processes were in accordance with all USACE guidance documents. Listed below are summaries of how the IEPR panel experts in the different disciplines approached their reviews, comments that the panel members made, and the status of any open issues including critical items.

4.1 Overall Review Approach

This section describes how the IEPR panel members in the different disciplines approached their reviews and documented their comments in DrChecks. The IEPR panel members were encouraged to work individually according to their assigned expertise and to also contribute to the reviews being conducted by the reviewers in the other disciplines, as appropriate based upon their experience. In general, each of the reviewers worked individually in reviewing the 25%, 75%, and 100% IEPR review versions. IEPR panel members were able to discuss their comments with the other panel member if they determined that this was appropriate prior to input of their comments in DrChecks. Internal IEPR panel discussions occurred on several occasions.

Geotechnical Engineering Review Approach
During the review of the documents, the geotechnical engineer focused on:

- Understanding the issues associated with using SWP piles as deep foundation elements based on his knowledge and experience, as well as independent research and the information presented in the document;
- Identifying critical issues that could be associated with using SWP piles as deep foundation elements;

- Understanding the various components of the test programs and assessing their ability to provide the information necessary to answer questions about the suitability of SWP piles to be used as deep foundation elements;
- Identifying the limitations of the test programs and assessing their influence on the data obtained;
- Reviewing the data from the test programs and the USACE's interpretations and conclusions derived from the data;
- Making an independent interpretation of the data to the extent necessary to evaluate the USACE's conclusions and develop his own opinions and conclusions; and
- Assessing the degree to which the final document completely and clearly describes the study and its findings.

Structural Engineering Review Approach
Since the SWP Piles are being used for the first time for some structures and floodwalls in the USACE's GNOHSDRRS projects in New Orleans and vicinity, the primary objective of the Structural Engineer was to assess the structural integrity of the proposed pipe piles and the spiral welded joints. The Structural Engineering review mainly focused on the following major areas:

- The quality of spiral welded joints;
- Concerns about the potential weld defects (e.g., root pass penetration, lack of side wall fusion, lack of cross penetration, for high strength steel matching weld metal properties to base metal);
- Need for In-Process Quality Assurance (IPQA) of the spiral weld;
- Four Point Flexural Load Tests procedures and results; and
- Finite Element Analysis (FEA) and results.

4.2 Summary of IEPR Panel Comments

The comments made during the SWP Pile Section reviews have been placed into one of four categories based on the response provided by the USACE PDT. These categories include:

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

Table 4 provides a summary of the number of comments in each of the above categories.

Table 4. Categorized DrChecks Comments

Review	Total Comments	Initial Critical Comments	For Information	Suggestion for Clarification	Value Added	Open Comments
25%	21	9	1	12	8	0
75%	53	5	6	40	7	5
100%	71	8	11	48	12	0

Following are summaries of the types of comments provided in DrChecks for each of the reviews and the resulting USACE evaluations (i.e., concurred and non-concurred).

25% SWP Pile Version Review

For this review, the document was in the first stages of development. Therefore, in general, the 21 comments developed by the panel requested additional information or clarification about a specific topic.

The geotechnical engineer provided eight comments. USACE responded to the comments, concurring with seven and non-concurring with one. The seven comments that USACE concurred with focused on clarification of the report, specifically, recommendations to provide more information on:

- Historical versus current manufacturing process in Section 2;
- Pile driving and load tests in Section 6;
- Field splicing procedures presented in Appendix A;
- Interviews with owners, designers, and contractors to include any lessons learned;
- Proposed static load testing installation and testing programs;
- The test site's geotechnical conditions, instrumentation, installation, and loading programs;
- Where factual statements versus opinions are used, especially in Section 4; and
- The conclusions drawn, to more strongly support the documents findings.

The one comment that USACE responded with "Non-concurred" suggested that the report contain guidance for geotechnical and structural engineers on conducting soil-structure interaction (SSI) analyses using SWP piles. The reason provided by the USACE for their non-concurrence was that the intent of the report is a performance assessment on SWP piles for consideration in future southeast Louisiana projects rather than development of a guidance document. With this explanation from USACE, this comment was closed by the panel member with no further discussion.

