



DEPARTMENT OF THE ARMY
MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
P.O. BOX 80 VICKSBURG, MISSISSIPPI 39181-0080

REPLY TO
ATTENTION OF:

12 DEC 2012

CEMVD-PD-N

MEMORANDUM FOR Commander, New Orleans District
(ATTN: CEMVN-PM-B)

SUBJECT: Hurricane Storm Damage Risk Reduction System
(HSDRRS) Armoring - Peer Review Plan (RP)

1. References:

- a. Memorandum, CEMVN-PM-B, 10 December 2012, SAB (encl 1).
- b. Memorandum, CEIWR-RMC, 11 December 2012, subject: Risk Management Center Endorsement - HSDRRS Armoring Program RP (encl 2).
- c. Engineering Circular (EC) 1165-2-209, Change 1, Civil Works Review Policy, dated 31 January 2012.

2. The subject RP provided under Reference 1.a. was reviewed and endorsed for approval by the Risk Management Center. The RP provides for an adequate level of peer review and complies with current peer review policy requirements outlined in EC 1165-2-209.

3. I hereby approve this RP, which is subject to change as circumstances require, consistent with the Project Management Business Process. Subsequent revisions to this RP or its execution will require new written approval from this office.

4. The RP is to be posted to the District website.

5. The POC for this action is Mr. Gary Young, CEMVD-PD-N, at (601) 634-5902.

A handwritten signature in black ink, appearing to read "Edward E. Belk, Jr.", is located below the fifth numbered point.

EDWARD E. BELK, JR., P.E., SES
Director of Programs

2 Encl

CF:
CECW-MVD (J. Redican)

HSDRRS ARMORING PROGRAM REVIEW PLAN
Technical Reviews of Technical Documents and Services for Hurricane Storm
Damage Risk Reduction System (HSDRRS)
Armoring Program

1. General

The Agency/District performing the technical review in accordance with the EC1165-2-209 dated 31 January 2010 shall furnish all services, materials, supplies, plant, labor, equipment, superintendence, and coordination with Federal authorities as required for the review of all technical documents and services related to the HSDRRS Armoring program. A list of all documents and services related to the program including estimated dates for the start of each review is included in Section 3.

2. Program Description:

The scope of the armoring program is to provide recommendations on:

1. the level of resiliency (the extreme storm surge greater than the 1% annual chance of exceedance storm surge) to design levee armoring to resist
2. the erosion resistance performance ranges of several classes of armoring material based on test results
3. the type of armoring material to be placed in each reach of the HSDRRS

Key components of the system which may require armoring are the levee crown and landside slopes, especially at the levee toe where the upper slope meets the stability berm and transition areas where hardened structures such as floodwalls meet earthen levees. Armoring solutions will vary with location and with site specific physical and environmental conditions. Critical areas for armoring within the system are likely to be closely associated with those reaches assessed to experience the highest wave overtopping flow rates and/or velocities. Deterministic and probabilistic processes will be used in the determination of system armoring needs and the development of armoring recommendations.

The recommendations in the Project Description Document (PDD) on the type of Armoring to be constructed in each reach will be driven by full scale wave overtopping testing, a risk assessment, and an Alternative Evaluation Process, which determines the numerical relative scores of all of the feasible alternatives. The Wave Overtopping Testing will determine the capacity thresholds of several classes of armoring materials when subjected to wave-only overtopping. Using a full scale wave overtopping simulator, constructed and operated at CSU (with quality assurance by ERDC), empirical data will be collected and analyzed. The test results will allow the development of landside levee armoring design guidance recommendations.

The Armoring Program Delivery Team (PgDT) will determine average overtopping flow rates in each reach of the HSDRRS for selected storm surge events greater than the 100-year event. After an extensive analysis, it was determined that levees should be armored to resist a minimum 500-yr storm surge. Utilizing the results of the full scale wave overtopping testing, the team will compare the armoring material erosion resistance capabilities with the average wave overtopping flows and determine which armoring materials are necessary for resiliency in each reach of the system for at least two sets of extreme storm surges. With this information the team will prepare armoring

alternatives for at least the 500-yr and the 750-yr storm surges for use in the risk assessment model.

The Risk Assessment will determine which armoring material class in each reach provides the optimal reduction in risk (inundation consequences) for the available funds. The Risk Assessment will assess the overtopping velocities for at least the 100, 500 and 750-yr annual chance of exceedance levels. Cost estimates for armoring the system based on the selected armoring alternatives will be developed and used to compare risk reduction to armoring cost in order to establish the point of diminishing returns.

The output of the risk assessment will be inundation levels for each annual chance of exceedance storm surge, or level of resiliency, the armoring should be designed to resist and what reaches should be armored from a consequences viewpoint.. The output of the CSU test results will be used in conjunction with the output of the risk assessment to develop the HSDRRS armoring recommended in the PDD (using the AEP process).

The Armoring Program shall make recommendations as to the amount and type of armoring required at transitions. Scaled overtopping tests have been performed at Texas A&M on typical levee slope and floodwall transition configurations to determine the required armoring footprint and type of armoring materials required in those areas.

The Armoring Team shall also make recommendations as whether armoring is required on the flood-side of levee and floodwall structures. The recommendation will draw on an ERDC Flood-side Wave Erosion white paper commissioned by the Armoring PgDT to study international practices and IPET findings after Hurricane Katrina to recommend domestic flood side risk reduction.

All technical and R&D information developed and used in support of the recommendations will be placed in the PDD and compiled and issued in the form of a Levee Armoring Research and Recommendations Report (LARRR). This will describe the general approach and testing results appropriate to the type of armoring applications required in the HSDRRS. Actual armoring recommendations will be compiled into the PDD which will describe the basis of all armoring recommendations taken in support of the HSDRRS.

The New Orleans District will implement armoring reach by reach at the end of the final levee construction of the HSDRRS which will be on or about March of 2013. Plans and Specifications will be prepared by CEMVN Engineering Division, or by A-E's, for each reach indentified to be armored.

3. Documents and Services requiring Review

All work products and reports, evaluations and assessments produced as part of the deliverables will undergo necessary and appropriate District Quality Control/Quality Assurance (DQC). An overview of DQC Team members and milestones is provided in Appendix B.

Technical documents produced as part of the deliverable will undergo an Agency Technical Review (ATR), as necessary. For each deliverable requiring a separate review, the ATR team will be established in accordance with EC 1165-2-209.

The Armoring Program will deliver the following deliverables, which are critical for successful design and construction of Armoring for the HSDRRS.

Transition Testing for Design Verification: This project provided a numerical model to be used to support the design of levee to floodwall transition features of the Greater New Orleans HSDRRS. The numerical model was verified with a scaled physical model. The results of this study are documented in a Texas A&M Numerical Analysis Report, reviewed internally by MVN. Based on this report, the Armoring PgDT assessed the required footprint of the transition armoring and verified the suitability of present HSDRRS design with regard to the footprint and type of armoring required at these features. This guidance, which will be incorporated in the LARRR, verified that the interim transition design was more than adequate upon completion of its DQC.

ERDC Flood Side Wave Erosion White Paper: The purpose is to identify available research that can guide flood-side armoring requirements specific to the 1% HSDRRS system design. A white paper was produced by ERDC that provides results of the desk study research effort and includes recommendations for flood-side armoring. The guidance and conclusions derived from this work required an ATR. Recommendations will be included in the PDD. This deliverable will be referenced in the LARRR as a source of contributing information, since it was published as an ERDC Technical publication.

Full Scale Wave Overtopping tests: In order to analyze the performance of classes of armoring materials (under hydraulic wave loading and environmental conditions which are appropriate to the New Orleans area) Colorado State University (CSU) performed Full Scale Wave Overtopping tests. Test trays of classes of armoring materials including the tray fabrication, clay compaction, and grass growth were prepared at ERDC and DQC'd by MVK and LSU. After testing was completed, CSU produced a report on the testing with information on average overtopping flow rates, overtopping velocities and armoring material class performance. The excellent results of this wave overtopping testing compared to the Dutch test results required that LSU be commissioned to compare the quality of the grass tested to the quality of the grass on real levees of various ages. It also required that a study by Dutch SME's be made to recommend an allowable wave overtopping flow rate (or Factor of Safety(FOS) applied to the flow rates sustained) for Bermuda grass. This is commonly referred to as the FOS Report but the official title is "Methodology to Determine Need for Protected Side Slope Armoring" by Royal Haskoning. The Armoring PgDT analyzed and interpreted the Full Scale Overtopping Tests Results, the LSU Study and the FOS Study to develop recommendations for inclusion of armoring material class erosion resistance performance in the LARRR. The result of this effort informed the AEP and the PDD Recommendation, and was documented in the LARRR. The Full Scale Overtopping Test Results was DQC'd by ERDC, TFH, and MVN. The Tray Fabrication and Clay Compaction, the Full Scale Testing program, the LSU Study and the FOS Report being research work, do not require a separate ATR. These studies and the CSU testing deliverable would be subject to an ATR and IEPR as part of the LARRR deliverable, to be completed later in the program.

Risk Assessment for Armoring: The Armoring Program will utilize risk methods based on the work developed by the Interagency Performance Evaluation Task Force (IPET) to achieve the optimal risk reduction for the system as a whole for at least two extreme events greater than the 100-year event. This risk assessment deliverable will be used by

the Armoring PgDT to formulate additional risk based armoring alternatives in the AEP. The armoring alternative with the highest score will be recommended in the PDD. The execution of the Risk Model will require separate ATRs. The Risk Model ATR shall be conducted concurrently with the project work by former IPET team members.