The structural engineer provided 13 comments. USACE concurred with ten of the comments and provided a "Check and Resolve" response to one comment. These comments covered the following topics:

- Providing additional discussion and justification for the use of SWP piles as structural piles in lieu of the conventional steel H-piles;

- Studying and evaluating the potential for eccentric cross sections at the field splice and its overall effect on the pile load carrying capacity (Note: this was a "Check & Resolve" status);
- Adding a detailed description on the SWP pile manufacturing process, including sketches and photographs;
- Providing a discussion on the material properties of the steel (base metal) and the weld material used for SWP pile;
- Evaluating and discussing the interaction between the SWP pile and splice welded pile and its effect on the pile load carrying capacity;
- Adding discussion on the potential weld defects and imperfections, as appropriate;
- Including a detailed discussion on the Skyline Steel's laser vision seam tracking operation and their Weld Quality Assurance procedures;
- Implementing an In-Process Quality Assurance (IPQA) Program to assure the quality of the spiral weld during manufacture;
- Explaining the effect of "stress concentration" at the spiral welded joint during pile driving operations and throughout the service life;
- Addressing the effects of weld-profile and pipe thickness on fatigue strength in areas where pile foundation may be subjected to cyclic loading; and
- Providing a discussion on the types of pile hammers which may be used for driving piles along with a selection of pile hammer size, setup, refusal, installation recording keeping, and corrosion and corrosion protection.

The two items that USACE evaluated as "nonconcurred" were related to SSI analysis and additional pile test load recommendations. Both comments were closed without further discussion.

Responses to several of the comments stated that additional information would be included in the report. This was taken into consideration upon reviewing the 75% version. Comments made on the 75% version are provided below.

75% SWP Pile Version Review

During review of the 75% version, the panel developed 53 comments. In general, the comments requested additional information, identified spelling or grammatical errors, or requested clarification of a specific topic.

The geotechnical engineer provided 30 of the 53 comments during the review. USACE concurred with 25 of the geotechnical comments, provided a "Check and Resolve" response to one comment, and non-concurred with four comments. Of these comments, five comments remain open at this time for discussion, including three that were originally given a status of "Non-concurred" and two that were originally given a status of "Concurred."

Of the 25 geotechnical-related comments with which USACE concurred, 23 comments were closed by the panel member. The content of these comments ranged in nature from minor editorial changes to data clarifications. Details regarding some of the data clarification comments are provided below as examples:

- Clarify the discussion about artificial fill in Section 6.7.1.
- Furnish additional supporting information in Section 6.7.1 in regards to the undrained shear strength.
- Provide the electric cone penetrometer test (CPT) data and include a discussion in the text and appendices.
- Provide a clarification on the description of the strength conditions between El-29 and -66.
- Recommend that the section that discusses the purpose of the restrike tests be reworded as it is misleading and would benefit from clarification.
- Recommend that reassessment of the conclusions be conducted regarding the discussion in Section 6.8.8 about the apparent differences in axial pile capacity between pile types.
- Recommend updating the rate of increase in the axial pile capacity based on the reviewer's graphs.
- Recommend adding the requirement to use a pile driving analyzer (PDA) as part of the driving record information that is obtained, recorded and assessed.
- Recommend adding language about using a PDA and conducting Case Pile Wave Analysis Program (CAPWAP) analyses to Appendix E.

The four geotechnical comments that USACE nonconcurred with focused on the importance and significance of discussing specific data such as:

- Discussing the relevance of the minimum time between conducting the compression and tension load tests.
- Providing the status of CAPWAP analyses on the dynamic pile monitoring and testing.
- Clarifying the summary of the test results from the 18-inch diameter pipe piles and discussing the results in the report.
- Emphasizing the value of the PDA data from the initial driving.

The five geotechnical comments that remain open are focused on clarifying discussions of the CAPWAP analysis, restrike test, pile capacity, and load testing. In each case USACE responded to the comment, the panel member and USACE further discussed the comment during a conference call on October 28, 2009, and the panel member responded in DrChecks, documenting his understanding of the USACE/IEPR panel member discussion and conclusions. In four of the five instances these conclusions would result in changes to the document. The panel member is awaiting concurrence by the USACE with these entries (posted November 12, 2009) before closing these comments.