Levee Armoring Research and Recommendations Report (LARRR): The LARRR will provide levee armoring designers with armoring material erosion resistance performance guidance recommendations. The LARRR will be an amalgamation of research derived technical design guidance recommendations as previously described in this section. The LARRR, being a compilation of all technical knowledge either researched or developed through this program, will require an ATR and IEPR. In order to avoid duplication of effort, this will be the only deliverable IEPR'd as part of this program.

Project Description Document (PDD): The PDD is a compilation of technical documentation produced under the Armoring program which supports the armoring recommendations in each reach of the HSDRRS. The PDD will contain a summary of all the Armoring Program R&D Activities and Deliverables required to arrive at the armoring material erosion resistance performance ranges; the AEP; the Risk Assessment; and Armoring Recommendations needed for the design and execution of armoring. The PDD, being a decision document, will not require an ATR or IEPR.

4. Specific Required work items

Specific work items shall include but not be limited to the following:

- 4.1 DQC reviews of all technical products and reports
- 4.2 Full ATR Review of all decision and implementation documents identified in Section 3, with the exception of R&D reports and the PDD.
- 4.3 For the LARRR, a full ATR is required because these documents are compilations of research components that were not subject to a full ATR. In addition to a summary ATR, the LARRR will be Independently Externally Peer Reviewed as well.
- 4.4 The PDD will not require an ATR. The technical information in the LARRR contributing to the AEP will have been ATR'd separately.
- 4.5 Enter and resolve and backcheck all review comments resulting from review of the work through DrChecks
- 4.6 ATR certification will be completed in accordance with EC 1165-2-209. Each certification will include copies of DrChecks review comments showing that all comments are resolved and closed.
- 4.7 Specific submission requirements will be coordinated with the appropriate POC.

5. Objectives

5.1 Primary objectives

The primary objectives of the reviews are to ensure that:

- (a) The project meets the Government's scope, intent and quality objectives
- (b) Design concepts are valid, feasible, safe, functional and constructible.
- (c) Research will be safe, functional and constructible
- (d) Appropriate methods of analysis were used and basic assumptions are valid and used for the intended purpose.
- (e) The source, amount, and level of detail of the data used in the analyses are appropriate for the complexity of the project.
- (f) Where possible the project complies with accepted practice and design criteria within the industry
- (g) All relevant engineering and scientific disciplines have been effectively integrated
- (h) Content is sufficiently complete for the current phase of the project and provides an adequate basis for future development effort
- (i) Project documentation is appropriate and adequate for the project phase

5.2 Team Membership

DQC: Quality checks can be performed by staff responsible for the work, such as supervisors, work leaders, team leaders, designated individuals from the senior staff, or other qualified personnel. It cannot be performed by the people who originally performed the work. DQC reviews are performed by members of the Armoring PgDT or any other qualified personnel to ensure consistency and effective coordination across the project disciplines. DQC Review Team members have been identified and are summarized in appendix B.

ATR: For a couple of the deliverables, the selection of ATR reviewers requires a departure from EC 1165-2-209. This directive states that the appropriate Review Management Organization (RMO) should select the review team leader and review team members. However, for the ERDC Floodside Wave Erosion White Paper and the Risk Analysis, there are a number of reasons which dictate an alternative approach.

The Armoring Program Management Plan (PgMP) was developed in the Spring of 2009. Although the latest draft has not yet been approved, much of the content of the program have been driven by the need to gain input from (and the availability of) several specific Subject Matter Experts in the fields of Coastal Engineering Risk Management and Hydraulic Engineering. Without the early identification of such personnel, significant changes to the overall approach to the Armoring Program would have been required.

The risk analysis of the program is dependent on input from the former IPET personnel. Their knowledge, skills, software and processes are entirely compatible with the program requirements and are also unique. Without having early commitment of these specific personnel, the entire risk analysis component of the program would not be possible in its current format.

Efforts to establish the input of these SME's, from an early stage in the program, is an essential step in the progress of this program. This success of this program will be dependent on swift completion of each stage in order to match the progress of the entire HSDDRS.

The PgMP, and the identification of reviewers, was developed before the requirements of EC 1165-2-209 were published. A detailed Quality Management, addressing all current USACE QA and QC requirements was developed with the full support of MVN District. Upon receipt of the new directive, the team considered, in depth, how and where changes could be made to the QAP and QCP's in order to ensure future compliance. It was acknowledged that the home district selection of ATR staff was not in line with future requirements. However, the decision was taken to continue with the original Quality Review Plan for the following reasons:

- i. As described, the nature of the program (and timely completion) was dependent on continued collaboration with specific ATR staff;
- ii. Due to the scarce availability of SME's, it was not considered that the RMO selection of ATR staff would identify alternatives;
- iii. The Armoring Program management had been directed that the RMO was not yet in a position to fulfill its obligations in the timeframe required; and
- iv. Communication with MVD had advised that the Review Plan was appropriate.

For the remaining deliverables, the Armoring PgDT will rely upon the RMO to identify and direct appropriate ATR review staff.

5.3 Comments: DrChecks will be used by the Corps DQC and ATR Teams in the formal review of the documents. A Corps of Engineers POC will facilitate DrChecks setup and use for these reviews. All comments provided by Team members should give a clear statement of concern, the basis of the concern and, when appropriate, the actions necessary to resolve the concern. Comments will cite appropriate references. The PDTs of the Armoring Product will respond to each comment in DrChecks and will clearly state concurrence or non-concurrence with the comment. Concurrences shall include what the corrective action is and where and when it will be done. Non-concurrences will require a mutual resolution between the PDT and the ATR Team. When all comments are resolved the Completion Statement of Agency Technical Review can be signed. A printout of DrChecks comments together with the signed ATR Completion certificate will accompany the submittal of each document noted above. A template ATR Completion certificate is included in appendix C.

6. References

- Hurricane and Storm Damage Risk Reduction System Quality Management Plan (4/17/2009)
- EC 1165-2-209, Water Resources Policies and Authorities. Civil Works Review Policy (1/31/2010)
- ER 5-1-1, Project Management Business Process (11/1/2006)
<http://140.194.76.129/publications/eng-regs/er5-1-1/entire.pdf>
- ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999
- ER-1110-1-12 Quality Management (6/21/2006)
<http://140.194.76.129/publications/eng-regs/er1110-1-12/entire.pdf>
- ES-08011 QA-QC Process for Study-Design,
<https://kme.usace.army.mil/CE/QMS/QMS%20Documents/2007-10/08011%20QC-QA%20Processes%20for%20Study-Design%20Phase.DOC>

- PMBP Manual, Proc 2000 PMP/PgMP Development
http://bp.usace.army.mil/robo/projects/pmbp_manual/PMBP_Manual/proc2000.htm
- PMBP Manual, REF8008G Quality Management Plan
http://bp.usace.army.mil/robo/projects/pmbp_manual/PMBP_Manual/REF8008G.htm
- Armoring Team PgMP (DRAFT), September 2009
- Hurricane Storm Damage Risk Reduction System PgMP, June 2010

7. Points of Contact

The technical point of contact for this work is Dean Arnold. The Agency performing the review shall appoint one individual as team lead for the ATR to serve as a single point of contact and liaison between the reviewers and the PDTs. Upon acceptance of this work an estimated cost along with information on how to fund this work shall be provided to the POC so that funding can be set up.

APPENDIX A – Flowchart

Deliverable & Review Flow Chart

Armoring Activity	Activity Type	QC	QA	DELIVERABLE TIER ONE			DELIVERABLE TIER TWO			FINAL DELIVERABLES			IEPR	
				Activity	DQC	ATR	Activity	DQC	ATR/app.	Activity	DQC	ATR		
Transition Testing & Design Check	R&D Physical Modeling & Numerical Analysis	TAMU	Dr Edge	Physical Testing & Numerical Analysis Rpt	MVN	n/a								
ERDC Floodside Wave Erosion White Paper	Existing R&D Desk Study	ERDC	MVN	Flood-side Wave Erosion Guidance	MVN	HQ			n/a					
CSU Full Scale Wave Overtopping testing	Tray Fab & Clay Comp.	ERDC	MVK								Levee Armoring & Recommendations Report	MVN TFH ERDC	RMO	Batelle
	Establish Grass	ERDC	LSU											
				CSU Wave Overtopping Testing	ERDC	n/a								
Risk Assessment for Armoring (RAA)	RAA Model Dev & Armoring Risk Analysis			Preliminary Armoring Design Methodology	MVN	Dr Link			LSU Root Study	TFH	n/a			
								Royal Haskoning FOS Assess.	LSU	E-G				
Armoring Alternative Selection, Recommen., & Approval	Alternative Evaluation Process			Select Armoring for each reach and add recom. to PDD					Reaches Recommended for Armoring b/c of Consequences					
	Armoring Approval Process							PDD Approval	MVN	MVD				
Armoring Design (P & S) & Execution	Armoring Design			Plans & Specs	MVN	SAJ								
	Armoring Construction							Field Construction of Armoring	MVN-CD	n/a				500-yr HSDRRS Armoring

Appendix B

**Estimated Dates for Reviews
and
Selection of Team Members**

Product: Transition Testing & Design Check
Component: Texas A&M Physical Testing & Numerical Analysis Report
 Type of Review: DQC/QA

Ready for ATR:
 Final Report: 04/09/2010

Product Delivery Team

Name	Function	Organization	Phone	Years Experience
Dr. Patrick Lynett	Principal Investigator/ Team Leader	Texas A&M		20+
Dr. Billy L. Edge	Coastal Engineer.	Agency Consultant	601-634-5917	20+
Johnnie Reed	Lab Technician	Texas A&M		20+
Carmine Cruz	Research Eng	Texas A&M		20+
Oscar Cruz-Castro	Graduate student	Texas A&M		20+