The fifth comment that remains open is in regards to conducting a comparison of CAPWAP load distributions and static pile capacity methods. This was also discussed on the October 28, 2009 call and a response from the panel member was added in DrChecks on November 12, 2009 documenting the discussion. In the response it was noted that the panel member agrees with USACE that the SWP pile document is not the place for the requested comparison; however, he noted that it should be evaluated as part of the overall development of the Design Guidelines (as per the October 28, 2009 discussion) because many engineering decisions are being made based on the CAPWAP analyses. The panel member is awaiting concurrence by USACE with this last entry before closing the comment.

Of the 23 comments on the 75% version presented by the structural engineer, USACE concurred with 18. Eight of the comments that USACE concurred with were minor and focused on items such as spelling mistakes, inconsistency of terms, and data errors. Two comments with a status of "Concurred" requested additional information for objectives or were comments previously addressed and concurred with during the 25% review. The remaining eight comments that USACE concurred with focused on the clarification or addition of data to support the document. The following are examples of the comments requesting additional information:

- Two comments requested clarification on the Skyline Steel's laser vision seam tracking system.
- One comment suggests a discussion be added on the Pipeline Welding IPQA Program.
- One comment suggests including actual values of "Load", "P", "Bending Moment", and "M" at various stages specifically when the failure occurred in the test load results.
- Four comments focused on either the FEA model predictions versus actual results/observations or the selection of the Lack of Penetration direction in the FEA model.

The USACE non-concurred with five of the comments provided by the structural engineer. These five comments focused on three main issues.

- An objective to prepare a QA/QC program for manufacturing the materials used for SWP piles was not included in the report.
- Conclusions surrounding the CAPWAP pile capacity data were not presented in the report.
- Data presented on Site 1 and 2 SWP without the weld beads grounded did not support the conclusions presented in the report.

In all five instances, the panel member provided a response to the USACE's "Non-concurred" designation, and then closed the comment.

Responses to several of the comments stated that additional information would be included in the report. This was taken into consideration upon reviewing the 100% version. Comments made on the 100% version are provided below.

100% SWP Pile Version Review

The review of the 100% version resulted in 71 total comments from the panel. The comments ranged from small editorial changes to clarifications in terminology and data presented. Overall, it was noted that this document was much stronger and better report than previously provided.

The geotechnical expert provided a total of 52 comments on the main 100% version and geotechnical appendix provided. Twenty-four comments focused on editorial updates needed in the report for overall enhancement of the report. These suggestions included minor spelling changes, rewording for consistency and clarity, and notations to make the document easier to read. Thirty-three comments were recommendations for clarification of the data discussions or

suggestions for additional data to enhance the technical report. Examples of those recommendations are provided below:

- Clarify the historic use of SWP piles by USACE and provide additional information to support the application of the study's findings.
- Clarify pile performance in regards to D/t ratio and its importance to weld performance.
- Clarify existing concerns regarding the weld beads and their possible influence on axial pile capacity.
- Provide the locations of the Valero Refinery and the Berth 2 Upgrade projects to aid the reader in understanding the overall area where these tests were conducted.
- Summarize in one section, rather than throughout the document, the load test programs used and dynamic pile monitoring using a PDA and the CAPWAP process.
- Specify the locations where PDA and CAPWAP analyses were not preformed.
- Clarify the interpretation of the overburden influences on the embedded portion of the pile below El-26.
- Clarify discussion of the vibratory hammer on porewater pressure to not unduly target vibratory hammers.
- Update the conclusion section to reflect discussions on rate of strength of gain in the first 10 days.
- Modify the driving resistance description to describe driving penetration.
- Review and confirm that a restrike test should be conducted a minimum of 14 days following completion of the static load test.
- Clarify that the current pile driving and load test discussion focuses on piles that are plugged or have end plates installed rather than open-ended pipe piles that are coring.
- Clarify that piles will penetrate multiple strata that will contribute to the skin friction component of pile capacity, rather than just one stratum.
- Summarize the load test programs to provide a roadmap for the reader.
- Describe operational and interpretive methods in respect to PDA and axial pile load tests in one location in the report then reference throughout the document.

Several comments focused on discussions regarding the strength, consistency, and location of specific clays such as:

- Clarification is needed regarding the discussions of soils in Section 6.8.3 as conflicting data is presented.
- Discussion regarding shear strength of the clays should be updated to note that strength varies by depth depending on the clay type (Recent vs. Pleistocene).
- Explanation is needed on the ground surface elevation value or range in values at the test sites along with a greater explanation of the fill to EL -15.
- Discussion regarding the relative density of SM stratum based on standard penetration test (SPT) and/or CPT data for the granular strata should be included to be consistent with information provided for cohesive strata.
- Discussions around the swap layer at EL -98 should be reviewed and updated along with the consistency description of the Pleistocene clay layer (should be medium to stiff not medium).

The Geotechnical expert also provided a marked-up (i.e., track changes) version of the document containing many of the suggested changes.

The Structural Engineer provided 19 comments on the 100% version of the report. USACE designated all but one of these comments as "Concurred"/"For Information Only." Four comments, including the one comment that the USACE "nonconcurred" with pointed out comments from the 25% and 75% reviews that had not been addressed even though the USACE's evaluations indicated they would be addressed. These included missing data and clarifications in Section 7.3, which had several ambiguous sentences. The one comment that the USACE designated as "Non-concurred" was in regards to a discussion of including additional information on the QA/QC program for the manufacture of the SWP piles. This information was not included in the 100% version though it was stated in the 75% review that it would be included.

The remaining structural engineering comments requested minor editorial changes or the inclusion of additional information to support the document and data presented. Examples of the comments regarding additional information are provided below:

- Clarify in the report the IPQA determination of weld defects.
- Include the actual values of "Load," "P and Bending Moment," and "M at various stages" of the tests including when the failure occurred.
- Include the missing data noted throughout the report.
- Include the findings of the FEA study with regards to the effect of the lack of root pass penetration (LOP) on the stress concentration, associated crack initiation and propagation in the spiral weld joints.

Overall Evaluation

The following sections provide conclusions drawn by each reviewer over the three reviews.

Geotechnical Engineering Overall Comments. From a geotechnical perspective, one of the primary concerns about SWP piles was the influence of the weld beads on axial pile capacity. Another concern was the durability of SWP piles during handling and pile driving. The study revealed that longitudinally welded pipe (LWP) piles and SWP piles with the same diameter and driven at the same site had axial pile capacity values that were similar. This indicates that the weld beads on the exterior of the SWP piles did not have a detrimental influence on axial pile capacity at the test sites. Furthermore, SWP piles proved to be durable and were able to withstand handling and driving without experiencing problems. Thus, axially loaded SWP piles with and without the weld bead ground appear to be acceptable alternatives to LWP piles within the limits of the GNOHSDRRS and in southeastern Louisiana on sites that have geotechnical conditions similar to those at the test sites.

Structural Engineering Overall Comments. Based on the results of the static axial load tests at various sites in Greater New Orleans and the results of Four Point Flexure Load Tests, the SWP may be a viable alternative to using conventional H-Piles or Longitudinal welded steel pipe piles (LWP) for floodwalls and other structures for the USACE's HSDRRS projects in New Orleans and vicinity.

However, the absence of a comprehensive IPQA program for the spiral weld operation remains an area of concern. Due to a lack of an IPQA program, there is a risk that potential weld defects (e.g., lack of cross penetration, lack of side wall fusion, lack of root pass penetration, for high strength steels; matching weld metal properties to base metal) may go undetected. Currently, only the visual inspection of the SWP operation is being performed.

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

As a result of the IEPR teleconferences and resolution of issues included in DrChecks, there are five remaining open comments from the three reviews. None of these open issues were considered critical comments by the panel member at the conclusion of the IEPR of the SWP Pile section reviews. However, one issue needs to be addressed elsewhere within the Design Guidelines report and is described below.

During construction, the USACE relies extensively on the PDA and CAPWAP analyses as QA tools and major components of its pile acceptance criteria. While the PDA and CAPWAP analyses can be valuable, CAPWAP is a curve-fitting technique with more than one possible solution. So while the total CAPWAP capacity may be close to the SLT or predicted capacity, which consists of a skin-friction component and an end-bearing component, it is possible for multiple load-distribution combinations to give the same total capacity value. Because multiple solutions are possible, not all of them are necessarily reasonable, so a separate study should be initiated to compare the CAPWAP load distributions with those from the static pile capacity methods based on the geotechnical design soil parameters and instrumented load tests. Data from the study can then be used to help refine the choice of input parameters for the CAPWAP analysis and to validate the USACE's reliance on the PDA and CAPWAP.