District Quality Control Review Team

Name	Function	Organization	Phone	Years Experience
Mathijs van Ledden	DQC Review Team Leader	CEMVN-HPO	504-862-2491	15
Bob Bass	H&H Engineer	CEERD-ED-HM	504-862-1749	20+

Milestones and Review Activities

DATE		TASK
Scheduled	Actual	
February 2009	February 2009	Contract Awarded
June 2009	November 2009	Draft Physical modeling report delivered
June 2009	November 2009	Final Physical Modeling Report delivered
June 2009	November 2009	Draft Numerical modeling report
June 2009	November 2009	Final Numerical Modeling Report delivered and TR Completed
March 2010	March 2010	MVD DQC Review Completed

SIGNATURES

PDT Member

DQC Review Team Leader

_____(signed)_____
 Dr. Pat Lynett

_____(signed)_____
 Mathijs van Ledden.

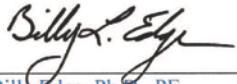
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 Date

_____(date)_____
 Date

Quality Control Report was done internally at the university by Dr. Billy Edge and Dr. Patrick Lynett, dated 05 Nov 2009.

**STATEMENT OF COMPLETION OF INTERNAL/INDEPENDENT TECHNICAL
REVIEW (AE)**

The Contractor, Bio Engineering/Arcadis, has completed the modeling, and analysis, to identify the effects of transitions on run-up and overtopping at adjacent levees in the HSDDRRS system by performing physical and numerical modeling at the Texas Engineering Experiment Station of Texas A&M University. Notice is hereby given that an internal/independent technical review, that is appropriate to the level of risk and complexity inherent in the project, has been conducted as defined in the Quality Control Plan. The internal/independent technical review included review of: assumptions; methods, procedures, and material used in analyses; the appropriateness of data used and level obtained; and reasonableness of the result, including whether the product meets the customer's needs. The internal/independent technical review was accomplished by an internal/independent team. All comments resulting from the review have been resolved and incorporated in the final reports.



Billy Edge, Ph.D., PE
Technical Review Team Leader

November 5, 2009

Date



Patrick Lynett, Ph.D.
Project Manager

November 5, 2009

Date

CERTIFICATION OF INTERNAL/INDEPENDENT TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows:

- Draft physical modeling report and draft numerical modeling report lacked appropriate background and general purpose of study. **Information has been included in final report.**
- Draft physical modeling report did not discuss the re-reflection of the waves off the wavemaker, and how this might affect the waves approaching the structure. **Analysis and discussion has now been included in final report, showing that this re-reflected energy is included as part of the incident wave energy.**
- Instrumentation calibration was not discussed in draft physical modeling report. **This information is included in the final report.**
- Implementation of the empirical overtopping calculations in draft physical modeling report is unclear. **All internal overtopping calculations have been removed from the final report. The District has furnished their empirical calculations, and these are now presented in the final report.**

- In draft numerical modeling report, the background and provided references of the employed numerical model was insufficient. **Appropriate background and literature review has been added to the final report.**
- Additional discussion and analysis of velocity statistics/parameters, and their usefulness for design should be added. **In the final numerical modeling report, a section has been added which addresses the proper meaning of the various velocity parameters, and their relationship to scour and armor unit stability.**

As noted above, all concerns resulting from internal/independent technical review of this engineering product have been fully resolved.



Billy Edge, Professor

November 5, 2009

Date

Product: Flood side Design Guidance
Component: ERDC Flood-side Wave Erosion White-Paper
Type of Review: DQC/QA and Agency Technical Review

Ready for ATR:
Final Report: 04/09/2010

Product Delivery Team

Name	Function	Organization	Phone	Years Experience
Dr. Hughes	Senior Research Engineer	CEERD-HN-HH	601-634-2026	30

District Quality Control Review Team

Name	Function	Organization	Phone	Years Experience
Mathijs van Ledden	DQC Review Team Leader	CEMVN-HPO	504-862-2491	12
Bob Bass	H&H Engineer	CEERD-ED-HM	504-862-1749	20+
Dave Beck	E-D Engineer	CEMVN-ED-LW	504-862-2406	20+
Ray Devlin	Civil Engineer	CEMVN-TFH	504-862-2042	12

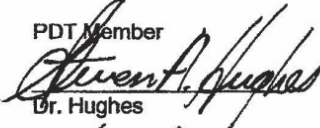
Agency Technical Review Team

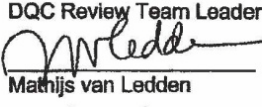
Name	Function	Organization	Phone	Years Experience
Jerry W. Webb	H&H- ATR Team Lead	CECW-CE	202-761-0673	20+
Bruce A. Ebersole	Researcher/Subject Expert		601-634-3209	20+
John W. Hunter	H &H	CECW-CE	202-761-4826	20+
Joseph P. Koester	Geotechnical	CECW-CE	202-761-4828	20+
Patrick O'Brien	MVD	CEMD-PD-WW	601-634-5946	20+