The IEPR teleconferences conducted throughout these three reviews provided an effective voice medium to communicate and discuss peer review comments on the SWP Pile Section with the USACE PDT interactively and in real time. The teleconferences were critical components of the independent peer review process, especially since there was no e-mail or additional telephone contact between the USACE PDT and the IEPR panel members.

5. CONCLUSIONS

The selection of the panel members using pre-defined technical and conflict of interest criteria, as well as the IEPR process itself, were conducted in strict compliance with USACE peer review guidance documents (described previously), and in the PRQCP.

The IEPR panel members were provided with hard and/or electronic copies of the 25%, 75%, and 100% versions of the SWP Pile section documents and supporting documentation. Across the three reviews, 145 comments were developed. The USACE PDT concurred with 116 comments; agreed to provide additional information in support of four comments; stated they needed to check and resolve issues raised on five comments; and non-concurred with 20 comments. An explanation was provided with each comment assigned a "Non-concurred" status. Upon review of the USACE PDT responses, the IEPR panel members determined that some comments needed further discussion as the comments were inadequately addressed. Four IEPR teleconferences were conducted throughout the three reviews for the IEPR panel and

USACE PDT to discuss those comments that were either identified by the panel as being inadequately addressed or for which the USACE PDT needed further explanation (see Table 1).

Of the 145 comments, the IEPR panel identified 22 (15%) as critical comments, and the USACE classified 27 of the 145 comments (19%) as IEPR value-added remarks. Within the comments, the IEPR panel members recommended various additional details/clarifications be added to improve the design guidance and future use of the SWP piles. Below are those items noted by the panel as being most important:

- Ensure that the guidance conveys that pile capacity values are time-dependent and the capacity that is determined from CAPWAP analysis is the capacity that exists at the time the data were collected, not necessarily the ultimate pile capacity.
- Recognize that CAPWAP is a curve-fitting technique with more than one possible solution. So while the total CAPWAP capacity may be close to the static load test (SLT) or predicted capacity, which consists of a skin-friction component and an end-bearing component, it is possible for multiple load-distribution combinations to give the same total capacity value. Given this possibility and given that data from the pile driving analyzer (PDA) and CAPWAP analyses are being used as part of the USACE's quality assurance (QA) and pile acceptance procedures during construction, a separate study should be initiated to compare the CAPWAP load distributions with those from the static pile capacity methods based on the geotechnical design soil parameters and instrumented load tests to support the reliance on the PDA and CAPWAP.
- Provide guidance about the planning and execution of future pile installation and load test programs to ensure that they are well conceived and comprehensive to maximize their value. Additionally, the programs should be structured such that contract and logistical issues do not diminish the value of the test program.
- The absence of comprehensive In-Process Quality Assurance (IPQA) for the spiral weld operation is a major concern as there is a significant risk that potential weld defects along the spiral may go undetected.
- Lack of complete joint penetration along the spiral weld has been a major problem associated with the spiral welded pipes.
- Add guidance to the Design Guidelines document for geotechnical and structural engineers about conducting soil- structure interactions (SSI) analyses using SWP and other pile types.

Note that it was recognized that some of the items noted above will need to be addressed in other sections of the Design Guidelines and in reports other than the design guidance. The remaining comments focused on offering recommendations to clarify the SWP Pile section and ensure interagency approval. Upon completion of the IEPR teleconference and subsequent evaluations by the USACE PDT, the IEPR panel members considered most of the comments adequately addressed and closed all of the comments except five that are awaiting response from USACE. In general, the IEPR panel members agreed that axially loaded SWP piles appear to be acceptable and viable alternatives to H-piles, LWP piles, and other piles for coastal structures in the USACE's GNOHSDRRS projects. The IEPR panel members base this conclusion on their review and interpretation of the data developed

during this study, which was presented to the panel. Furthermore, the panel members' conclusion about the use of SWP piles is subject to following limitations:

(1) The sites must have geotechnical conditions similar to those at the test sites, and the installation and monitoring of the piles during installation must be consistent with the methods used to install the test piles; and

(2) The spiral welding operations and the resulting spiral welded joints must be subjected to adequate quality control and quality assurance programs.

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APPENDIX A

IEPR Panel Member Resumes

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

Experience
25+ years

Expertise
Structural design
Structural integrity assessment

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

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

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

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

Summary of Experience

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

Relevant Projects

- Independent Technical Review (ITR) for USACE's Hurricane Protection Project: Structural Design of T-Walls, 56 feet Sector Gate, Pile Foundation, etc. (95% Submittal), "WBV 16.2 Segnette Pumping Station to New Westwego Pumping Station Flood Wall," N-Y Associates, New Orleans, LA.
- Independent Technical Review for USACE's Hurricane Protection Project: Structural Design of T-Walls, Pile Foundation, etc. (100% Submittal), "Fronting Protection at Cousins, Whitney Barataria and Estelle 1 & 2 Pumping Stations," N-Y Associates, New Orleans.
- Independent Technical Design Review for USACE's Hurricane Protection Project: "Reconnaissance Level Study for three (3) Hurricane Protection Alignments Western Tie-in," Jefferson and St. Charles Parishes, Lake Cataouatche Hurricane Protection Levee, N-Y Associates, New Orleans.
- Independent Technical Design Review for USACE's Project: Structural Design of "Inner Harbor Navigational Canal Replacement Lock, Riverside Gatebay Module," Brown Cunningham and Gannuch, Inc., New Orleans.
- Independent Technical Design Review for USACE's Project: Structural Design of "Harvey Canal Flood Walls," URS Corporation, New Orleans.
- International Matex (IMTT), "Six-Oil" Project: Structural Design of Pipe Bridge (112 feet long), Pipe Racks, Electrical Platform, Reinforced Concrete Pump-Pit Foundation Slab and Containment Wall, Walkway, Pipe Supports, etc., W. S. Nelson and Co., New Orleans.
- Structural design of reinforced concrete pile-foundation of about 56,000 sq. ft. for a proposed new church to be located at Marrero, LA.
- Structural rehabilitation of a floor slab and the foundation for a commercial building by: (i) designing new reinforced concrete foundation slab and grade beams and, (ii) foundation Under-Pinning using concrete Segmented Piles, New Orleans.
- Structural design for reinforced concrete slab with or without pile foundation for: various carwash structures, vacuum canopy structure, etc., New Orleans.
- Structural design of a reinforced concrete foundation for an 8000 gallon insulated double-wall fuel storage tank, New Orleans.
- Structural design of IPS weather station equipment support structure at various canals in New Orleans, Sutron Corporation, Sterling, VA.
- Structural design of lateral support system for DCP stations installed at various canals in New Orleans, Sutron Corporation, Sterling.

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

- Residential structural assessment of more than 225 houses, to determine the extent of structural damage caused by hurricane-Katrina to the houses in New Orleans, a FEMA/Shaw Project, New Orleans.
- Structural integrity assessment of various shutters, doors, framings, etc., for various wharf structures in Port of New Orleans, to determine the extent of structural damage caused by hurricane-Katrina, Port of New Orleans, Hurricane Reconstruction Program, PB Americas, New Orleans.
- Structural design of a proposed new casino building, and a food court building to be constructed in Baton Rouge, LA, using PolySteel Form, Insulated Concrete Building System. Also designed roof system for both the structures using Vulcraft Steel Joists.
- Structural integrity assessment of all phases of offshore platform design for various projects including in-place analysis, transportation analysis, installation engineering (lift analysis, lift rigging design, etc.), pile foundation design, earthquake analysis of offshore platforms, etc., J.Ray, McDermott Inc., New Orleans.
- Analysis and structural integrity assessment of Shell's Na Kika (TLP) hull pipe support design based on PDMS model. Consultant to Deepwater Consultant Alliance (DCA), New Orleans.
- Design and analysis of A&R and SCR hooks for several deepwater pipeline installation projects, using J. Ray McDermott's J-Lay System. The pipeline hook design included a 775 Kips capacity A&R hook for one of Shell's subsea pipeline projects. Also performed a finite element analysis for 775 Kips hook, using 'COSMOS' FEA software to study the stress distribution in the hook in a more comprehensive manner.
- Reassessment of PEMEX's Bay of Campeche platforms and subsea pipelines. Responsibilities involved evaluation of structural integrity of potentially unstable marine pipelines subjected to a 100-year storm condition. The analysis included: (i) assessment of on-bottom stability of the pipelines subjected to a 100-year storm condition; (ii) determination of hydrodynamic loads; (iii) determination of the soil friction and passive resistance; (iv) estimation of maximum lateral movement and bending stress in the pipelines caused by a 100 year storm condition. Also performed a 1000-year return period earthquake analysis for the ductility assessment of Pemex's CA-AC-1 platform.
- Worked on all phases of structural design engineering in the field of offshore marine construction including: (i) analyses of offshore oil/gas pipelines; (ii) earthquake analysis of offshore platforms; (iii) installation engineering, including jacket/deck tow-safety analysis, jacket and deck lift analyses, hook evaluations, jacket/deck/pile tie-down design, jacket on-bottom stability analysis, barge structural integrity assessment, etc.
- Worked on all phases of naval architecture and structural design engineering in the field of offshore marine construction including mating of TLP deck-hull, analyses of lateral mooring system for TLP hull, deck transportation analyses, and miscellaneous installation procedures for Shell's "Auger" Tension-Leg-Platform (TLP), installed in a water depth of 2,860 ft. in the Gulf of Mexico.