Milestones and Review Activities

DATE		TASK
Scheduled	Actual	
30 Oct 2009	Dec 2009	Complete First Draft.
15 Jan 2010	9 April 2010	Resolve comments from DQC Technical Review.
11 Jun 2010		Resolve Agency Technical Review (ATR)
28 Jun 2010		Resolve ATR Comments at Complete Final Report

SIGNATURES

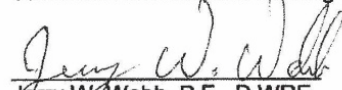
PDT Member

 Dr. Hughes
 7/28/2010
 Date

DQC Review Team Leader

 Mathijs van Ledden
 7/20/2010
 Date

ATR Team Leader
 SEE STATEMENT OF TECHNICAL REVIEW
 Jerry W. Webb
 5/28/10
 Date

**USACE STATEMENT OF TECHNICAL REVIEW
COMPLETION OF AGENCY TECHNICAL REVIEW**

The Agency Technical Review (ATR) Team has completed the ATR of the ERDC Floodside Wave Erosion White Paper for the HSDRRS Armoring Program. Notice is hereby given that an ATR has been conducted in accordance with requirements of EC 1165-2-209. The review was appropriate to the level of risk and complexity inherent in the project. The review was conducted as defined in the HSDRRS Armoring Program Review Plan. During the agency technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the result, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy.


Jerry W. Webb, P.E., D.WRE
ATR Team Leader
CECW-CE


31 MAY 2010

**CERTIFICATION OF AGENCY
TECHNICAL REVIEW**

Significant concerns and the explanation of the resolution are as follows:

-All comments and impacts were resolved during the Technical Review

As noted above, all concerns resulting from agency technical review of the project have been fully resolved.


Walter O. Baumy, P.E.
Chief, Engineering Division
CEMVN-ED

16 Aug 2010

Product: Full Scale Levee Overtopping Tests (ERDC)
Component: Tray Fabrication and Clay Compaction
Type of Review: DQC/QA only.

Product Delivery Team

Name	Function	Organization	Phone	Years Experience
Dr. Steven Hughes	Oversight and PM	CEERD-HN-HH	601-634-2026	30
Dean Arnold	PDT-Team Leader	CEMVN-TFH	504-862-2674	30
Dr. Donald Ward	Tray fabrication, population and cultivation	CEERD-HN-HH	601-634-2092	25
Mr. Thad Pratt	Development of velocity meter	CEERD-HN-HH	601-634-2959	n/a
Mr. Charles Wilson	Clay prep and installation in trays	CEERD-HN-HH	601-634-2414	n/a
Dr. Chris Thornton	Technical advisor	CSU	970-491-8394	20+
Mr. Paul Beatty	Tray fabrication	CEERD-HN-HH	601-634-3559	20+

District Quality Control Review Team

Name	Function	Organization	Phone	Years Experience
Chuck Mendrop	DQC-Team Leader	CEMVK-EC-G	601-634-5208	20+
Lane Cox	QA - Geotech	CEMVK-EC-GA	601-631-7021	n/a
Dr. Beesley	QA - Grass SME	LSU		20+

Milestones and Review Activities

DATE		TASK
Scheduled	Actual	
February 2010	Feb 2010	TRM Installed, Grass Sown, Trays Complete
June 2010	Mar 2010	Clay Compaction & Tray preparation report, DCQ'd.
July 2010	Aug 16	Remaining trays transported to CSU

SIGNATURES

PAT Member

Dean Arnold

Dean Arnold

10/7/10
Date

DQC Review Team Leader

Chuck Mendrop

Chuck Mendrop

10/12/2010
Date

Product: Full Scale Levee Overtopping Tests at CSU
Component: CSU Wave Overtopping Test Results, LSU Root Study, FOS Report
 Type of Review: DQC/QA only.