David E. Lourie, P.E.
Geotechnical Engineer

Experience
30 years

Expertise
South Louisiana soil conditions, local area geology, geotechnical conditions

Education
M.S., Civil Engineering, Illinois Institute of Technology, Chicago, 1981
B.S., Civil Engineering, Illinois Institute of Technology, Chicago, 1979

Registration
Professional Engineer, Louisiana, Civil Engineering (1984) Environmental Engineering (1994) Water Well Drillers, Louisiana, (1987)

Professional Affiliations
Louisiana Engineering Society (former Lake Charles Branch President)
National Society of Professional Engineers
American Society of Civil Engineers (former New Orleans Branch President and Chairman of the Geotechnical Activities Group)
American Council of Engineering Companies (former New Orleans Chapter President)
ASFE (current President)
Chi Epsilon

Publications
Authored and co-authored numerous technical papers and presentations on coal mine waste material disposal, use of electric cone penetrometers, building large tanks on very weak soils, soil sampling, expansive clays, Brownfield site development, professional liability, professional ethics, and alternate covers and liners for waste disposal facilities.

Summary of Experience

Mr. Lourie is founder and CEO of Lourie Consultants, Metairie, Louisiana, a consulting engineering firm that has been providing geotechnical and geoenvironmental consulting and engineering services to clients in the commercial, governmental, and industrial business sectors since 1992.

He serves as a liaison to the Peer Review Committee of ASFE/The Geoprofessional Business Association and is its current national president. He has been an adjunct professor at Tulane University, a visiting professor at McNeese State University, and a guest lecturer at Louisiana State University and the University of New Orleans.

Relevant Projects

- Worked 11 years for Fugro-McClelland (Southeast), Inc. (formerly McClelland Engineers) in Louisiana and Texas. Between 1983 and 1992, served as president of FMSE, and gained broad experience in the financial and technical operations of the firm's geotechnical, environmental, and construction materials engineering and testing practice in Louisiana.
- Served as the primary engineer on hundreds of studies for many types of projects, dealt with commercial buildings, industrial facilities, offshore and near-shore structures, roads, bridges, railroads, groundwater studies, landfills, site assessments, and pipelines.
- Formulated and conducted forensic investigations and engineering studies to assess failure causes and identify remedial measures for sheet pile walls, earth slopes and levees, foundations, and pavement systems.
- Worked on the field, laboratory, and engineering aspects of many types of projects throughout Texas, in the Gulf of Mexico, and in the Arabian Gulf. Worked on roadways, bridges, major transportation projects (rail and highways), industrial facilities, schools, hospitals, landfills, etc. Frequently planned, supervised, and participated in site investigation programs and developed laboratory testing programs to determine relevant soil properties for design and construction.
- Conducted detailed geotechnical engineering analyses, including those to compute axial and lateral pile capacity, assess the bearing capacity of foundation soils, predict settlements of shallow and deep foundation systems, evaluate the stability of earth slopes, compute lateral earth pressures for permanent and temporary retaining structures, identify constructability issues, develop performance monitoring programs, and interpret the results from various types of field tests.

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