Product Delivery Team

Name	Function	Organization	Phone	Years Experience
Dr. Christopher I. Thornton	Principal Investigator (PI)(TL)	CSU Hydr Lab	970-491-8394	20+
Bryan Scholl	Co-PI	CSU Hydr Lab	970-980-1709	20+
Ms. Amanda Cox	Schedule Lab test	CSU Hydr Lab	979-491-8099	n/a
Jr Garza	Construction	CSU Hydr Lab		n/a
Jentsje van der Meer	Wave Simulator Calibration & Operation, Reporting	Van der Meer Consulting, B.V		20+
Dr. Jeff Beasley	Principal Investigator (TL)	LSU Ag Center	225-620-6087	20+
Jaap-Jeroen Flikweert	Principal Investigator (TL)	Royal Haskoning	+44-1733-336-543	20+

District Quality Control Review Team

Name	Function	Organization	Phone	Years Experience
Dr. Steven Hughes (retired-2/28/11)	Technical QA&PM -CSU	CEERD-HN-HH	601-634-2026	30
Patrick O'Brien	Hydraulic Engineer	CEMVD-PD-WW	601-634-5946	10
Ray Devlin	Contract Engineer	CEMVN-HPO	(504) 862-2042	12
Dean Arnold	Program Manager	CEMVD-TFH	504-862-2674	40
Robert Bass	Hydraulic Engineer	CEMVN-ED-HM	504-862-1749	20

Milestones and Review Activities

DATE		TASK
Scheduled	Actual	
Jul 2010	21 Aug 2010	Calibration Wave Overtopping Simulator and modifications (if any) completed
July 2010	25 Aug 2010	Calibration/tests Flow depth instrumentation complete
July 2010	30 Aug 2010	Calibration Velocity Meter complete
30 August 2010	31 Aug 2010	Commence Testing Schedule
30 Sep 2010	Mar 2011	Complete Testing and DQC
6 Dec 2010	Jun 2011	Physical modeling report.
8 Jan 2010	Jul 2011	Complete Report DQC
May 2011	Jul 2011	Complete LSU Root Study
April 2011	Jul 2011	Complete FOS Report

SIGNATURES:

PDT

DQC Review Team Leader

Dr. Thornton, (TL)

Dr. Hughes (DQC Team
Leader –CSU)

Date

Date

Dr. Beasley(TL)

Patrick O'Brien (DQC Team Leader – Grass Study, FOS)

Date

Date

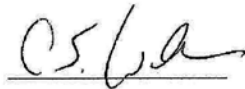
Jaap-Jeroen Flikweert (TL)

Date

Attachment C-2

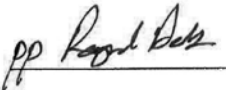
A-E CONTRACTOR STATEMENT OF TECHNICAL REVIEW
COMPLETION OF AGENCY TECHNICAL REVIEW

The A-E Contractor (Evans-Graves Engineers, Inc.) has completed the (Agency Technical Review) of the (Report titled; "Methodology to Determine Need for Protected Side Slope Armoring" for the HSDRRS). Notice is hereby given that an agency technical review, appropriate to the level of risk and complexity inherited in the project, has been conducted as defined in the project's Quality Management Plan. During the agency technical review, compliance with established policy principles and procedures, utilized justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the result, including whether the product meets the customer's needs consistent with law and existing Corps policy. All comments resulting from ATR have been resolved.



Date: 11/8/11

Clinton S. Willson, Ph.D., P.E.
Associate Professor
Department of Civil & Environmental Engineering
Louisiana State University
Technical Review Team Leader



Date: 11-8-11

Maartje Wise
Project Manager
Haskoning, Inc.

CERTIFICATION OF AGENCY TECHNICAL REVIEW

There are no significant concerns remaining following the review of this report. All concerns resulting from agency technical review of the project have been fully resolved.



Date: 11-8-11

Robert A. Rowlette, Jr. P.E. COL(ret)
Evans-Graves Engineers, Inc.
Senior Program Manager

Product: Risk Assessment for Armoring (RAA)
Component: Revised Risk Maps and Damage Reduction
 Type of Review: DQC/QA and Agency Technical Review (concurrent with project)

Ready for ATR:
 Final Report Ready: 01/31/2013

Product Delivery Team

Name	Function	Organization	Phone	Years Experience
Reuben Mabry	Sr Proj Manager	CEMNV-TFH		30
Robert Patev	Risk Model Rep.	CEN-AE-EP-WG	978-318-8394	
Jerry L. Foster	Risk Model-TL	CECW-EC(RAC)	202-761-7781	30+
Wayne Jones	ModelConst. Rep	CESPK-CO-SD	530-432-6427	20+
Brian Maestri	Economics Rep	CEMVN-PM-AW	504-862-1915	20+
Warren Cashen		CEMVN-ED-S	504-862-1694	20+
Ries Kluskens	H&H rep	CEMVN-TFH	504-862-2868	12
Ray Devlin	Civil Engineer	CEMVN-TFH	504-862-2042	12

District Quality Control Review Team

Name	Function	Organization	Phone	Years Experience
Keely Crowder	ED-Rep-TL	CEMVN-ED-H	504-862-2114	10+
David Ramirez	Hydraulics	CEMVN-ED-H	504-862-2454	10+

Agency Technical Review Team

Name	Function	Organization	Phone	Years Experience
Dr Ed Link	Risk Expert-TL	Private Consultant		40+
Greg Baecher		Private Consultant		30+
Brian Harper	Consequences Expert	Institute of Water Resources		20+

Milestones and Review Activities

DATE		TASK
Scheduled	Actual	
7 May 10	23 Sept 2010	Revise and/or develop the system definition (spreadsheets and shape-files)
23 May 10	23 Mar 2011	Determination of adequacy of current hydrographs for the RAA model runs
14 Jun 10	Oct 2010	Revise and/or develop stage damage curves (Complete Economics)
1 Nov 10	May 2011	Develop overtopping velocities and initial Armoring Alternatives (e.g., 100, 500, 750-yr storm events)
1 Nov 10	May 2011	Develop modified fragility curves for the Armoring Alternatives
30 Nov 10	May 2011	Run RAA model
24 Jun 11	Aug 2011	Develop a RAA Report & Graphics
30 Jun 11		Resolve DQC of the RAA model execution
30 Jul 11		Conduct and resolve ATR of the RAA model execution

SIGNATURES

PDT Member

DQC Review Team Leader

ATR Team Leader

Jerry Foster

Date

Keely Crowder

Date

Dr. Ed Link

Date

Product: Levee Armoring Research and Recommendations Report (LARRR)
Component: n/a
 Type of Review: DQC/QA, SUMMARY ATR and IEPR
 Draft Report Ready: 08/2011
 Final Report Ready: 04/2012

Program Delivery Team

Name	Function	Organization	Phone	Years Experience
Dean Arnold	ProgramMan-TL	CEMVN-TFH	504-862-2674	40+
David A. Beck	ED Rep	CEMVN-ED-LW	504-862-2406	20+
Gary Leblanc	Constr.Div Rep	CEMVN-CD	504-862-2751	20+
Karen L. Oberlies	Ops rep	CEMVN-OD-W	504-862-2313	15+
Ray Devlin	Civil Engineer	CEMVN-HPO	504-862-2042	12
Robert H. Bass,	Civil Engineer	CEMVN-ED-HM	504-862-1749	20+
Jeffery M. Richie,	Struct.Engineer	CEMVN-ED-T	504-862-2745	15+
Ries Kluskens	GIS	CEMVN-TFH	504-862-2868	12
Daniel Haggarty	Geotech Engr	CEMVN-ED-FS	504-862-2403	20+

District Quality Control Review Team

Name	Function	Organization	Phone	Years Experience
Brian Bonanno	Geotech Engr	CEMVN-ED-FS	504-862-2983	20+
Tim Ruppert	ED Rep-TL	CEMVN-ED-E	504-862-2106	20+
Andy Gaines	Coastal Engineer	CEMVM -ED- HM	901-544-3392	20+

SUMMARY ATR

Name	Function	Organization	Phone	YearsExperience
Thomas Terry	ATR Review Ldr	CEIWR-RMC-WD	720-325-4226	20+
David Margo	Hydraulic Rev.	CEIWR-RMC	412-667-6629	?
Kevin Holden	Landscape Arch	CEIWR-RMC-WD	309-794-5236	?
Scott Shewbridge	Civil Engr	CEIWR-RMC-WD	720-201-9299	?

IEPR Team

Name	Function	Organization	Phone	Years Experience
Julia A. Fritz	Ind.External Peer Review	CENAB-EN-WW and Battelle	410-962-4895	15+

Milestones and Review Activities

DATE		TASK
Scheduled	Actual	
15 June 2011	01 Aug 2011	Complete Draft Armoring Report
30 June 2011	09 Aug 2011	DQC of the Draft Armoring Report
15 July 2011	15 Nov 2011	ATR of Draft Armoring Report.
15 Sept 2011	15 Jan 2012	Conduct and conclude IEPR

SIGNATURES

PDT Member DQC Review Team Leader ATR Team Leader IEPR Team Leader

_____ Dean Arnold	_____ Tim Ruppert	_____ Thomas Terry	_____ Julia A. Fritz
_____ Date	_____ Date	_____ Date	_____ Date

USACE STATEMENT OF TECHNICAL REVIEW

COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed of the Levee Armoring Research and Recommendations Report for the HSDRRS Armoring Program. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-209. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy. The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be appropriate and effective. All comments resulting from the ATR have been resolved and the comments have been closed in DrCheckssm.

Thomas Terry
ATR Team Leader
CEIWR-RMC-WD

Date

Dean Arnold
Project Manager
CEMVN-TFH

Date

SIGNATURE
[Name]
Architect Engineer Project Manager ¹
[Company, location]

Date

SIGNATURE
[Name]
Review Management Office Representative
[Office Symbol]

Date

**CERTIFICATION OF AGENCY
TECHNICAL REVIEW**

Significant concerns and the explanation of the resolution are as follows:

All comments and impacts were resolved during the Technical Review.

As noted above, all concerns resulting from the ATR of the project have been fully resolved.

SIGNATURE
Walter O. Baummy, P.E.
Chief, Engineering Division
CEMVN-ED

Date

Appendix D - Schedule

